

WEST YORKSHIRE COMBINED AUTHORITY

# CONNECTIVITY TO LEEDS BRADFORD INTERNATIONAL AIRPORT

OUTLINE OPTION APPRAISAL

REDACTED

MARCH 2016

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## OUTLINE OPTION APPRAISAL

**West Yorkshire Combined Authority**

### **Final Report Redacted**

Project no: 70016455  
Date: 11<sup>th</sup> March 2016

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**WSP | Parsons Brinckerhoff**  
Three White Rose Office Park  
Millshaw Park Lane  
Leeds  
LS11 0DL

Tel: +44(0) 113 395 6200  
Fax: +44(0) 113 395 6201  
**[www.wsp-pb.co.uk](http://www.wsp-pb.co.uk)**

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# QUALITY MANAGEMENT

<b>ISSUE/REVISION</b>	<b>FIRST ISSUE</b>	<b>REVISION 1</b>	<b>REVISION 2</b>	<b>FINAL</b>
Remarks				
Date	December 2015	14 <sup>th</sup> January 2016	22 <sup>nd</sup> February 2016	11 <sup>th</sup> March
Prepared by	RG/HR	RG	RG	MH
Signature				
Checked by	MH	MH	GJ/EOL	MH
Signature				
Authorised by	MH	MH	MH	MH
Signature				
Project number	70016455	70016455	70016455	70016455
Report number	Draft v1.0	Draft v1.1	Draft v2.0	Draft v2.1
File reference				

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# PRODUCTION TEAM

## CLIENT

Project Director                      DH

Project Manager                        RC

## WSP|PB LTD.

Project Director                        MH

Project Manager                        RG

Rail Planning                            EOL/GJ

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## APPENDIX A

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# 1 INTRODUCTION

- 1.1.1 In 2014, WSP|Parsons Brinckerhoff (WSP|PB) completed a study which considered the connectivity and accessibility of Leeds Bradford Airport (LBA) as one of six strategic studies on behalf of Government identified in the Government's (HM Treasury) strategic document "Investing in Britain's Future" (2013) that defines a long term commitment to build, repair and renew infrastructure critical to the economic prosperity of the UK.
- 1.1.2 Responding to the study, Government, in the 2014 Autumn Statement, recommended that the West Yorkshire Combined Authority consider how to take the recommendations of the study forward as part of the progression of devolved decision making.
- 1.1.3 From that report, several follow on tasks were identified, one of which being to establish any 'gaps' in analysis, including additional information on airport land-use changes, housing developments, commercial development and key settlements in the Leeds City Region and the airport's area of influence. A further consideration was the potential changes in airport catchment, making best use of the regional airport network, associated with infrastructural investment.
- 1.1.4 The 2014 study set out details of the transport opportunities and constraints in the area, the area of influence of the airport, socio demographic characteristics of the surrounding geography and the potential policy documents which could strengthen, or otherwise, the case for improved access to what is seen as a regionally important airport.
- 1.1.5 The aim of this evidence and objective review is not to repeat any of the previous work, but to draw from it and establish what new information is now available beyond that which was included in the 2014 study, and how alternatives to the criteria set as part of the study by DfT, with particular reference to passenger forecasts, could positively influence specific options. Since 2014 there have been some significant political shifts in policy, which have resulted in city regions having far greater control over investment in their own areas.
- 1.1.6 In addition, the LBA Masterplan has been prepared and circulated in draft in order to contribute to this study. The draft Masterplan provides greater clarity on the proposals for development of the airport itself and the land around it. Some local district planning documents are further progressed than at the time of publishing the previous report and consequently, they are able to provide a greater level certainty over future growth.
- 1.1.7 This work is intended to provide the following outputs:
- Evidence and Objective Review (updating the previous Evidence Base);
  - Early feasibility assessment of connectivity improvements for LBA;
  - Technology and Infrastructure Review;
  - Demand Assessment; and
  - Option Assessment.
- 1.1.8 The work is not intended to recommend any single option, but will provide a more detailed assessment of the approaches available to enable stakeholders to decide which option, if any, should be progressed to further levels of detail. This study provides direct links into wider network studies being completed by Leeds City Council (LBA Link Road) and the West Yorkshire Combined Authority (LCR Connectivity).

