

Birmingham Eastside Extension

APP/P3.1

Transport and Works Act 1992

The Transport and Works
(Applications and Objections Procedure)
(England and Wales) Rules 2006

APP/P3.1
Stephen Luke
Engineering
Main Proof of Evidence



WEST MIDLANDS
COMBINED AUTHORITY

TRANSPORT AND WORKS ACT 1992

PROPOSED MIDLAND METRO (BIRMINGHAM EASTSIDE EXTENSION) ORDER 201[X]

PROOF OF EVIDENCE

OF

**Stephen Luke
Engineering**

FOR

WEST MIDLANDS COMBINED AUTHORITY

19 October 2017

CONTENTS

1. QUALIFICATIONS AND EXPERIENCE	4
2. SCOPE OF EVIDENCE.....	5
2.1 Overview.....	5
3. INTRODUCTION.....	6
3.1 Background to the Application Proposal.....	6
4. REVIEW OF EXISTING CONDITIONS	7
4.1 Highway Network.....	7
4.2 Cycle and Pedestrian Facilities	10
4.3 Structures	11
4.4 Drainage	13
5. SUMMARY OF WORK CARRIED OUT.....	14
5.1 Design Basis.....	14
5.2 Route Description	14
5.3 Interface with HS2 Curzon Street.....	15
5.4 Tramway.....	16
5.5 Tramstops.....	17
5.6 Bus Facilities.....	18
5.7 Parking and Loading	20
5.8 Cycle Facilities.....	20
5.9 Pedestrian Facilities.....	21
5.10 Highway.....	22
5.11 Proposed BEE Key Junctions	23
5.12 Urban Realm and Landscaping.....	23
5.13 Traction Power.....	24
5.14 Street Lighting.....	26
5.15 Drainage (Attenuation) Tank	27
5.16 Tram Signalling, Communication, and Electrical Equipment	27
5.17 Alternatives Considered.....	27
6. STATUTORY UNDERTAKERS EQUIPMENT	30
7. CONSTRUCTION	32
7.1 Introduction.....	32
7.2 Utilities Diversions.....	32
7.3 Construction Areas	32
7.4 Site Compound.....	33
7.5 Traffic Management.....	33

7.6	Sequence of Operations	34
7.7	Site Construction Considerations	36
8.	OPERATIONS.....	41
9.	STATEMENT OF MATTERS.....	42
9.1	Matter 4a – Dust	42
9.2	Matter 4c – Flood Risk and Groundwater	42
9.3	Matter 6 – Mitigation Measures	43
10.	RESPONSE TO OBJECTORS.....	44
10.1	Introduction	44
10.2	Martineau Galleries No 1 Ltd, Martineau Galleries No 2 Ltd [OBJ/06]	44
10.3	Quintain City Parkgate [OBJ/07]	46
10.4	Network Rail [OBJ/09].....	46
10.5	Hotel LaTour [OBJ/12]	46
11.	SUMMARY AND CONCLUSIONS	48
11.1	Scheme Proposals.....	48
11.2	Route Description	48
11.3	Statutory Undertakers Equipment	49
11.4	Construction.....	49
11.5	Operations	50
11.6	Secretary of States Matters.....	50
11.7	Response to Objectors	50
11.8	Conclusion	51
12.	STATEMENT OF TRUTH.....	52

1. QUALIFICATIONS AND EXPERIENCE

- 1.1.1 This evidence is prepared by Stephen Luke MSc, BEng (Hons), CEng, MICE.
- 1.1.2 I have been a member of the Institution of Civil Engineers since 1995 and hold an MSc in Transport Planning and Operations from Newcastle University (1995) and a BEng (Hons) in Civil Engineering from Nottingham University (1990). In 2017 I commenced a distance learning MSc in Sustainable Urban Development at Herriot-Watt.
- 1.1.3 I have over 30 years of experience in the planning and development of urban public transport, both in local government and private consultancy. I currently hold the positions of Transport Planning Practice Leader for Mott MacDonald which is a UK and European role and Deputy Practice Leader for Light Rapid Transit internationally have held these positions since June 2016.
- 1.1.4 Between 2012 and 2016, I was a Project Director with Mott MacDonald in Australia responsible for urban public transport development including roles on Sydney CBD and South East Light Rail, Brisbane Metro and the Metro Tunnel in Melbourne with includes modifications to the Melbourne Tram Network [the longest tram network in the world]. Preceding this I was Project Director responsible for Urban Public Transport advisory services with a full international remit. Other Light Rail specific experience includes management of studies to examine extensions to the Nottingham Express Transit including a link to the East Midlands HS2 Station Hub, Tyne and Wear Metro, several potential extensions to the London Tramlink system, extensions to Blackpool Tram, Cross River Tram (London) and planning for metropolitan wide BRT/LRT networks in South Africa (Durban and Johannesburg) and the UAE.
- 1.1.5 In this matter, the West Midlands Combined Authority have instructed me to act as expert witness on engineering matters for the Public Inquiry in respect of the 'called-in' Birmingham Eastside Extension (BEE) in the City of Birmingham. I was not involved in the scheme prior to being instructed in May 2017 to act as expert witness.

2. SCOPE OF EVIDENCE

2.1 Overview

- 2.1.1 My evidence covers the engineering of the scheme and layout of the elements of the project.
- 2.1.2 In response to the Statement of Matters my evidence addresses:
- Matter 4a – Scheme Impacts. Dust
 - Matter 4c – Flood Risk and Groundwater
 - Matter 6 – Mitigation Measures. Mitigation of harm in relation to construction through the proposed Code of Construction Practice, and measures to avoid, reduce or remedy any major or significant adverse environmental impacts of the scheme in terms of noise and vibration during construction.
- 2.1.3 In response to specific objections [INQ3] my evidence addresses those that have not been withdrawn as of 17 October 2017:
- Martineau Galleries No 1 Ltd, Martineau Galleries No 2 Ltd [OBJ/06]
 - Quintain City Parkgate [OBJ/07]
 - Network Rail [OBJ/09]
 - Hotel LaTour [OBJ/12]

3. INTRODUCTION

3.1 Background to the Application Proposal

3.1.1 This proof of evidence is prepared on behalf of West Midlands Combined Authority. It is structured as follows:

- Section 3 describes existing conditions
- Section 4 deals with the scheme proposals:
 - a. Design Basis
 - b. Route Description
 - c. Interface with HS2 Curzon Street
 - d. Tramway
 - e. Tramstops
 - f. Cycle Facilities
 - g. Pedestrian Facilities
 - h. Highway Arrangement
 - i. Modifications to key Junctions
 - j. Urban Realm and Landscaping
 - k. Traction Power
 - l. Street Lighting
 - m. Drainage
 - n. Tram signalling, communications and electrical equipment
 - o. Alternative Proposals (stop locations)
- Section 5 discusses Statutory Undertakers Equipment and the proposed approach for protection or diversion
- Section 6 details construction arrangement
- Section 7 outlines the operational features of the BEE
- Section 8 addresses Statement of Matters
- Section 9 addresses objections

4. REVIEW OF EXISTING CONDITIONS

4.1 Highway Network

- 4.1.1 “Upper” Bull Street and “Lower” Bull street are separated by Corporation Street and the existing Midland Metro infrastructure. The Midland Metro runs between Upper Bull Street and Corporation Street (west) and a pedestrian central reserve provides a segregation to Lower Bull Street and Corporation Street (east), which is open to Buses and cycles only. Lower Bull Street runs one-way in a north-westerly direction and has a contraflow cycle lane on its northern side.
- 4.1.2 Lower Bull Street becomes High Street at its junction with Dale End. The junction is a give way arrangement and Dale End is a Pedestrian Zone open to Buses, taxis and for access to off street premises only.
- 4.1.3 Kings Parade is a pedestrian alley that runs alongside McDonalds fast food restaurant. McDonalds backs onto New Meeting Street which provides staff parking and disabled parking spaces as well as access to St Michael’s Church and delivery access to properties on High Street and Carrs Lane. It is two-way and leads onto Albert Street at a give way junction.
- 4.1.4 Albert Street is open to all vehicular traffic and runs two-way for its entire length. There is a signal controlled junction with Dale End to the north and a signal controlled junction with Moor Street Queensway to the south. To the north of the junction with New Meeting Street are disabled parking spaces on the south side and a double length bus stop on the north. Opposite the New Meeting Street junction are two entrance points to the multi-storey High Street car park, separated by a bus stop. The car park entrance opposite New Meeting Street is for a ‘secure parking area’ for permit holders only. The second entrance point is located on Dingley’s Passage and houses a traditional ticket controlled barrier system. Dingley’s Passage is also the means of access to the IKEA collection point.
- 4.1.5 Opposite Dingley’s Passage is an entrance point to a private car park for St Michael’s Church.
- 4.1.6 Albert Street’s junction with Moor Street Queensway is a three-way signal controlled junction. Albert Street splits into two lanes to separate left and right turning traffic. An advanced cycle stop line is in place.
- 4.1.7 Moor Street Queensway is a wide, straight, two-way six lane carriageway, open to all vehicular traffic in both directions. The northbound carriageway has off-line bus

laybys, with the southbound having in-line bus stops in lane one. Both sides have wide (approximately 6 metres) footways.