## 2 WIDER CONTEXT & PREVIOUS STUDIES

- 2.1.1 This section sets out details of recent studies undertaken and also of national and local changes in policy since the publication of the WSP|PB study in 2014. The section also provides data from the latest Civil Aviation Authority Survey reports and from the draft LBA Masterplan, and associated studies released late in 2015.
- 2.1.2 The previous work undertaken by DfT in 2014 set out a long list of possible connectivity options for consideration. The study also set the context within which LBA operates, in terms of spatial planning, economic growth and wider demographic and social issues. It is expected that there will be significant growth within the Leeds City Region, both in terms of the economy, of housing (largest planned housing growth outside London), and in terms of employment sites in the area (including at the airport itself).
- 2.1.3 The 2014 study concluded that rail options were more challenging than road options in terms of implementation, with the road proposals scoring a higher indicative BCR and wider connectivity benefits.
- 2.1.4 The study therefore proposed that further analysis be undertaken on the following packages:
- Short/Medium Term - A65 to Leeds Bradford International Airport Link Road with improved bus services to Leeds and Bradford; and
  - Long Term - Heavy Rail (Guiseley – LBA – Horsforth).
- 2.1.5 The Link Road project is being taken forward separately by Leeds City Council, and a public consultation exercise is currently underway on a number of possible route alignments. These consultation alignments have been used in this study to ensure the two projects complement each other, and the possible interfaces are understood.
- 2.1.6 As a detailed technical assessment was not undertaken as part of the previous study, several other public transport options have been assessed as part of this follow up report to ensure more detailed consideration is given to the most appropriate, and deliverable, solution.
- 2.1.7 In addition, the formation of Transport for the North and Rail North will bring about changes in the investment landscape and the way in which decisions are made on infrastructure delivery, offering different opportunities for funding.

## 2.2 PREVIOUS STAKEHOLDER ENGAGEMENT

- 2.2.1 Stakeholder engagement was carried out as part of the 2014 DfT study through the establishment of a Stakeholder Reference Group, most of who are also involved in this study. In addition to technical considerations which were raised, linked to the modelling and appraisal of proposals, issues were also raised by the neighbouring authorities of North Yorkshire and Harrogate relating to access to the airport from the East, and more specifically from the A1 motorway.
- 2.2.2 In addition, LBA as an organisation raised issues with regards to the potential alignment of any new road or rail link being critical in terms of providing access to land to be developed as part of the airport Commercial Hub and Airport Masterplan. This integration is being considered as part of this study.

- 2.2.3 As the previous study was intended to provide a strategic assessment of a number of proposals, public consultation was not carried out at that time, and the involvement of the private sector was limited. Users of the airport were represented through a member of the airport consultative committee, and a local ward councillor, both of whom are involved in this study.

## 2.3 SPATIAL PLANNING

- 2.3.1 The airport is situated such that it attracts users from across the Yorkshire and Humber region. This is reflected in its inclusion in several of the Local Plans, as a necessary connectivity hub. The key information of relevance from immediate and adjacent district Local Plans (Leeds, Harrogate and Bradford) has been set out in the section below. This details where residential and commercial developments will be concentrated and how this might influence potential investment in transport interventions.
- 2.3.2 The **Leeds** Local Development Framework<sup>1</sup> (Leeds being the local planning authority within which the airport sits), notes the role of the airport as part of the strategic infrastructure for the City Region<sup>2</sup>.
- 2.3.3 Spatial policy 12<sup>3</sup> sets out the detail on how expansion of the airport will be permitted, through the planning framework with mitigation via investment in sustainable transport options (specifically Tram Train) and improved surface access. The policy does not give any indication of potential sources of investment.

### *'SPATIAL POLICY 12: MANAGING THE GROWTH OF LEEDS BRADFORD INTERNATIONAL AIRPORT*

*The continued development of Leeds Bradford International Airport will be supported to enable it to fulfil its role as an important regional airport subject to:*

- (i) Provision of major public transport infrastructure (such as Tram Train) and surface access improvements at agreed passenger levels;*
- (ii) Agreement of a surface access strategy with identified funding and trigger points;*
- (iii) Environmental assessment and agreed plans to mitigate adverse environmental effects, where appropriate; and*
- (iv) The management of any local impacts and implementation issues, including visual and highway issues.'*

- 2.3.4 The plan also notes<sup>4</sup> the role that the airport plays as a Strategic Gateway to the wider city region stating 'For the future growth of the airport to be sustained, improved connectivity via surface access needs to be delivered. The former Leeds City Region Transport Strategy (2009) identified improved surface access to the airport as a policy priority. Measures are currently being investigated including a tram-train link from the Leeds – Harrogate line and an A65/A658 road link.'
- 2.3.5 The Leeds Publication Draft Site Allocations Plan (SAP) sets out the preferred sites for development within the Leeds planning area. The SAP sets out five areas either on the airport site, or immediately adjacent, allocated for employment uses. Four of these are allocated for general employment use (57.75ha) and one is allocated for office space (0.8ha). These are expected to form the basis of the Airport Commercial Hub – further details of this are set out in section 2.6.6.

<sup>1</sup> Leeds City Council, Core Strategy, Leeds Local Development Framework, Adopted November 2014, <http://www.leeds.gov.uk/SiteAllocationMaps/Core%20Strategy/Adopted%20Core%20Strategy%20Nov%202014%20Final.pdf>

<sup>2</sup> Ibid. p13 section 2.27

<sup>3</sup> Ibid. p56

<sup>4</sup> Ibid. pp55-56, section 4.9.13

- 2.3.6 The plan below shows the details of the sites noted above. The pink shaded areas represent land identified for general employment uses (but not yet allocated) and the purple shaded areas represent land actually allocated for general employment uses.

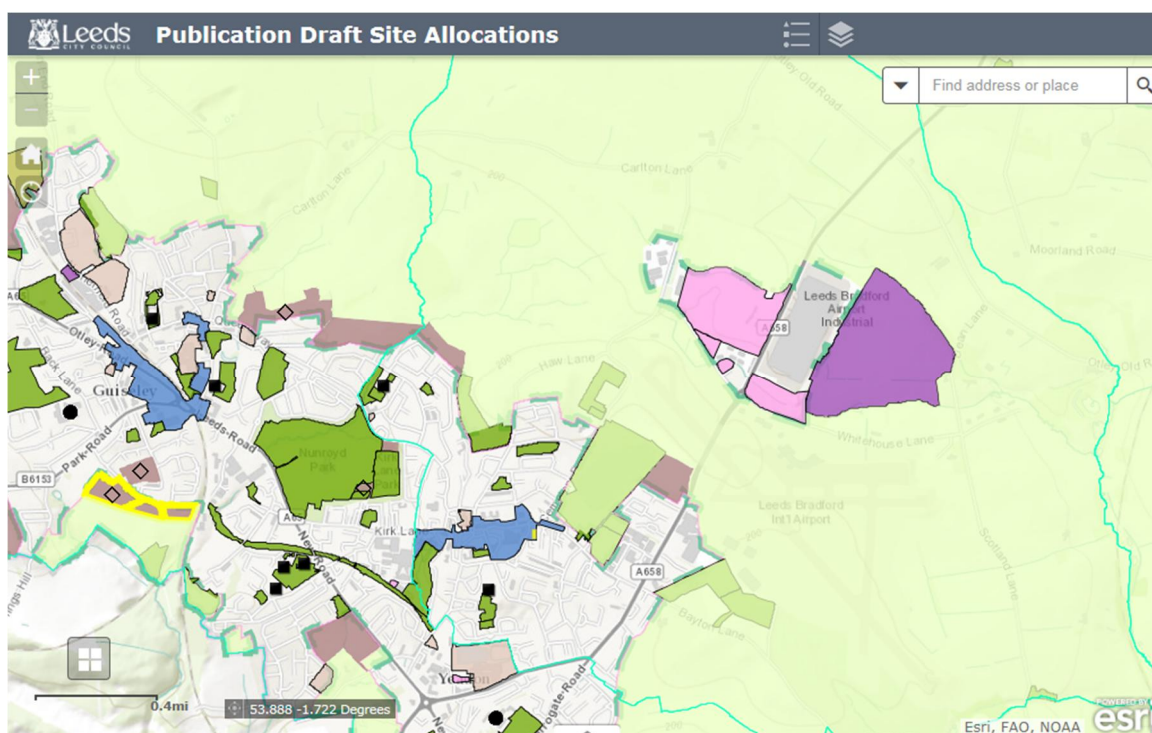


Figure 1 - Leeds sites and policies mapping<sup>5</sup>

- 2.3.7 The Leeds Local Plan also sets out the scale and location of housing development within the Leeds district. The Leeds Core Strategy identifies the number of dwellings to be built over the plan period, (2012-2028), currently set at 70,000 net dwellings. Within the Aireborough and North Leeds districts, which are those most closely linked to LBA, 8,300 houses are planned. These account for a 3% and 5% increase respectively.
- 2.3.8 The local plan for the airport's nearest neighbouring authority of **Bradford** notes<sup>6</sup> the increasingly important role of LBA both to the Bradford district and also to the wider city region. The role of the airport in improving connectivity and making the district, region and the north more competitive as a whole, is set out<sup>7</sup> in the Plan.
- 2.3.9 The Bradford Core Strategy<sup>8</sup> provides an approach on locating development where it can ultimately benefit from sustainable transport options. In order to allow these settlements, and others in the district, the opportunity to connect most effectively to economic opportunities and support growth in the district, the plan identifies that links must be maintained and improved to LBA and also to Manchester Airport.

<sup>5</sup> <http://www.leeds.gov.uk/council/Pages/Site-allocations-plan-publication.aspx>

<sup>6</sup> , Local Plan for the Bradford District, Core Strategy Development Plan Document, Publication Draft, February 2014

<sup>7</sup> Ibid. p.40 section 3.54

<sup>8</sup> Ibid. p.129, section 5.2.10.

- 2.3.10 Bradford MDC have indicated that there is potential for approximately 2000 new dwellings to be provided (up to 2030) on the Harrogate Road/Apperley Bridge corridor, with additional opportunity for provision of a new 'high quality employment site' close to the new railway station at Apperley Bridge. The council have also indicated that 40 hectares of employment land could be provided on the site of the former water treatment works at Esholt, close to the A658 Harrogate Road. All of this development would be particularly relevant for services between Bradford and the Airport.