- 4.1.8 There is a triangular wedge of pedestrian plaza bound by Moor Street Queensway, Seymour Street and Hotel LaTour's south façade. The northeast corner meets Park Street, which is a two lane, one-way carriageway running parallel to Moor Street Queensway and Park Street burial ground. Adjacent to the main Hotel LaTour reception entrance is a drop off area off Park Street which consists of a one-way access road with a parking bay and footway. Opposite the drop off area on Park Street is a bus stop.
- 4.1.9 To the north of Hotel LaTour is Masshouse Lane which is a one-way street that diverges from Park Street.
- 4.1.10 To the east of Park Street and Masshouse Lane is Eastside city park which is home to a mixture of large grassed areas, trees, water features and recreational space.
- 4.1.11 East of Eastside city park is New Canal Street, which is a two-way single lane carriageway open to all vehicular traffic. The Eagle and Tun public house is situated on the corner of New Canal Street and Banbury Street. Banbury Street is a two-way street that meets New Canal Street at a give way junction.
- 4.1.12 New Canal Street passes under the Rugby to Penkridge rail line in advance of a traffic signal controlled cross roads with Fazeley Street. All approach arms have advanced cycle stop lines. It is sensible to assume that the signals are in place not to control the flow of traffic but as a safety measure owing to poor junction intervisibility, contributed to mainly by the rail overbridge structures.
- 4.1.13 New Canal Street continues to run on a north-south orientation until it reaches a cross roads with Bordesley Street, where priority is given to New Canal Street. The Bordesley Street arms are controlled by stop lines. At this point, New Canal Street becomes Meriden Street and the alignment of the carriageway skews slightly before passing under the Didcot and Chester rail line viaduct, through a brick arch structure. Directly south of the brick arch is Coventry Street car park.
- 4.1.14 Meriden Street meets Coventry Street at a cross roads, where priority is given to Meriden Street. The Coventry Street arms are controlled by give way markings.
- 4.1.15 Meriden Street meets Digbeth at a signal controlled junction. Digbeth is a wide two way six lane carriageway open to all vehicular traffic (three lanes in either direction)

up to Oxford Street, which runs parallel to Meriden Street and meets Digbeth at a junction controlled by give way markings. To the east of Oxford Street the eastbound Digbeth carriageway becomes two lanes for general traffic plus a nearside bus lane. There is also a segregated right turn facility into Rea Street, which is controlled by traffic signals. Digbeth has a 30mph speed limit for its entirety. There are bus stops on Digbeth either side of Oxford Street.

- 4.1.16 Approximately 100 metres to the east is Milk Street, a one-way street running northeast open to all vehicular traffic. Digbeth's Bus Lane truncates in advance of Milk Street to provide a dedicated left turn lane. There is a segregated right turn facility provided in the centre of Digbeth into Milk Street. It is in this vicinity that Digbeth becomes High Street Deritend.
- 4.1.17 To the south is Rea Street, which meets High Street Deritend at a signal controlled junction. A segregated right turn facility is in place from High Street Deritend into Rea Street.
- 4.1.18 The six lane High Street Deritend continues to run on a northwest-southeast orientation until it reaches the side road of Floodgate Street to the north. Floodgate Street is a two-way street open to all vehicular traffic and has a 20mph speed limit. The junction of Floodgate Street and High Street Deritend is positioned on a bridge over the river Rea. The river and its bridge structure is not visible from street level.
- 4.1.19 To the southeast of the river Rea are two side roads in close proximity that meet High Street Deritend at give way junctions. The western-most road is Stone Yard and the eastern road is Chapel House Street. Both roads are two way and used heavily for parking for local businesses. At this point, High Street Deritend curves gently onto a more east-west orientation.
- 4.1.20 On the northern side of High Street Deritend are two side roads positioned approximately 20 metres apart. The western-most is Gibb Street and the eastern road is Heath Mill Lane. The junction of High Street Deritend and Gibb St is shaped such that traffic can only enter left in and not exit left out onto High Street Deritend. Gibb Street is not signed as a one-way street, but its narrow, pedestrianised nature lends itself to running one-way from High Street Deritend to the north, where it passes through The Custard Factory and gently bends to the east, where it meets Heath Mill Lane.

- 4.1.21 The junction of High Street Deritend and Heath Mill Lane is controlled by traffic signals. There is a break in the High Street Deritend central reserve to allow traffic to turn right out of Heath Mill Lane. There is also a right turn facility from High Street Deritend into Heath Mill Lane. Heath Mill Lane is open to all vehicular traffic and has a 20-mph speed limit. There is a pinch point on the footway on the northeast side where it narrows to approximately 0.5 metres at the corner of the Grade I listed Old Crown Public House.
- 4.1.22 To the east of Heath Mill Lane, High Street Deritend starts to gently curve onto a northwest-southeast orientation. On the southern side, approximately half way along the curve is Alcester Street, which meets High Street Deritend at a signal controlled junction. Alcester Street is open to all vehicular traffic and the junction permits all turning movements under staged traffic signals. A controlled pedestrian crossing facility is facilitated on the east side of the junction to allow crossing of High Street Deritend. The crossing of Alcester Street is uncontrolled.
- 4.1.23 To the northeast is Adderley Street which meets High Street Deritend at a give way junction. Adderley Street is open to all vehicular traffic and has a 20mph speed limit.

4.2 Cycle and Pedestrian Facilities

- 4.2.1 The main existing cycle facilities along the route include:
- A contraflow cycle lane from Corporation Street heading south in to Bull Street. This currently has a short section as shared cycleway / footway around the bend and rejoins the carriageway as a contraflow to the end of Bull Street where it rejoins the footway heading towards High Street / Carrs Lane.
 - Dale End / Albert Street an advisory, on road route (unsigned).
 - The pedestrianised area outside Hotel LaTour is an off-road route.
 - New Canal Street (from the junction with Fazeley Street) and Meriden Street are advisory on roads routes (unsigned).
 - The bus lanes on Digbeth High Street which are available to cyclists.
- 4.2.2 Pedestrian crossing facilities are primarily included within the method of control at traffic signal controlled junctions.

4.3 Structures

4.3.1 Bull Street Retaining Walls

4.3.2 The BEE requires the removal of an existing retaining wall and infilling of an associated ramp.

4.3.3 The Bull Street Northeast Retaining Walls are situated east of the Birmingham City Centre between Corporation Street and Martineau Way.

4.3.4 The retaining wall is approximately 38m long and up to 3.94m high at the Corporation Street end. Previously, the retaining wall formed part of an approach to a 10.6m wide 2.18m high subway below the Bull Street/Corporation Street Junction. The subway was subsequently disused and blocked following the redevelopment of the junction.

4.3.5 No original as-built drawings of the retaining wall were made available for review prior to and during writing this report. Therefore, details of its construction are unknown. However, the retaining wall was expected to be constructed in reinforced concrete and designed to typical highway loading carried by Bull Street.

4.3.6 New Canal Street Rail Bridge

4.3.7 The BEE passes below Network Rail Bridge RBS1/380 which is located between Adderley Park and Birmingham Moor Street Stations. It carries Up Stour, Down Stour, Up & Down Derby and Down Derby lines of the Rugby to Penkridge line over New Canal Street in Birmingham.

4.3.8 The bridge spans approximately 13m over the New Canal Street between brick abutments. All parapets are formed in steel.

4.3.9 The bridge consists of 5 No steel main girders with cross girders and steel deck plate. The substructure comprises brickwork abutments.

4.3.10 From a site visit the bridge deck appeared to be constructed from steel longitudinal girders with steel ballast plate and cross girders.

4.3.11 The bridge deck was in good condition. The inspection showed that the bridge deck has been reconstructed in recent years, although no record of this has been identified from archive data.

- 4.3.12 The abutments were generally in fair condition. They showed signs of mortar loss, water and efflorescence staining. Some brickwork has been repointed in localised areas.
- 4.3.13 Meriden Street Rail Bridge
- 4.3.14 The BEE passes below Network Rail Bridge No 228 (ELR: DCL), which is a 63 No. span brick arch structure carrying the 2 No. tracks of the Didcot & Chester Line, a siding and the ends of the platforms of Moor Street station over private properties, public roads and waterways. The viaduct is located south of Moor Street Railway Station.
- 4.3.15 The Viaduct consists of an arch constructed in engineering brickwork. The structure was constructed in 1908. The arch ring consists of 6 bricks on the south elevation and 7 bricks on the north elevation. The square span at the springing level is approximately 12.86m. Network Rail archive drawings indicates that the foundations of the structure consist of brick corbelled footings on a concrete base.
- 4.3.16 High Street Deritend / River Rea Canal Bridge
- 4.3.17 The BEE passes over this bridge which is located to the east of Birmingham City Centre on High Street Deritend. It carries the A34 in an east-west direction over the River Rea, adjacent to its junction with Floodgate Street.
- 4.3.18 The bridge was constructed in 1956. It has a skew angle of 38° with a skew span of 14.376m and a square span of 11.354m between abutment faces. It carries 7 lanes, 2 footpaths, a central reserve and 2 redundant toilet blocks.
- 4.3.19 According to the archive information obtained from BCC, the deck consists of 34 No. single span steel plate girders at 1550mm centres partially encased in concrete, forming a steel filler beam and concrete deck slab. The main beams are riveted steel plate girders with their top flanges and webs encased in concrete, supported on brick faced mass concrete abutments.
- 4.3.20 The deck slab is approximately 285mm deep at the level of the top flange for most of the carriageway, except the outer sections. At the outer sections, the slab is 280mm thick and is located at the bottom flange, forming service bays which are covered by concrete planks. The deck slab changes again beneath the men's toilets, to a thickness of 200mm at a level slightly below the top flange. Between the main

girders, and encased in the concrete deck, there are steel joists spanning transversely.

4.4 Drainage

- 4.4.1 From the existing drainage records it is understood that the existing surface water drainage along the route is a positive system collecting precipitation falling on the surrounding impermeable surfaces (paths, highways, hard surfaces, etc.) by gravity via crossfalls and channels to road gullies for collection by the public sewerage system.

5. SUMMARY OF WORK CARRIED OUT

5.1 Design Basis

- 5.1.1 The track alignment and associated infrastructure for BEE has been developed to accord with current Midland Metro system design parameters and technical requirements, Office of Road and Rail Regulation Tramway Technical Guidance Notes [BEE/C1], UKTram Guidance and best practice from other street running tramways. The geometric design parameters utilised in the development of the track alignment for BEE have been established to provide passenger ride quality, promote vehicle stability and reduce vehicle and infrastructure maintenance requirements commensurate with the existing Midland Metro Network.
- 5.1.2 The Railways and Other Guided Transport Systems (Safety) Regulations 2006 (ROGS) have been adopted [BEE/B17]. ROGS provides the regulatory regime for rail safety including tramways. The Regulations implement the European Railway Safety Directive (2004/49/EC), which aims to establish a common approach to rail safety and support the development of a single market for rail transport services in Europe. ROGS place a specific duty on transport operators to carry out risk assessments and put in place the measures they have identified as necessary to make sure the transport system is run safely. Pre-safety verification meetings have been held to identify and assess risks, and develop design and operating solutions as avoidance and mitigation measures.
- 5.1.3 The design basis for highway works adopts the technical specification is based on the 'Specification for Highway Works' published by The Stationery Office as Volume 1 of the Manual of Contract Documents for Highway Works and the amended appendices contained in the specification. The highway works are also in accordance with the Birmingham City Council standards.