- 2.3.11 There is an aspiration within the Bradford Local Plan<sup>9</sup> to improve air freight facilities at LBA, to reduce distribution trip lengths and to support economic growth within the district. Policy TR6: Freight<sup>10</sup> sets out this aspiration and aims to ensure that freight uses the most appropriate and sustainable route possible. It is unlikely however that rail would be able to provide a freight solution to the airport.
- 2.3.12 The airport is also closely linked to **Harrogate**, which is also the neighbouring planning authority to the north. Harrogate's Local Plan<sup>11</sup> notes the role of LBA in providing local opportunities for air travel. The Harrogate District Local Plan: Infrastructure Capacity Study<sup>12</sup> notes the existing bus service which operates between Harrogate and LBA, but does not comment on its patronage.
- 2.3.13 The Harrogate Local Plan allocations document is currently in development. However, Harrogate Borough Council has indicated that approximately 630 houses will be constructed each year for the next 21 years (c13, 200 in total). A significant proportion of these will be along the Leeds – Harrogate – York rail line corridor. Additionally, a further 25.8 Hectares of employment land across the district over the same plan period is expected.
- 2.3.14 The **York** Local Plan is currently being developed. However, the 2012 Transport Implications Supporting Document<sup>13</sup> does not mention airports at all. The York Preferred Options Report<sup>14</sup> notes the role of Manchester Airport and York's links by rail to Manchester, but does not make any direct references to LBA.

## 2.4 PAN REGIONAL TRANSPORT PLANNING

- 2.4.1 In 2014, the government published its National Infrastructure Plan<sup>15</sup> which sets out the importance<sup>16</sup> of the UK making greater and more efficient use of the existing airports in the country by encouraging further private investment and taking action to improve surface access to existing sites.
- 2.4.2 In advance of the publication of the Northern Powerhouse, and the formation of the now established Transport for the North body, the northern transport strategy was developed by One North – a collaboration of northern city regions in 'One North: a proposition for an interconnected north'.<sup>17</sup> The report sets out how measures complementary to High Speed two (HS2) and Northern Powerhouse Rail might be used to transform connectivity in the north.

<sup>9</sup> Ibid, p.144, section 5.2.49

<sup>10</sup> Ibid, p.148

<sup>11</sup> Harrogate Local Plan, Core Strategy adopted 2009,

<https://www.harrogate.gov.uk/plan/Documents/Planning%20Policy/core-strategy/core-strategy-full-version.pdf>

<sup>12</sup> Baseline Report 2015, <https://www.harrogate.gov.uk/plan/Documents/Planning%20Policy/evidence-base/2015-June-infrastructure-capacity-study-baseline-report.pdf>

<sup>13</sup> Transport Implications of the City of York Local Plan preferred Options (2013)

[https://www.york.gov.uk/downloads/file/1914/transport\\_implicationspdf](https://www.york.gov.uk/downloads/file/1914/transport_implicationspdf)

<sup>14</sup> York Local Plan Preferred options, 2013, [https://www.york.gov.uk/downloads/file/3639/local\\_plan\\_preferred\\_optionspdf](https://www.york.gov.uk/downloads/file/3639/local_plan_preferred_optionspdf)

<sup>15</sup> [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/381884/2902895\\_NationalInfrastructurePlan2014\\_acc.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/381884/2902895_NationalInfrastructurePlan2014_acc.pdf)

<sup>16</sup> Ibid, p57

<sup>17</sup> <http://www.westyorks-ca.gov.uk/uploadedFiles/Content/News/Articles/One%20North.pdf>

- 2.4.3 The report sets out the importance of linkages to international gateways, namely airports and ports. The report also sets out how airports might play an increased role in the movement of freight<sup>18</sup>. The report specifically notes<sup>19</sup> an aspiration for a rail/light rail connection to LBA which should be turned into a 'fully realised project' and notes that surface access plays a 'crucial role' in widening economic benefits of airport expansion across the North.
- 2.4.4 The Northern Powerhouse: one agenda, one economy, one north<sup>20</sup> was then published in 2015 and suggests how improved surface access to northern airports can make the north of England a competitive location for 'multi-national' business and how this will be delivered, ultimately, by individual city regions working with airports to develop connectivity plans.
- 2.4.5 The Northern Powerhouse Investment Pitchbook<sup>21</sup>, the first of its kind, was published in 2015, and details potential investment sites for foreign investors (predominantly from the Chinese market). Whilst some West Yorkshire sites and projects are promoted in the Pitchbook, there was no direct mention of Leeds Bradford Airport either in terms of its role in regional connectivity, or its potential for investment.

## 2.5 LOCAL TRANSPORT PLANS

- 2.5.1 The West Yorkshire Transport Strategy is currently being developed in line with the refresh of the Leeds City Region Strategic Economic Plan (see 2.6.2), due for completion in April 2016 for adoption during the summer. A key focus of the plan is the need for improved connectivity to support economic growth and for a resilient transport system which can adapt to meet changing needs and circumstances.
- 2.5.2 The aspirations for growth will be supported by better links to international business markets, in addition to improved internal connections to ensure the benefits of economic growth are shared by all communities. The Strategy identifies LBA as an international gateway, as part of an integrated transport network with clearly defined transport hubs. Sustainability, both in terms of transport and the economic growth that this allows, providing realistic alternatives to the private car, are key themes of the Transport Strategy.
- 2.5.3 **North Yorkshire** County Council is currently preparing a fourth LTP and has published a draft plan for consultation. The draft plan sets out that economic improvement will be one of the key objectives of the plan and that this will be achieved through improving connectivity between service centres within the county, but also by improving links to the wider region and ensuring that North Yorkshire residents can engage fully in the Northern Powerhouse.
- 2.5.4 The plan looks to address issues of rural isolation and allow businesses to be able to better connect to business opportunities national and internationally, through better links to nationally important infrastructure such as the strategic road network, rail network and airport and ports.
- 2.5.5 **City of York** Council (CYC) published their LTP in 2011 covering the period 2011 to 2031. Due to the longer lifespan of the York LTP, the current LTP does not need to be rewritten, but will be refreshed at appropriate intervals. The next planned review will not happen until after a decision is made on Leeds City Region devolution and also until the new Leeds City Region SEP is published.

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<sup>18</sup> Ibid, p8.

<sup>19</sup> Ibid, p24

<sup>20</sup> [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/427339/the-northern-powerhouse-tagged.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/427339/the-northern-powerhouse-tagged.pdf)

<sup>21</sup> [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/464356/Northern.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/464356/Northern.pdf)