5.2 Route Description

- 5.2.1 The BEE is a 1.7km extension of the existing Midland Metro network from the junction of Corporation Street and Bull Street to a terminus on High Street Deritend near the junction with Heath Mill Lane.
- 5.2.2 The extension is on street, with around 51% sharing road space with other vehicular traffic and around 49% segregated running.
- 5.2.3 From the junction on Bull Street, the BEE will run on street along this highway in a southeast direction sharing space with other vehicular traffic; southbound along Bull

Street it is proposed as tram and cycles only, and northbound tram, bus and cycles only. The route then crosses Dale End with a tramstop on the realigned Albert Street to serve the HS2 station, Moor Street Station and the Dale End area of the city centre. From here it continues over Moor Street Queensway running adjacent to Eastside Park and a proposed pedestrianised area as part of the HS2 scheme, then for a short distance alongside Park Street with a tramstop at the north end of New Canal Street under the HS2 station. This tramstop will provide interchange with the secondary (eastern) HS2 Curzon Street Station access and will also serve Millennium Point, the Education Quarter and other destinations.

- 5.2.4 The BEE route then runs on street along New Canal Street with a tramstop on the northern side of the junction with Bordesley Street to provide a connection to the Typhoo Wharf development and other proposed developments as well as existing businesses. From here, the tram continues on-street along Meriden Street sharing space with other traffic to turn east at the junction with Digbeth to run in a segregated alignment in the middle of the highway. At the junction of Rea Street and Floodgate Street there would be a terminus tramstop to serve Birmingham Coach Station, South and City College Birmingham, the Custard Factory and other destinations.
- 5.2.5 From the terminus tramstop there will be a 0.2km length of track to the junction of Heath Mill Lane to provide a turnback facility. The proposed Order limits extend to the junction of Clyde Street to provide some highway alterations to facilitate the BEE.

5.3 Interface with HS2 Curzon Street

- 5.3.1 The BEE tramstop has been included within the core HS2 station scope that is the subject of a procurement exercise by HS2 for a designer. WMCA have provided requirements to enable the BEE tramstop to be fully integrated into the High Speed 2 Curzon Street station. This is documented in an approved paper to the HS2 Growth Board essentially approving the design and the subsequent alterations to the HS2 station design and utility diversions. Commitments were also made that the parties would work together to achieve this through the development of a 'Station Working Group' including representatives from BCC, WMCA, MMA and HS2. This Group addresses developments including the station, urban realm, archaeology, utilities and the BEE. There is also a Tram Stop Working Group focusing upon the specific elements of work required to accommodate the BEE stop.

5.4 Tramway

- 5.4.1 Consideration has been made in the design and location of tram tracks to mitigate the potential for noise and vibration impacts particularly near designated noise sensitive receptors (as specified in the ES [BEE/A13/1-3]).
- 5.4.2 It is envisaged that the rails will be embedded and wrapped in an elastomer material to minimise stray electrical current leakage and reduce noise and vibration levels including the addition of a stray current collection mat built into the concrete track-bed of all embedded and street-running sections.
- 5.4.3 Generally, it is currently proposed that two types of trackform will be provided. It is envisaged that the majority of the route will be constructed using pre-formed tied-block sleepers, founded upon a formation layer and cast into the reinforced concrete road construction. The rails would be clamped onto the precast sleeper blocks and encased in the highway surfacing. Where the tracks pass over large voids or bridge structures, the trackform would be an in-situ reinforced concrete trackslab (e.g. the River Rea crossing). The trackslab would be formed in two stages, with the rails laid in troughs formed within the second stage concrete. This type of track form would also be used through and near rail switches and crossings.
- 5.4.4 A floating trackform will be constructed for specified locations requiring attenuation of vibration from the tramway. The system shall incorporate a concrete track slab with grooved rails fixed on tied twin-block sleepers embedded in concrete. The track slab will be placed on an elastomeric floating slab mat of specified stiffness and supported within a concrete trough element. I refer to the evidence of Mr Rupert Thornely-Taylor (APP/P5.1) on Noise and Vibration for the identification of sensitive receptors (Section 7.3.2).
- 5.4.5 Trams progress along the highway and through highway signal controlled junctions in the same manner as other road vehicles. Trams will be provided with an agreed level of priority with BCC, provided via a ground loop detection and an on-board transponder system.
- 5.4.6 There will also be some earthworks required in the laying of the tracks and other associated infrastructure such as track drainage (to control and contain surface water run-off) and alterations to existing highway drainage.

5.4.7 Accommodation works, for example works required to boundary walls, gates or frontages to accommodate the tram alignment will also be required within the design of the BEE.

5.5 Tramstops

5.5.1 Four tramstops are proposed.

5.5.2 The Albert Street tramstop is close to the proposed western Moor Street entrance of the HS2 Curzon Street Station, as well as the development at Martineau Galleries, Hotel LaTour, High Street and Dale End, and will also provide interchange with bus services and Moor Street Rail Station.

5.5.3 The proposed tramstop located at New Canal Street is to serve the New Canal Street entrance of the HS2 Curzon Street Station as well as Millennium Point, Thinktank, University buildings Eastside City Park and the Eastside area. This tramstop is located between the two sections of the proposed HS2 Curzon Street Station building, and will be oversailed by the HS2 platform level above.

5.5.4 The proposed tramstop at Meriden Street is to serve existing premises in the vicinity as well as proposed developments within the HS2 Curzon Street Masterplan [BEE/E19] such as the Typhoo Wharf development. The tramstop at Meriden Street requires the permanent acquisition of land belonging to the Gooch Estate to provide for adequate pavement widths as specified by BCC.

5.5.5 The tramstop proposed at High Street Deritend / Digbeth High Street is located between the Coach Station and the Custard Factory to serve these and other existing businesses along High Street Deritend, including Birmingham South and City College.

5.5.6 A turnback facility extends beyond this tramstop up to the junction with Heath Mill Lane to allow the tram vehicles to recharge batteries and turn around for the return journey towards the City Centre.

5.5.7 BEE tramstops will be designed to complement those on the existing Metro network to avoid visual confusion and have cognisance to their environment in terms of the size and length of platforms as well as the finishes and appearance [see Urban Design Strategy BEE/A13/2]. The tramstop platforms will be 300mm high and designed to provide access in accordance with the Equality Act (2010).

- 5.5.8 High quality materials and finishes will be employed to provide integration with the surrounding areas (including developments where sufficient detail is available in the stage of the development) and consider BEE Urban Design Strategy [BEE/13/2] alongside other BCC development, highways and regeneration aspirations. The detailed design of the tramstops will be a reserved matter for approval by BCC under conditions 2, 3 and 4 to be attached to the deemed planning permission [BEE/A2].
- 5.5.9 Each tramstop will be designed to include either canopies or shelters with seating, passenger information and help points, lighting and CCTV. All the tramstops will consist of two side platforms, separately serving the north and southbound directions, except for the tramstop at Albert Street which will consist of a central platform.

5.6 Bus Facilities

- 5.6.1 The BEE alignment requires the removal of three bus stops on Moor Street Queensway, one of which will be re-provided at a different location along the Queensway, the other two are re-provided in the realigned section of Albert Street near Hotel LaTour and the proposed HS2 Curzon Street Station. In addition, two existing eastbound bus stops along the north section of Albert Street near Dale End are affected in that they will remain on the realigned Albert Street, one in an eastbound direction, the other for westbound bus services.
- 5.6.2 Details of the required bus facilities near Hotel LaTour and the justification for their location is dealt with in the evidence of Mr E Mellor (APP/P4.1) on traffic and transport.
- 5.6.3 The layout of the bus facilities has undergone design changes throughout the development of the BEE. Originally the bus lane and stops were located closer to Hotel LaTour, with the tram to the south, to remove the conflict between trams and buses at the junction with Masshouse Lane considering the urban design strategy (BEE/A13/3 Appendix TA B). Following discussions with the hotel, the arrangement was altered to move the tramway closer to Hotel LaTour, allowing the bus carriageway and stops to be positioned further away. This led to the requirement for a signalised crossing at the junction with Masshouse Lane as the tracks cross the bus lane. This was then further refined by the addition of a planting strip to allow screening to be provided between the bus stops and Hotel LaTour.

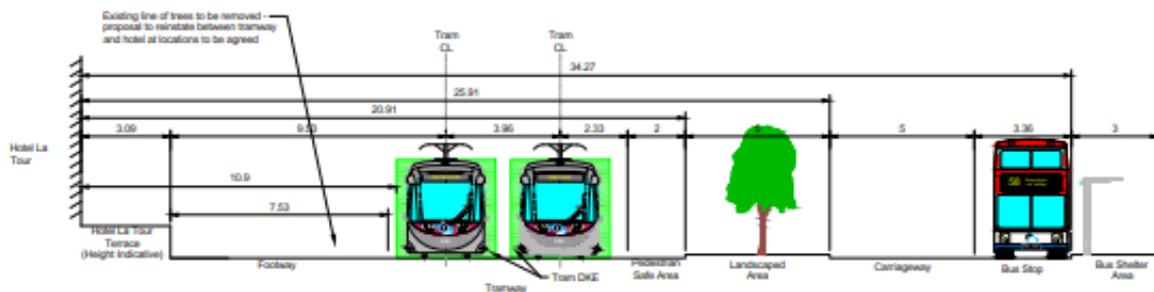
5.6.4 The interchange configuration was developed to enable buses to dock and leave their stops without being blocked by other buses at adjacent stops. A computer aided design process using specific software (Autotrack) was utilised to confirm the spatial requirements for bus manoeuvring. A longer double bus stop is provided at the easternmost stop for SPRINT services (which will allow for operation of double articulated buses).