## 2.6 EMPLOYMENT AND ECONOMY

- 2.6.1 Leeds Bradford Airport sits within West Yorkshire and further within the Leeds City Region, which benefits from a polycentric spatial and economic distribution. The towns and cities within the LCR have distinct features and economic strengths and as a consequence, each have their own travel patterns.
- 2.6.2 The **Leeds City Region Strategic Economic Plan** (LCR SEP) is currently being refreshed, but is likely that its aim to improve connectivity (Delivering the infrastructure for growth) will remain a key pillar of the plan.
- 2.6.3 The current SEP states that *'good international connectivity will also support our drive to attract more foreign direct investment and boost companies' export performance. Better links to the airport are the key to realising these ambitions.'*
- 2.6.4 The Leeds Bradford Airport Economic Impact Assessment<sup>22</sup> (2009) was prepared by Arup on behalf of the airport and sets out the potential impact which the expansion of the airport could have on the economy in the area.
- 2.6.5 This has since been superseded by a report by York Aviation, published in April 2015<sup>23</sup>. This report sets out the current economic impact of the airport and then uses data from the airport's Masterplan to forecast economic impacts in 2020 and 2030. The report estimates, that the airport, taking into account all aspects of its influence, currently adds £336m in GVA to the city region economy, which equates to around 5,200 jobs. The report estimates that should growth occur in line with Masterplan forecasts, that GVA will amount to approximately £724m per year (2015 prices) and over 10,000 jobs in total supported by LBA (essentially the figures will double).
- 2.6.6 The LBA Commercial Hub Assessment<sup>24</sup> notes growth of the airport as an intrinsic part of the City Region growth strategy. The report notes the importance of business land being developed in the vicinity of the airport, to ensure that the district has an appropriate stock of suitable premises to accommodate business wishing to locate on an airport site and to which complements that provided elsewhere in the neighbouring districts.
- 2.6.7 The Leeds Local Plan sets the details of the allocations of land adjacent to the airport as 58 hectares for employment use (see previous Figure 1 - Leeds sites and policies mapping.)
- 2.6.8 The report identifies the assessment which has been completed<sup>25</sup> which concludes that 'land at LBA is worth 1.5 times as much in GVA as land elsewhere'. This is because the 'Commercial Hub will address a gap in the supply of land and premises in Leeds and appeal to a distinct occupier mix, it will attract occupiers and activities that might otherwise not be attracted/retained in Leeds. As a result it is reported to generate a greater level of economic benefit than a typical employment site, where there is likely to be higher displacement of local occupiers from within the administrative area of Leeds'.

<sup>22</sup> <http://www.leeds.gov.uk/docs/CD10-3%20LBIA%20Economic%20impact%202009%20report.pdf>

<sup>23</sup> Leeds Bradford International Airport Limited, the Impact of Leeds Bradford Airport-Final Report, York Aviation (2015).

<sup>24</sup> DTZ (2014)

[http://democracy.leeds.gov.uk/\(X\(1\)S\(fkn0jfigeevz5oferbipik55\)\)/documents/s133968/LBIA%20DTZ%20Report%20-%20Growth%20Hub%20Assessment.pdf](http://democracy.leeds.gov.uk/(X(1)S(fkn0jfigeevz5oferbipik55))/documents/s133968/LBIA%20DTZ%20Report%20-%20Growth%20Hub%20Assessment.pdf)

<sup>25</sup> Calculated NPV of GVA, from 'Leeds Bradford International Airport - Commercial Hub assessment'

[http://democracy.leeds.gov.uk/\(X\(1\)S\(fkn0jfigeevz5oferbipik55\)\)/documents/s133968/LBIA%20DTZ%20Report%20-%20Growth%20Hub%20Assessment.pdf](http://democracy.leeds.gov.uk/(X(1)S(fkn0jfigeevz5oferbipik55))/documents/s133968/LBIA%20DTZ%20Report%20-%20Growth%20Hub%20Assessment.pdf)

- 2.6.9 The hub would have the ability to provide accommodation for specialist businesses, particularly those requiring easy access to international markets. The report sets out that several existing businesses had moved out of the LCR area due to a lack of suitable premises in the area. This is something that the hub would aim to address by providing a range of facilities to suit specialist businesses within the LCR.
- 2.6.10 In addition, it is estimated that expanding the Commercial Hub at the airport will result in 5,500 additional jobs, which could bring about an estimated £3bn additional GVA to the economy over a 25 year period.

## 2.7 AIRPORT MASTERPLAN

- 2.7.1 In early 2016 the airport made available for the purposes of this study, the draft of its new Masterplan, 'Route to 2030 – Strategic Development Plan'<sup>26</sup>. Amongst other objectives, the Masterplan sets out a strategic objective (Objective 3<sup>27</sup>) to improve surface transport links. Aims include improving accessibility by making it easier for sustainable transport modes to access the site, working with stakeholders to deliver key improvements such as a strategic link road, and securing a rail link to the airport. Also, the Masterplan notes that surface access to the airport has been highlighted as an issue at a national level, by the Department for Transport (see Introduction).
- 2.7.2 The Masterplan sets out how the airport intends to expand, with a focus on several key factors which make airports successful; quality of airport experience, ease of accessing the airport, improved technology to aid customer experience, improved retail and refreshment facilities and commercial development beyond the airport terminal building.
- 2.7.3 The Masterplan notes (p25) "However, whilst it is important to fulfil the leisure needs of those living within the airport's catchment area, the airport's ability to provide business focussed connectivity is currently 17% of the market share (York Aviation pg.10), and represents a targeted opportunity for the airport to grow."
- 2.7.4 In addition at p26 the Masterplan states, "Alongside securing new routes, LBA will be promoting enhanced surface access infrastructure and improvements in the range and quality of facilities to drive forward growth in business travel through LBA."
- 2.7.5 The nature of the passenger base is important. The combination of user types and their spread of origins/destinations will affect the scope for public transport use. Generally inbound (non-UK resident) passengers are more likely to use public transport, because these passengers' initial destination is likely to be centrally based, or with links to PT. This may have a greater influence than the business/leisure split.
- 2.7.6 Because so many UK resident business trips start from people's home rather than from the office (and vice versa on the way back), the business trips may not be as city centre focused, and therefore not as relevant for public transport. This was demonstrated in previous analysis of passenger surveys<sup>28</sup> at LBA and would need to be explored in greater detail as part of future demand forecasting.

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<sup>26</sup> Footnote required once Masterplan fully published

<sup>27</sup> Ibid, p33

<sup>28</sup> Leeds Bradford International Airport Connectivity Study (DfT, 2015) - Working Paper 1 – Existing Situation

- 2.7.7 The airport Masterplan details several objectives which will facilitate economic growth;
- *Meeting demand for air travel in our region.* This objective seeks to grow the leisure market, but also to increase the importance of LBA as a business travel hub, taking advantage of its connections to international travel hubs and Amsterdam Schiphol and London Heathrow, as well as offering a wider range of flights to European business destinations. In addition, the plan looks to increase use of the airport for leisure and tourism, both outbound, and inbound to destinations within and beyond the City Region;
  - *Delivering a Great Service.* This objective focuses primarily on improved customer service and spreading the peak of departures to maximise the number of services that the airport can accommodate, as well as ensuring that the airport, its services and the area around it attain the highest safety standards. Improvements in technology, both in terms of improved customer experience, and also in monitoring of operational matters will be a focus.
  - *Expanding employment opportunities.* This objective focuses on the development and expansion of an airport Commercial Hub and sets out the processes that have been undertaken to date towards securing this development.
  - *Improved surface transport links.* This aims to achieve the following high levels objectives;
    - To enhance the economic and social development of the LCR by planning for growth collaboratively with local partners;
    - To ensure that, as a gateway, the first impression of the LCR is of a well-connected, positive, thriving, and sustainable centre for business and culture;
    - To target investment in surface access to support the Airport's defined role as a sustainable economic hub for the growth sectors of the LCR, as well as a tourist destination;
    - To function as an attractive and sustainable local employment centre; and
    - To build the Airport's role as a potential regional interchange centre to further improve public transport services in the area.
- 2.7.7.1 Whilst no specific methods of financing the surface access improvements to the airport are detailed, there are a variety of mechanisms which could potentially provide funding for the improvements noted above, including planning gain, business rate retention, central government funding, or more innovative funding sources made available through devolution.
- 2.7.7.2 The Masterplan details the current link road proposals under consultation by Leeds CC and sets out that the link road has been 'identified for delivery in 2023' (timescales taken from the West Yorkshire plus Transport Fund programme, updated by Leeds City Council).
- 2.7.7.3 The Masterplan also notes that car is currently the dominant mode of access to the airport (p18), with 60% of journeys to the airport 'forecourt' made by car according to the forecourt survey undertaken by the LBA Travel Plan Co-Ordinator in 2015. The year-on-year information provided by the airport shows that whilst there have been fluctuations in mode split over the period 2005-2015, the overall mode shares have remained similar over the ten year period.