5.6.5 The figure below shows the proposed cross-sectional arrangement of the BEE and bus interchange. The main elements comprise of:

- 10.9m is the distance from Hotel LaTour Structure to the DKE of the eastbound tramway.
- 9.53m is the distance from the extents of the Hotel LaTour Terrace to the centre line of the eastbound tramway
- 3.96m is the distance between the centre of the tramways which is based upon half the width of the Developed Kinematic Envelope (DKE's) of the eastbound tramway + half the width of the westbound tramway and a 500mm clearance between tramways. The tramways are set out with the required clearance between DKEs on a straight.
- 2.33m is the distance from the centre line of the westbound to the start of the pedestrian area, which is based upon half the DKE's of the westbound tramway + approximately 600mm to the pedestrian refuge area.
- A 2m width for the pedestrian area was provided in line with standard engineering practice.
- 3.36m has been provided for the bus vehicle swept paths into and out of the bus lay-bys (see 5.6.4 above)
- The existing footway of approximately 7.53m was maintained between the extents of the Hotel LaTour Terrace and existing tree line.
- The alignment of the tramway and footway adjacent Hotel La our is aligned to minimise the removal of trees and provide a sufficient area to replace existing trees that have been removed in addition to providing a reasonable footway width outside Hotel LaTour

- 5m has been allowed for a landscaped barrier between the tramway and bus interchange.
- A 5m width has been provided for the carriageway to allow for the bus vehicle swept path onto Moor Street Queensway (see 5.6.4 above).
- 3m has been allowed for the bus shelter area in line with conventional engineering practice

Some of the dimensions above are greater than design standards although are in accordance with industry practice for this planning stage of design and provide scope for optimisation during the detailed design of the scheme.



Hotel La Tour Landscaping

Cross Section 0001

Scale - 1:100

5.7 Parking and Loading

5.7.1 Parking and loading aspects are dealt with in the evidence of Mr E Mellor (APP/P4.1).

5.8 Cycle Facilities

5.8.1 The proposed cycle facilities have been discussed with Birmingham City Council and presented at a monthly cycling group run by the council.

5.8.2 Key modifications to existing facilities include:

- Retain cycleway from Corporation Street to Bull Street heading south and east, removing section of shared footway to provide a continuous cycleway

alongside the BEE through to the junction with Moor Street Queensway. This route can exit the cycle lane and use a proposed toucan crossing to head towards High Street or cross Moor Street Queensway to enter the pedestrian area alongside the HS2 station, or to join Moor Street Queensway heading south, whilst avoiding the need to cross the BEE tracks at an undesirable angle.

- Due to the position of the tracks it is proposed that the route along New Canal Street / Meriden Street is no longer shown as an advisory route, although cyclists will not be banned. Alternative advisory routes on adjacent streets are proposed.
- The potential for a cycle route around the HS2 station onto Andover Street was also discussed with HS2. This will need to be further considered alongside the detailed design of the two schemes.
- Bus lanes on High Street Deritend are being removed. This was discussed with BCC who were more concerned with the ability to cross High Street Deritend from South to North, and vice versa. As such existing crossing points have been retained and additional crossings added around the BEE stop to facilitate this movement.

5.8.3 There is no westbound route from Moor Street Queensway along Albert Street onto Bull Street to accompany the route heading east. Whilst the route will not be prohibited for cyclists, a more desirable route is likely to be Carrs Lane and the pedestrianised Union Street. This will be considered as part of the detailed design process.

5.9 Pedestrian Facilities

5.9.1 Generally, modifications to pedestrian facilities are slight amendments to existing facilities and crossing points to accommodate junction layout changes.

5.9.2 The inclusion of additional signalised junctions as part of the BEE provide for formal pedestrian crossings where currently there are none in the following locations:

- Dale End / Bull Street.
- Meriden Street / Bordesley Street.
- Meriden Street / Digbeth.

5.9.3 Along High Street Deritend, existing signalised crossings have been retained, although positions may have altered slightly. Additional crossing points have also been provided at the following locations:

- Western end of High Street Deritend stop.
- Eastern end of High Street Deritend stop.
- Eastern side of Heath Mill Lane junction.

5.10 Highway

- 5.10.1 The scheme includes highway alterations including highway realignment where required and reinstatement / repaving of highway footpaths and dedicated cycle facilities. It also includes modifications to highway signalling, the final designs of which will be agreed with BCC as part of the conditions to be attached to the deemed planning permission [BEE/A2]. A one-way dedicated bus interchange will be provided to serve new stops adjacent to the HS2 Curzon Street Station.
- 5.10.2 The horizontal alignment of the carriageway and associated footways has been developed to facilitate the safe on-street operation of BEE as well as the needs of all other road users including heavy goods vehicles, private vehicles, passenger service vehicles, cyclists and pedestrians. Consultation has been undertaken with BCC as the local highway authority for any additional requirements and will continue as the BEE is taken forwards.
- 5.10.3 The installation of infrastructure enabling the operation of BEE will require the reconstruction of the immediate carriageway and footway and other areas local to the scheme resulting from associated accommodation and utility diversion works.
- 5.10.4 The design of the carriageway and pavements will be to current BCC design standards, acknowledging aesthetics, vehicle class and vehicle volume, and any specific maintenance requirements with respect to the trackform and tram operations.
- 5.10.5 The construction and operation of the BEE may require the introduction of and modification to some highway junctions along the route. The ability to undertake these modifications is included within the Order. All modifications will require the approval of BCC, and will incorporate pedestrian and cycle facilities as appropriate.

5.11 Proposed BEE Key Junctions

- 5.11.1 The junction of Bull Street and Corporation Street will be modified to join up Upper and Lower Bull Street to enable passage of tramcars for all movements. This will be controlled by three-way traffic signals.
- 5.11.2 The proposed BEE alignment requires the removal of the Kings Parade building on the Dale End/High Street junction. The junction of Dale End and Albert Street will be moved approximately 50 metres to the south where it will meet the realigned Albert Street. Three-way signals will operate on High Street, Lower Bull Street (which will be open to Trams only in a southeast direction) and New Meeting Street, which will be open to all traffic.
- 5.11.3 The BEE will cross Moor Street Queensway and run parallel to the south façade of Hotel LaTour in a segregated area of two-way track. The existing Albert Street / Moor Street Queensway junction will require modification to facilitate the new cross roads, which will operate under signal control.
- 5.11.4 The BEE tracks meet New Canal Street to the north of the Rugby to Penkridge rail line rail over road bridge. At the Fazeley Street crossroads, the existing traffic signals remain as existing with the only alteration being that New Canal Street will become Tram-only on its northern arm.
- 5.11.5 It is proposed that the BEE runs in a central segregated corridor along Digbeth and High Street Deritend, with the only shared sections being where general traffic turning movements are required. To facilitate the Metro's movement into a segregated corridor, it is necessary to alter the junction of Meriden Street and Digbeth. Meriden Street's southbound lane will become Tram only and a new left turn lane for general traffic will be provided onto Digbeth. The right turn lane into Meriden Street will be removed (except for Trams) and the numerous existing traffic signals and nearby controlled pedestrian crossings will be relocated to suit the new junction's needs with Metro having priority.

5.12 Urban Realm and Landscaping

- 5.12.1 The general approach to urban realm is the creation of a high quality public realm creating visual continuity and promoting a distinct identity. This has typically involved the replacement of existing surface materials, the removal and replacement of street furniture and sensitive integration of the tram infrastructure. This is outlined in the

draft Urban Design Strategy located within the Environmental Statement technical appendices [BEE/A13/3]).

- 5.12.2 Design details have not yet been developed for the different sections of the route. In general, it is anticipated that a similar approach to the BCCE and Line 1 will be taken in the detailed design. The townscape value to the city centre will benefit from the BEE with investment in new paving and street furniture. The WMCA is continuing to liaise closely with BCC as local authority in the development of the detail, and HS2 near the footprint of that scheme. The WMCA will also consult with developers in the vicinity as appropriate to their location and the development / phase of their design. The proposed deemed planning conditions require BCC's approval for design, external appearance, and materials used for the scheme.
- 5.12.3 Through design of surfacing and integration of street furniture, the proposals will also seek to reduce risk between vehicular traffic and pedestrians.
- 5.12.4 There are opportunities to enhance the existing streetscape along the route of BEE, as well as creating and integrating new areas of sociable and usable space for pedestrians including outside Hotel LaTour and the potential for grass track. There will inevitably be compromise in some aspects of the design and use of materials, particularly near the operational tramway. These areas of opportunity are identified within the ES [BEE/A13/1-3] and will be captured through the planning conditions attached to the Deemed Consent [BEE/A2].
- 5.12.5 Attention has been paid to the landscape and urban realm proposals adjacent to Hotel LaTour. Three semi-mature trees (London plane) will be removed from the footway in Moor Street Queensway and of these, one will be replaced at the end of construction. Eight young trees (London plane) will be removed from outside Hotel LaTour, but in their place, eight new semi-mature trees will be planted in a line, 1-2m closer to the hotel. The 5m wide border between the tram tracks and the bus stand will be planted with a line of semi-mature trees, a 2m high hedge and shrub and perennial planting. landscaping works and improvements to urban realm will be carried out as part of the scheme.

5.13 Traction Power

- 5.13.1 Midland Metro is an electrically-powered tramway conforming to European Standards in terms of traction voltage and design criteria. The system operates on direct current (dc) at a nominal voltage of 750 V, fed via traction substations.

- 5.13.2 The electricity supply for the BEE will be taken from a proposed new substation located on the land at the corner of Meriden Street and Coventry Street as shown on Sheet 2 of the Works and Land Plans [BEE/A11].
- 5.13.3 Many sites were initially assessed and considered to be feasible for the location of the substation. These possible sites were assessed for suitability against several criteria including; impact on heritage assets, ecology, land use and current planning applications. Discussion was also undertaken with BCC as part of this assessment, and a Flood Risk Assessment was also undertaken given the area is in Flood Zones 2 and 3 (1 in 1000 year and 1 in 100 year storms respectively).
- 5.13.4 The initial site proposed to accommodate the substation is currently in use as a pay and display car park. An alternative location for the substation underneath the railway viaduct arches has been developed to minimise the impact on the car park land owners. Agreement has been reached with Network Rail for this location (see section 8 of this proof) and this is the preferred substation location.
- 5.13.5 It is envisaged that Overhead Line Electrification (OLE) will extend along approximately 33% of the BEE to facilitate the operation of the tram. Due to industry advances in on-board tram battery power technology, it is proposed that approximately 67% of the BEE route will be 'catenary free' with trams operating on battery power and not requiring the use of affixing OLE to buildings or the use of poles. The section requiring OLE extends from the junction with BCCE at Bull Street to the tramstop at Albert Street, and a short length from the terminus tramstop on High Street Deritend going south east along the turn back facility; the remainder of the BEE will be catenary free. This will reduce the visual impact of the BEE as detailed in the ES [BEE/A13/1-3].
- 5.13.6 The area considered to be most appropriate for catenary free operation was between the Albert Street stop, alongside the proposed HS2 station and under the railway bridge onto New Canal Street. The reasoning behind this section being essential was firstly based on visual impact, to reduce impacts and the amount of street furniture within the public realm alongside the station and outside Hotel LaTour. Secondly, being wire free would be beneficial as the BEE passes below the HS2 platforms along New Canal Street and the Network Rail structure leading to the junction with Fazeley Street. This would remove the need to have to fix overhead equipment to the HS2 and Network Rail structures and remove potential safety concerns as a wire would have to be lower than the normal recommended wire

height (approx. 6m) as it passed through the Network Rail structure which would lead to height restrictions on the proposed road alongside the HS2 station.

- 5.13.7 The section between the Meriden Street stop and the High Street Deritend stop was also desirable for wire free operation. This is due to limited space being available for footways and the existing buildings being too low to be suitable for building fixings. As such OLE poles would need to be positioned which would further limit the available footway width at these points.
- 5.13.8 Operational modelling undertaken by the vehicle supplier confirmed that wire free operation in these areas would be possible.
- 5.13.9 Where OLE is required along the route of the BEE, approximately 28 OLE poles will be installed along the route, including the associated foundations to support the poles (the final number of poles will be determined by detailed design).
- 5.13.10 Where practicable, where OLE is required, OLE poles will be combined with lighting columns or closed-circuit television (CCTV) poles to reduce street clutter, increase effective footway width and reduce construction work. Where possible, the contact wires will be suspended from cross-street span-wires using simple fixings attached to buildings. This will reduce visual intrusion through optimizing the need for poles and foundations. Approximately 14 permanent OLE building cable fixings will be required for the BEE (with final number subject to detailed design).
- 5.13.11 OLE building fixings are generally spaced at about 20m – 30m on straight alignments and closer together on curves. Where suitable buildings are not available for fixings, poles will be used like those existing along the Metro network.
- 5.13.12 The principle of attaching OLE to buildings in preference to poles has already been established through their use along the BCCE and Midland Metro Line 1. Discussions with stakeholders including BCC, and others, are ongoing. Both visual and intrusive surveys will be undertaken to confirm the suitability of the structure and design of the connection detail.
- 5.13.13 As part of the catenary-free operation of the Metro, trams will recharge their batteries via lengths of OLE, including at the terminus tramstop in High Street Deritend.

5.14 Street Lighting

- 5.14.1 The most appropriate class of lighting for the various sections of route will be considered including user type and safety, as well as other local factors such as the

existence of public transport facilities. Both new and existing lighting will need to provide adequate lighting levels on the road surface throughout. This may necessitate amendments to luminaires outside of the immediate area affected by the tram. Lighting will require the approval of BCC through the planning conditions set out in the request for planning permission [BEE/A2].

5.14.2 The principal assumptions and approach to the design of the lighting include but are not limited to:

- where practicable, street lighting will be combined with OLE poles and that BCC and their nominated lighting contractor will accept the principle and methodologies;
- lighting levels will need to be improved and increased to consider any increased risk to road users and pedestrians using combined running; and
- minimise light pollution, light trespass and sky glow.

5.15 Drainage (Attenuation) Tank

5.15.1 It has been identified that there is a potential need to provide an additional drainage tank to attenuate the flow into the existing drainage system near Eastside City Park. This location is included within the land identified for permanent acquisition.

5.16 Tram Signalling, Communication, and Electrical Equipment

5.16.1 The BEE includes the installation of tram signalling, communication and electrical equipment as well as the installation of parallel feeders (cables and ducting that will run parallel to both the Digbeth terminus bound line and the Birmingham City Centre bound line) and cabinets to contain communication equipment and system, envisaged to be located within highway land.

5.17 Alternatives Considered

5.17.1 Alternative Modes

5.17.2 The evidence of Mr Peter Adams (APP/P1.1) on scheme development addresses this matter.

5.17.3 Alternative Alignments

- 5.17.4 The evidence of Mr Eddie Mellor (APP/P4.1) on Traffic and Transport addresses this matter.
- 5.17.5 Alternative Tramstop Locations
- 5.17.6 As part of the development of the route, the location and number of tramstops was the subject of the design evolution process.
- 5.17.7 Considerations included how to achieve a high-quality interchange for both interconnecting Metro services (for which a tramstop as close as possible to BCCE would be the best option) and with HS2 (for which a tramstop close to the station would be best), whilst still maintaining commercial journey speeds for the tramway and considering the large level differences across the route.
- 5.17.8 Initially a tramstop on lower Bull Street and one outside Hotel LaTour were considered; these were amalgamated into a single tramstop on Albert Street to serve both the city centre and the western entrance to the HS2 Curzon Street Station. (The eastern entrance to the HS2 Curzon Street Station is served by another tramstop on New Canal Street.) A further tramstop was introduced on Meriden Street, primarily to serve the major redevelopment in that area, with a terminus tramstop on High Street Deritend.
- 5.17.9 Initial options for the Albert Street tramstop located the tramstop to the east of Moor Street Queensway, in the area alongside the proposed HS2 Curzon Street Station. However, discussions with HS2 and BCC identified that a Metro tramstop was not ideal due to the large level difference between the proposed concourse and the tramstop. The stop would also not be visible to users exiting the front of the station which was not desirable to either BCC or HS2, and this location was also further away from the city centre core area. As such, the tramstop was moved to its current position on Albert Street on the west side of Moor Street Queensway, where it better balances demands and constraints, and enhances the potential for a high-quality redevelopment of the Martineau Galleries site.
- 5.17.10 The proposed tramstop located at New Canal was originally located along the line of New Canal Street, but was revised during discussions with HS2 and BCC to move it further away from the face of the proposed HS2 structure (including the locally listed Eagle and Tun Public House) to provide a footway around the tramstop platform and more space for pedestrian movements in the area.

5.17.11 During ongoing consultation with BCC, and following response to BCC's consultations on the HS2 Curzon Masterplan for Growth [BEE/E19], the Council expressed a desire to have a tramstop along New Canal Street / Meriden Street to serve regeneration of Eastside and proposed developments in the vicinity, principally the Typhoo Wharf development. During both engineering and modelling work including BCC's requirement for adequate footway provision, different locations were considered to maximise the tramstop position and minimise any land and property acquisition, including a staggered platform arrangement with the northbound platform and the southbound platform either sides of the junction with Bordesley Street. As such, the tramstop was relocated north of the junction to reduce landtake and impacts on existing businesses

6. STATUTORY UNDERTAKERS EQUIPMENT

- 6.1.1 To ascertain the extent and cost of utility works, guidelines for the diversion and protection of apparatus given in New Roads and Street Works Act 1991 'Measures necessary where Apparatus is affected by Major Works', are being followed. These guidelines have been developed to address major issues that have affected Statutory Undertakers plant during major highway, bridge, or transport improvement works [BEE/B15]. The basic stages are as follows
- Preliminary Enquiries and request for Record plans (C2 stage)
 - Draft scheme and Budget estimates (C3 stage)
 - Detailed scheme and Detailed estimates (C4 stage)
 - Formal Notice and Advance orders (C5 stage)
 - Selection of Contractor and issue of main orders (C6 Stage)
 - Construction (C7 Stage)
- 6.1.2 The majority of the construction of BEE will take place within the highway boundary where utilities are maintained by the utility companies. Utility companies have therefore been contacted to provide information initially on the location of their apparatus and later to determine the nature and extent of any diversions they consider to be necessary because of BEE.
- 6.1.3 C2 stage enquiries were made under the New Roads and Street Works Act (NRSWA) requesting records of the location and depth of apparatus in the area of the proposed BEE. Responses were received and the information was transferred to composite utilities plans showing all the apparatus plotted onto plans of the BEE route.
- 6.1.4 C3 stage enquiries under the NRSWA have been made requesting outline details of any diversions required by utility companies together with budget costs for those diversions.
- 6.1.5 Notice of the Transport and Works Act Order application was served on all the statutory undertakers and other utility providers and there are no residual objections.
- 6.1.6 The draft Order [BEE/A8/2] deals with provisions for statutory undertakers.

6.1.7 The construction strategy will be to undertake most of the requisite utility diversion works before the commencement of the Metro infrastructure works. This has both a time and cost benefit to a project and significantly de-risks the scope since the act of undertaking the diversions gives greater certainty of ground conditions and provides contractors with a 'clear site'. Best value will be obtained through the diversion of utilities by the utility companies' own contractors. To provide best value, optimum programme and appropriate stakeholder communications, WMCA will actively co-ordinate and manage the utility companies' programmes, in conjunction with Birmingham City Council pursuant to their statutory role as Traffic Manager and NRSWA co-ordinator.

7. CONSTRUCTION

7.1 Introduction

7.1.1 A draft Construction Strategy Report for BEE has been prepared [Appendix D1 of the Environmental Statement BEE/A13/2]. It will be further developed and defined by the Midland Metro Alliance.

7.1.2 Initial consultation has taken place with the Emergency Services and is continuing. It will be necessary to develop an efficient and consistent construction traffic management plan to minimise the effect of the construction of the BEE on general traffic flows and to manage the movement of people and materials associated with the construction itself, as required by the Draft Code of Construction Practice for the project (see Appendix D2 of the Environmental Statement [BEE/A13/2]). BEE works will be carried out in stages and, as far as practicable, to maximise traffic circulation, particularly where works affect major junctions. Loading and access requirements will be maintained as far as practicable.

7.2 Utilities Diversions

7.2.1 Diversion of utility company equipment will take place ahead of the main construction works where possible. This is required to provide suitable safe access to apparatus for maintenance on completion of the tram infrastructure and to maintain apparatus at a depth such that apparatus is not at risk from highway loads.

7.3 Construction Areas

7.3.1 The draft Construction Strategy envisages the main works being undertaken within a series of fenced off sections of carriageway (Section 4 of Appendix D1 [BEE/A13/2]). Proposed construction work sections have been identified considering:

- possible traffic management requirements and likely availability of suitable diversion routes within each construction section,
- the uniformity of work type and method of construction to maximise the Contractor's opportunities to utilise plant and resources efficiently,
- road space requirements,
- the ease with which the adjacent sections can commence without conflict,
- the degree of complexity,
- the availability of potential construction compound sites,
- possible testing and commissioning requirements.

7.3.2 The exact sequence of work and areas to be occupied will be subject to development by the Midland Metro Alliance and to agreement of temporary traffic management arrangements with BCC's Traffic Manager and the Police.

7.4 Site Compound

7.4.1 Potential compound sites were identified in a desk-based exercise in accordance with pre-determined compound selection criteria. The approach was to visit each site to assess its suitability as either a strategic or a local compound. The strategic site compound would contain the main contractor's and project manager's offices, a small number of essential car parking spaces for visitors, space to allow storage of construction materials and an area to accommodate construction operations including the preparation of tied reinforcement. Some material and plant required for the local construction site will be delivered from the Strategic Compounds, to the Local Compounds and then stored at the secure Local Compound before being used to service local worksites at locations along the route. The local compounds will be sited closer to the construction sites.

7.4.2 The Construction Strategy for the scheme has been devised on the basis that there will be no space made available at worksites along the route for the storage and stockpiling of materials and plant to support the construction. Excavation, demolition and new materials will be transported by road (see section 4.6 of Appendix D1 [BEE/A13/2]).

7.5 Traffic Management

7.5.1 To provide an efficient and consistent temporary traffic management regime, the intention is to maintain the direction of traffic on the existing network wherever possible and keep the direction of respective lanes during construction. To maintain traffic circulation and construction where the tram route crosses major junctions, works will be carried out in stages and, wherever possible, at times of minimal traffic. This is dealt further in the evidence of Mr E Mellor (APP/P4.1).

7.5.2 Suitable footways will be maintained throughout the period of construction to enable the flow of pedestrians. Where footways are required to be closed to complete construction, suitable diversion routes will be provided with appropriate signage.

7.5.3 Access to premises will be maintained. Where construction takes place across an access, suitable measures will be taken to maintain access or works will be carried out at night or when access is not required.

7.6 Sequence of Operations

7.6.1 The sequence of work within each construction area will be as follows and has been reviewed by the construction arm of The Midland Metro Alliance and is compatible with their expectations for the construction of an urban Light Rail project. Sequencing is expected to be as follows.

- Enabling and Mobilisation Works- These will include advance roadworks and road diversion works including signage and junction improvements. Advanced notice of and where necessary to facilitate the initial works, enforcement of parking restrictions along the route of the works and any diversion routes will be implemented at this stage. Construction compounds will also be established by the contractor during the enabling works phase to facilitate the construction programme.
- Treatment of Trees- No work to take place within 10m of a tree between March and September unless netted out before 31 March or inspected by the ecologist before work starts. All trees in the immediate vicinity of the tram route and construction compounds will have to be surveyed and will be designated either for cutting back and protection during the construction period, or removal where this is unavoidable. An agreed tree-planting strategy will be implemented as works are completed.
- Site Clearance- Site clearance will consist of the phased removal of vegetation, fences and peripheral assets such as street furniture, signs, lamp columns, bus shelters, etc. which may be affected by the construction works. These works will be carried out with the agreement of the relevant stakeholders and, where appropriate, removed items will be stored for reuse or recycling.
- General Excavation- The excavation works are liable to have programme risk associated with the exposing of abandoned or unmarked utilities or other buried obstructions. Non-intrusive survey methods will be employed to determine the extent of buried obstructions prior to commencement of work. A permit to dig system will be implemented on the project. Excavation will be required to a depth of at least half a metre to prepare the foundation of the track slab. The length of the excavation will depend upon the predetermined access arrangements. The sides of the excavations will generally not require any support. Additional excavation may be required in some areas where additional drainage or ducts are required. Excavated material will be removed

from the site using HGVs. Where possible designated lorry routes will be used as haul routes to reduce disruption to traffic, residents and businesses. Any suitable excavated material will be reused where possible for engineering fill.

- Structures- No works are anticipated for the existing bridges passing over the route of the BEE.
- Utility Protection- Following excavation, approved and appropriate protection will be provided to the services that cross the new tram alignment.
- Track Slab Construction- Track slab construction is of reinforced concrete. Conventional reinforced concrete track construction using 'fixed form' methods will be used. The track-bed is then made up to road level with a second stage layer of concrete.
- Ducting and Drainage- Service ducts and draw pits for traction power, SCADA, communication fibre optic cables and LV power for stops will be installed. Drainage components and connections to rail groove drainage boxes will be installed at this stage.
- Highway Works- Following installation of the track slab the highway will be reinstated to the relevant highway standards.
- Installations of Overhead Power Supply- The traction power for the tram will be partly supplied by an overhead conductor system and elsewhere will operate catenary free. In certain areas of the route the overhead conductor wires will be supported from building fixings wherever suitable structures are available and the necessary approvals or consents can be obtained otherwise the overhead conductors will be supported on pole supports located on either the footways or verges. Generally, the bases for the support poles will be completed during the track works and support poles will be erected on completion of the highway works but before the surface finishes are completed. The contact wire will not be suspended in position until all major construction activities have been completed on that section. It is probable that some of this work will be carried out at night, subject to Local Authority approval, to minimise disruption to traffic.
- Stop Construction- There are 4 stops to be constructed. The laying of service ducts and draw pits will be required for power and communications cabling which will be connected during the stop fit-out phase.
- Stop Fit-out- Stop fit-out will comprise the installation of the shelter canopy structure incorporating integral seating, installation of lighting, and associated

tram infrastructure and operating equipment. Cables for the power supplies and communications systems (connecting back to the Control Centre) will have been pulled and coiled in draw pits awaiting fit out.

7.7 Site Construction Considerations

- 7.7.1 Construction in vicinity of sensitive receptors will adopt the Code of Construction Practice which I consider appropriate for the construction of urban LRT.
- 7.7.2 Consultation with the Midland Metro Alliance has confirmed that the Alliance will take all reasonable precautions in carrying out the works to prevent or reduce any disturbance or inconvenience to the owners, tenants or occupiers of adjacent properties, and to the general public. This will be carried out in accordance with a Project Communication Plan based on the Code of Construction practice which will be developed during the detailed design phase of the project.
- 7.7.3 It is envisaged that the Alliance's Communication Team will be a central point of contact for interested parties affected by the works. They will visit stakeholders affected by the works prior to commencing to understand their specific needs during the works. They will advise when and how works are to be carried out and how concerns will be managed. They will liaise with the stakeholders during the works and make arrangements for amendments to working practices where practical. They will attempt to get feedback from stakeholders following sections of works to see if lessons learnt can be implemented on the next phase. The details of the Communication Team will be displayed on display boards at all work location.
- 7.7.4 During the works noise will be kept to a minimum wherever possible to minimise the disturbance to the general public. This will be done in accordance with the code of construction practice (see section 4 of Appendix D2 [BEE/A13/2]). The choice of hoarding in such areas is to keep the disturbances to these businesses to a minimum. Agreed noise limits will be adhered to, but measures will be in place to keep noise as far as practicable below the specified limits. The Alliance's Communication Team will maintain regular contact with the premises to ensure that issues are resolved quickly and to enable the noisier construction activities to be programmed around especially pertinent times for some of the premises.
- 7.7.5 The Alliance will take necessary measures to avoid creating a dust nuisance and keep dust within acceptable levels during Construction and demolition works (see

section 6 of Appendix D2 [BEE/A13/2]). Means will be used to minimise dust including:

- Vehicles entering and exiting the site will run on hard standings wherever possible. These hard standings will be easily cleaned by means of a sweeper or jet wash with run off controlled. This will be of specific importance in heavily used areas such as haul routes and compounds.
- Where loose material is stockpiled it will be kept either damped down or sheeted during dry windy periods of weather to minimise the possibility of a dust nuisance to the surrounding environment.
- Cutting undertaken on site will where possible be undertaken within enclosed site boundary to minimise dust and noise nuisance and will use water suppression, with the slurry generated being controlled.
- Vehicles transporting granular material to, from or around site (including spoil) will ensure that the load being transported is properly loaded and sheeted on all sides. This may not be practical with dumpers; however the material will be dampened down where there is a risk of airborne dust being generated.
- Dust suppression techniques will be employed on unpaved surfaces and roads, such as dampening down with a water spray to minimise the impact of dust.
- The site will operate a 10mph speed restriction within the site boundary and on unpaved surfaces.
- Materials that are to be stored on site within silos, such as cement or other dust generating materials will be housed in silos with appropriate functioning filters and overflow alarms or storage bags.
- Where deemed necessary and as agreed with the Local Authority materials tipped on site that could produce dust during the tipping process will be subject to water spraying during tipping. Care will be taken with this process during freezing conditions not to introduce a slip hazard to workers or members of the public by spraying water.'

7.7.6 Specifically relating to Hotel LaTour; acoustic barriers will be used when working next to the hotel and noise reduction of plant and machinery will be undertaken where necessary to comply with the code of construction practice (section 4 of Appendix D2 [BEE/A13/2]). A hoarding will be erected around the main works of construction in accordance with the code of construction practice (see section 10 of Appendix D2 [BEE/A13/2]).

- 7.7.7 Through consultation with the Midland Metro Alliance specific consideration has been made to the maintenance of building access during construction in addition to the arrangements outlined in Section 4 of Appendix D1 [BEE/A13/2]. This is described below and illustratively in the figures in Appendix ??
- 7.7.8 Bull Street Tie-in to Moor Street Queensway
- 7.7.9 Martineau Place – Access from corner of Bull Street and High Street via Carrs Lane will be required permanently.
- 7.7.10 Pedestrians will need to be diverted around the works, particularly in Corporation Street, Bull Street and High Street. It is feasible to retain pedestrian movement through New Meeting Street, Kings Parade and Albert Street. Ideally however pedestrians should be re-routed via Carrs Lane to minimise conflicts during construction.
- 7.7.11 The Kings Parade Demolition will necessitate closing New Meeting Street to pedestrians and suspension of parking bays on Albert Street and half of first lane of carriageway. Accesses to businesses on Dale End (Betfred) would be maintained for pedestrians.
- 7.7.12 Vehicular access to the rear of the properties off Kings Parade will be maintained during construction across High Street / Dale End and in New Meeting Street and Albert Street. Temporary access will be available from the west via Carrs Lane / High Street and through the demolition area of Nos. 1-5 Dale End. To enable access to the rear of Kings Parade is available, construction between High Street and the Moor Street / Albert Street junction will need to be phased. This will enable High Street and the demolition area in Dale End to remain open while construction takes place in New Meeting Street and Albert Street.
- 7.7.13 During construction across Albert Street opportunities for access / egress from Moor Street Queensway will be limited. High vehicles, however, cannot access via Dale End due to the low bridge so access will need to be maintained direct from Moor Street Queensway or via Carrs Lane and High Street (subject to amendment of the existing bus only order). Vehicles other than service vehicles will need to be temporarily banned from the area or access via Dale End to enter IKEA car park.

- 7.7.14 Moor Street Queensway
- 7.7.15 Construction within Moor Street Queensway will require special consideration as this is a main route in to the City Centre from the north. For example, out of hours working and temporary closure/possession coupled with the use of prefabricated track elements may provide one solution. Before a construction method can be adopted, however, the impact on traffic flows will have to be assessed and compared for each alternative. Practical methods of construction will need to be considered, and congestion assessed both at the junction and within the wider highway network. Approval of the local authority will be required for whichever construction method is adopted.
- 7.7.16 Moor Street Queensway to West Coast Mainline (WCML)
- 7.7.17 Access onto Albert Street needs to be retained for high vehicles for access to IKEA car park or alternative access / egress provided as above. Light/low vehicles should be encouraged to avoid the junction and access / egress via Dale End.
- 7.7.18 St Michaels Church car park access will be maintained via Albert St or alternative parking provided within NCP car park. Pedestrian access will be via Moor St Queensway / Carrs Lane.
- 7.7.19 It is intended that service access to Travelodge and Betfred via Carrs Lane and High St or Moor St Queensway.
- 7.7.20 24 hour access to the Hotel LaTour drop off point will be maintained including full access for deliveries. If this is not possible then alternative arrangements will be identified in conjunction with Hotel LaTour. If appropriate and necessary, traffic marshals will be deployed to assist with traffic control around the hotel area during construction of the works for the BEE.
- 7.7.21 Access to the Woodman Public House will be retained during works from Curzon Street.
- 7.7.22 New Canal St and Meriden St
- 7.7.23 Access to businesses will be via Fazeley St and New Bartholomew St.
- 7.7.24 New side entrance to the car park fronting New Canal St would be created from Fazeley St.

- 7.7.25 It is envisaged that for Latifs and Digbeth Hall vehicular access will be retained from the rear (New Bartholomew St and Allison St) during construction. A two way rear entrance would be created for Latifs and Digbeth Hall. Some parking would be suspended and provided in carpark opposite.
- 7.7.26 Whitaker Fleet Care – this has access from New Canal Street as well as off a side road (Bordesely Street) which would enable this business to remain open with New Canal Street closed.
- 7.7.27 At least one junction on New Canal Street / Meriden Street would be kept open for construction at any one time to facilitate vehicular access.
- 7.7.28 Access to Wing Yip carpark will be via side entrance on Coventry Street.
- 7.7.29 Accesses to businesses on Meriden St will be via Allison St / Digbeth High St.
- 7.7.30 For Fancy Fabrics, there is opportunity to provide a loading bay on Digbeth High Street – utilising part of pavement and first lane carriageway.
- 7.7.31 Digbeth High St
- 7.7.32 The Custard Factory car park is accessed only from Digbeth High Street as the River Rea is adjacent to western side. Due to the presence of wooden fencing, it will be possible to move this access point to accommodate the works as required. It is likely that the inner traffic lane would remain open during the works.

8. OPERATIONS

- 8.1.1 Tram frequency on the BEE will be a peak six-minute service along the route, with alternate trams heading to Edgbaston and Wolverhampton. The capacity of the Corporation Street / Bull Street junction will operate satisfactorily for the future year tram and bus operations. The operational hours of the BEE are assumed to be:
 - 8.1.2 Monday to Wednesday inclusive from 06:00 to 01:00; and
 - 8.1.3 Thursday to Sunday inclusive from 06.00 to 03.00.
- 8.1.4 Terminus arrangements are proposed at High Street Deritend.
- 8.1.5 Bus and HS2 interchange will be facilitated through the location of tramstops, bus stops and pedestrian facilities. A new bus facility has been located adjacent to the HS2 station to facilitate bus interchange and provide for bus stops lost on Moor Street Queensway. The HS2 station is served by two tram stops. One tram stop has been located near the eastern entrance to the HS2 station on New Canal Street. The second is opposite the station on Albert Street. It has been located alongside the new bus stop facility to improve visibility for pedestrians using the western entrance to the HS2 station and to avoid it being too close to the New Canal Street stop.
- 8.1.6 The posted speed limit on street is 30 mph (48kph). Run time analysis (considering junctions, alignment and stops) indicates that trams will operate below this speed limit.

9. STATEMENT OF MATTERS

9.1 Matter 4a – Dust

9.1.1 The main air quality effects that may arise during construction are dust generating activities. A qualitative assessment of construction dust effects has been undertaken and, following implementation of the measures set out in the CoCP (see section 6 of Appendix D2 [BEE/A13/2], the assessment concludes that there will be no significant effects associated with construction dust.

9.1.2 Dust generation during operation will be insignificant.

9.2 Matter 4c – Flood Risk and Groundwater

9.2.1 The Flood Risk Assessment [BEE/A13/2] has identified that the majority of the BEE is located within Flood Zone 1. However, the last section of the route along High Street Deritend is located within Flood Zones 2 and 3. Likely construction effects associated with siltation, spillages and surface water runoff are not significant, subject to the design of embedded mitigation measures and implementation of the requirements of the CoCP (see section 3 of Appendix D2 [BEE/A13/2]. This will include temporary site drainage to prevent overflow of site surface water runoff to watercourses and highways. Flood risk during construction will be monitored and managed by the Contractor.

9.2.2 Potential groundwater, soil and contaminated land effects identified during the construction of the BEE will be mitigated by undertaking ground investigation surveys and subsequent risk assessment, along with the implementation of measures set out in the CoCP and other appropriate construction and environment plans. On this basis there will be no significant temporary or permanent effects relating to contamination during construction.

9.2.3 Track and highway drainage systems have been designed in accordance with relevant standards and on this basis there will be no significant temporary or permanent effects during operation.

9.2.4 The WMCA have agreed with the Environment Agency [REP/01/WD] to commit to:

- undertaking all measures stated within the Flood Risk Assessment
- Registering for the flood warning and alert service and to install CCTV
- Obtain the prior approval of the EA for any works as authorised by the TWAO as stated within the protective provisions of the application

- Reference to the CLAIRE CoP within the Project Sustainability Plan to be produced as part of the management of re-use of excavated soils where it is appropriate to do so. [CLAIRE provides good practice for those involved in sustainable land reuse. The CoP provides a clear, consistent and efficient process which enables the reuse of excavated materials on-site or their movement between sites].

9.3 Matter 6 – Mitigation Measures

- 9.3.1 A draft Code of Construction Practice (CoCP) has been submitted with the application which contains measures to mitigate the impacts of construction [BEE/A13/2].
- 9.3.2 The draft CoCP defines the minimum standards of construction practice acceptable to the WMCA and BCC, and therefore what is required of the Principal Contractor. During construction of the BEE, the environmental management process would be guided by a number of strategies including those required by the CoCP, which include a Construction Environmental Management Plan, a Construction Noise and Vibration Management Plan, and a Construction Traffic Management Plan.
- 9.3.3 Whilst there are likely to be potentially significant noise and likely vibration effects associated with construction activities and construction traffic, these will be mitigated via good practice guidance and the measures set out in the CoCP (see sections 4 and 5 of Appendix D2 [BEE/A13/2]) along with a Construction Noise and Vibration Management Plan. Whilst effects will remain, their extent and magnitude will be reduced by these mitigation measures. Although there is the potential for temporary disturbance due to vibration levels due to construction activity, vibration levels are predicted to be significantly lower than the threshold at which building damage could occur.

10. RESPONSE TO OBJECTORS

10.1 Introduction

10.1.1 This section address engineering aspects in response to objections:

10.2 Martineau Galleries No 1 Ltd, Martineau Galleries No 2 Ltd [OBJ/06]

10.2.1 The drawing included in the Proof of Evidence of Mr Bruce Fowler [APP/P7.1 to 3] regarding compulsory purchase and property matters highlights the extent of temporary and permanent acquisition.

10.2.2 Parcel 4 – Corporation Street and Bull Street Junction - this is included to allow for the construction of the delta junction on the junction of Bull Street and Corporation Street and the consequential tram tracks onto lower Bull Street including consequential alterations to the existing highway of Corporation Street in terms of for example kerb lines and levels. Infilling of basement level shops required to corner of Corporation Street and Bull Street to accommodate revised levels and to broaden out highway to accommodate the BEE, carriageway and footways resulting. Further southwards along Corporation Street levels are more fixed reflecting the presence of the existing Line 1 Metro.

10.2.3 Parcel 5 – Martineau galleries 1 – identified to locate building fixings to this building on the corner of Bull Street and Corporation Street. This location places the alignment adjacent to the newly created delta junction with the existing line 1. Placing building fixings at this location simplifies the OLE design and removes the need for poles here where there are gradient issues and the need to locate such assets in a complex highway environment. It also avoids the anticipated need to divert utilities in the footways at this location where the poles would be located and the disruption and cost associated.

10.2.4 Parcel 6 – Bull Street – lower portion between Corporation Street and High Street – this is identified to locate the permanent tram tracks and overhead line equipment and other associated BEE infrastructure. Alterations to carriageway and footways will be required consequential to the BEE including the location and number of bus stops and amendment to kerb lines.

10.2.5 Parcel 8 – High Street/ Dale End junction with Bull Street - this is included to allow for the construction of the tram tracks over High Street Dale End from Bull Street. The extent of land shown is to allow for consequential alterations to the highway including the levels and layout of the carriageway, footways and kerbs.

- 10.2.6 Parcel 11 to 14 – Units 3 to 6 Kings Parade – this is required to be demolished in line with the overall demolition of the Kings Parade building. This land is required to provide for the route of the BEE tram tracks and associated complementary highway works. These highway works include the formation of new carriageway and island to enable vehicles travelling west along the realigned Albert Street to access to the rear of the NCP car park and Ikea drop off and collection point. The positioning of the BEE stop on the realigned Albert Street prevents access to this location for west bound vehicles hence necessitating a right turn onto Dale End and looping round the newly created island and travelling eastbound before turning left to access NCP and Ikea.
- 10.2.7 Parcels 15 and 16 – Units 1 and 2 Kings Parade – this is required to be demolished in line with the overall demolition of the Kings Parade building. Thereafter land to support the works of construction in the area and or temporary landscaping.
- 10.2.8 Parcels 17 and 18 – Footway and Carriageway to Albert Street – this is required to support temporary works to demolish the Kings Parade building. The extent of temporary acquisition will be determined during detailed design.
- 10.2.9 Parcel 19 – Footway to Albert Street – this is required permanently to accommodate BEE tram tracks and highway including a portion of the east bound bus stand and to rear of footway.
- 10.2.10 Parcel 20 – Land to rear of Kings Parade – currently service yards and parking – this is required permanently to accommodate the tram tracks, carriageway and footways of the realigned Albert Street and the widening of the carriageway to form the bus stands on either side of the carriageway.
- 10.2.11 Parcel 21 – New Meeting Street and service areas to rear of Kings Parade and Carrs Lane – this is required temporarily to stop up the footway (New Meeting Street) to carry out works of demolition to the Kings Parade building (parcels 11 to 16). Permanent works will be carried out to parcel 21 to create the highway and footways associated with the proposed alignment at this location. The BEE alignment and adopted carriageway will occupy the northern portion of parcel 21.
- 10.2.12 Parcel 25 – Footway and Carriageway to Albert Street, access road to rear of Kings Parade and Carrs Lane service areas and car parking and junction with access to rear of NCP – this is required permanently to locate to the BEE tracks, tram stop and associated island platform, highway realignment of Albert Street, a bus stand

eastbound and westbound and revised access into rear of NCP and revised junction with Moor Street Queensway.

- 10.2.13 Parcel 26 – NCP Car Park – corner of building – identified to locate a building fixing to the corner of the building as this is the only structure to the north side of the alignment between Dale End and Moor Street Queensway and this is the only point close enough to the alignment to afford this opportunity.
- 10.2.14 Land identified as land parcels 11 to 16, and parcel 20 are land associated with the building that makes up nos. 1-7 Kings Parade and associated parking areas. This building is to be demolished as part of the works.
- 10.2.15 The area hatched in red shows an area of land not required permanently, which is bounded by the extent of the proposed scheme on Dale End and an allowance of 15m from the centreline of Work No. 1. The exact extent of land required will be dependent on detailed design.”

10.3 Quintain City Parkgate [OBJ/07]

- 10.3.1 Please refer to Section 5.3 of this Proof of Evidence in relation to coordination between HS2 and BEE during design development and implementation.

10.4 Network Rail [OBJ/09]

- 10.4.1 Positive dialogue has taken place with Network Rail regarding locating the required substation beneath the Chiltern Lines adjacent to New Canal Street. Network Rail have completed a License Condition 7 process to grant the necessary easement over their land and the WMCA is negotiating an agreement granting the necessary option over the land and setting out the rights of access over their land for works and subsequent maintenance. The substation will be the property of WMCA.
- 10.4.2 To facilitate the design and construction an initial basic asset protection agreement will be entered into providing the necessary access to carry out surveys of the arch structures. This will enable detailed design to be produced ahead of main works of construction. These works will be undertaken by WMCA.

10.5 Hotel LaTour [OBJ/12]

- 10.5.1 Please refer to section 7.7 of this Proof of Evidence regarding access and construction activity

10.5.2 Please refer to section 5.6 of this Proof of Evidence regarding spatial details of the bus facility adjacent Hotel LaTour.

11. SUMMARY AND CONCLUSIONS

11.1 Scheme Proposals

- 11.1.1 The track alignment and associated infrastructure for BEE has been developed to accord with current Midland Metro system design parameters and technical requirements, Office of Road and Rail Regulation Tramway Technical Guidance Notes [BEE/C1], UKTram Guidance and best practice from other street running tramways. The geometric design parameters utilised in the development of the track alignment for BEE have been established to provide passenger ride quality, promote vehicle stability and reduce vehicle and infrastructure maintenance requirements commensurate with the existing Midland Metro Network.

11.2 Route Description

- 11.2.1 The BEE is a 1.7km extension of the existing Midland Metro network from the junction of Corporation Street and Bull Street to a terminus on High Street Deritend near the junction with Heath Mill Lane.
- 11.2.2 The extension is on street, with around 51% sharing road space with other vehicular traffic and around 49% segregated running.
- 11.2.3 From the junction on Bull Street, the BEE will run on street along this highway in a southeast direction sharing space with other vehicular traffic; southbound along Bull Street it is proposed as tram and cycles only, and northbound tram, bus and cycles only. The route then crosses Dale End with a tramstop on the realigned Albert Street to serve the HS2 station, Moor Street Station and the Dale End area of the city centre. From here it continues over Moor Street Queensway running adjacent to Eastside Park and a proposed pedestrianised area as part of the HS2 scheme, then for a short distance alongside Park Street with a tramstop at the north end of New Canal Street under the HS2 station. This tramstop will provide interchange with the secondary (eastern) HS2 Curzon Street Station access and will also serve Millennium Point, the Education Quarter and other destinations.
- 11.2.4 The BEE route then runs on street along New Canal Street with a tramstop on the northern side of the junction with Bordesley Street to provide a connection to the Typhoo Wharf development and other proposed developments as well as existing businesses. From here, the tram continues on-street along Meriden Street sharing space with other traffic to turn east at the junction with Digbeth to run in a segregated alignment in the middle of the highway. At the junction of Rea Street and Floodgate

Street there would be a terminus tramstop to serve Birmingham Coach Station, South and City College Birmingham, the Custard Factory and other destinations.

- 11.2.5 From the terminus tramstop there will be a 0.2km length of track to the junction of Heath Mill Lane to provide a turnback facility. The proposed Order limits extend to the junction of Clyde Street to provide some highway alterations to facilitate the BEE.
- 11.2.6 It is envisaged that Overhead Line Electrification (OLE) will extend along approximately 33% of the BEE to facilitate the operation of the tram. Due to industry advances in on-board tram battery power technology, it is proposed that approximately 67% of the BEE route will be 'catenary free' with trams operating on battery power and not requiring the use of affixing OLE to buildings or the use of poles. The section requiring OLE extends from the junction with BCCE at Bull Street to the tramstop at Albert Street, and a short length from the terminus tramstop on High Street Deritend going south east along the turn back facility; the remainder of the BEE will be catenary free. This will reduce the visual impact of the BEE as detailed in the ES [BEE/A13/1-3].

11.3 Statutory Undertakers Equipment

- 11.3.1 Most of the construction of BEE will take place within the highway boundary where utilities are maintained by the utility companies. Utility companies have therefore been contacted to provide information initially on the location of their apparatus and later to determine the nature and extent of any diversions they consider to be necessary because of the BEE
- 11.3.2 The strategy will be to undertake most of the requisite diversion works before the commencement of the BEE infrastructure works. This has both a time and cost benefit to a project and significantly de-risks the scope since the act of undertaking the diversions gives greater certainty of ground conditions and provides contractors with a clear site'.

11.4 Construction

- 11.4.1 A draft Construction Strategy has been prepared. It is proposed this would be further developed and defined by the Midland Metro Alliance.
- 11.4.2 The draft Construction Strategy envisages the main works being undertaken within a series of fenced off sections of carriageway.

- 11.4.3 The exact sequence of work and areas to be occupied will be subject to development by the Midland Metro Alliance and to agreement of temporary traffic management arrangements with BCC's Traffic Manager and the Police.
- 11.4.4 To provide an efficient and consistent temporary traffic management regime, the intention is to maintain the direction of traffic on the existing network wherever possible and keep the direction of respective lanes during construction.
- 11.4.5 Suitable footways will be maintained throughout the period of construction to enable the flow of pedestrians. Access to premises will be maintained.

11.5 Operations

- 11.5.1 Tram services will run every 6 minutes in the peak hours Monday to Friday and every 15 minutes off-peak.
- 11.5.2 The posted speed limit on street is 30 mph (48kph). Run time analysis (considering junctions, alignment and stops) indicates that trams will operate below this speed limit.

11.6 Secretary of States Matters

- 11.6.1 This Proof of Evidence has addressed the following matters [INQ3]:
- Matter 4a – Scheme Impacts. Dust
 - Matter 4c – Flood Risk and Groundwater
 - Matter 6 – Mitigation Measures. Mitigation of harm in relation to construction through the proposed Code of Construction Practice, and measures to avoid, reduce or remedy any major or significant adverse environmental impacts of the scheme in terms of noise and vibration during construction
- 11.6.2 The findings of the Environmental Statement indicate that there are no significant areas of concern associated with these matters.

11.7 Response to Objectors

- 11.7.1 In response to specific objections my evidence addresses:
- Martineau Galleries No 1 Ltd, Martineau Galleries No 2 Ltd [OBJ/06]
 - Quintain City Parkgate [OBJ/07]

- Network Rail [OBJ/09]
- Hotel LaTour [OBJ/12]

11.7.2 Residual objections relating to the scheme in terms of engineering have been considered further and rebutted.

11.8 Conclusion

- 11.8.1 The engineering of the BEE has been carried out in accordance with accepted standards, has considered all appropriate options and reached a robust and justified proposal. The permanent land take for the scheme is justified and is limited to the minimum required to provide for a safe and efficient scheme.
- 11.8.2 The project is ready to be delivered and I urge the Inspector to recommend the powers applied for.

12. STATEMENT OF TRUTH

- 12.1.1 The evidence I shall give is true, given in good faith and represents my professional opinion regarding the merits of the Order proposal and I have carried out my assessment in accordance with the Code of Professional Conduct of the Institution of Civil Engineers.

Stephen Luke

[date] 2017