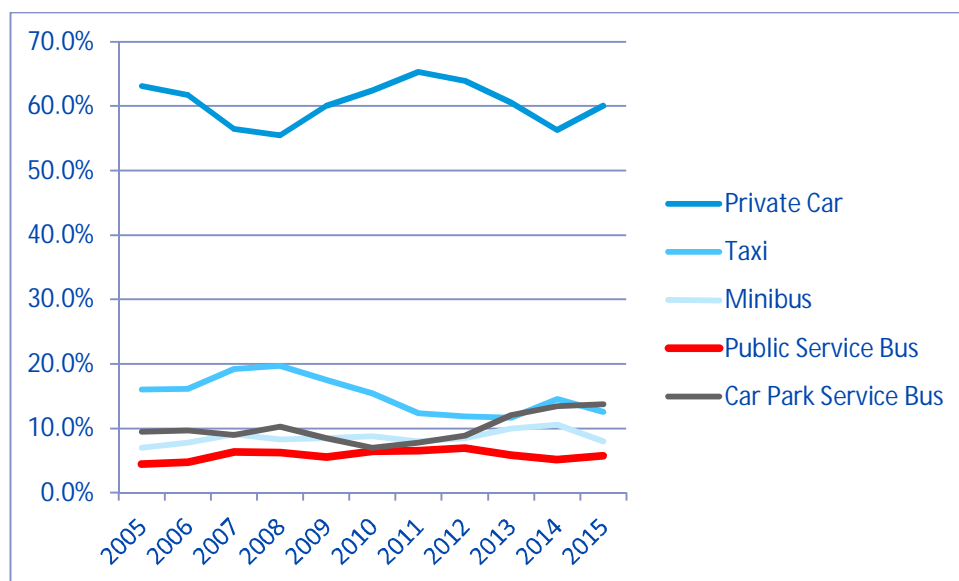


Figure 2 – Airport Forecourt survey data trends 2005 - 2015

2.7.7.4 The role of the airport as a regional interchange centre could be facilitated by the development of a park and ride facility. Potential demand for a park and ride facility is explored in section 6.

2.7.7.5 In conclusion, the airport sets out the following ambitions with regards surface access.

SUMMARY OF KEY OBJECTIVES	TIMESCALE	FUNDING <sup>29</sup> /DELIVERY MECHANISM
Continue feasibility and design work into the new road and fixed links;	Short Term (up to 2019)	Currently committed work, being funded by WYCA.
Work in partnership with bus operators and Councils to identify further improvements in bus services;	Short Term (up to 2019)	Partnership working with WYCA and NYCC to secure LTP funding
Improve marketing and ticketing for public transport offer;	Short Term (up to 2019)	Not defined
Provide a journey planning link on the airport website;	Short Term (up to 2019)	Not defined
Develop a strategy for improving walking and cycling access;	Short Term (up to 2019)	Not defined
Provide new on-site long stay car parking areas;	Short Term (up to 2019)	Not defined, but likely LBA
Incentivise staff to make more sustainable travel choices.	Short Term (up to 2019)	Not defined, but likely LBA
Deliver a new highway link to the airport;	Medium Term (Up to 2024)	Road link named scheme in the WY+TF. Rail link named scheme in WY+TF development pool.
Consider opportunities to link with Park & Ride sites;	Medium Term (Up to 2024)	Not defined

<sup>29</sup> Based on Leeds Bradford Airport Surface Access Strategy, Fore Consulting, 2015.

SUMMARY OF KEY OBJECTIVES	TIMESCALE	FUNDING <sup>29</sup> /DELIVERY MECHANISM
Develop an Airport Cycle Centre;	Medium Term (Up to 2024):	Not defined
Continue to work with WYCA to ensure a coherent and effective bus network.	Medium Term (Up to 2024):	WYCA
Deliver the first phase of the new fixed link to the airport;	Long Term (Up to 2030)	WY+TF
Provide new on-site long stay parking to satisfy anticipated demand.	Long Term (Up to 2030)	Not defined, but likely LBA

**Table 1 - Airport Surface Access Ambitions**

2.7.8 The Masterplan also sets out LBA's objectives and responsibilities with regards to sustainability. As would be expected, surface access and the role of travel planning and sustainable travel form a key part of this section along with noise, air quality and carbon management.

## 2.8 AVIATION POLICY REVIEW

2.8.1 The Aviation Policy Framework<sup>30</sup> (2013) sets out the government's principles and objectives for aviation growth, with the aim of supporting local decision making. It does not however, give any guidance on which airports should be further expanded; this detail is set out in the Final Report<sup>31</sup>, (2015) of the DfT appointed Airports Commission.

2.8.2 The Final Report sets out the Airport Commission's recommendations for UK airport expansion. The main thrust of the paper relates to the selection of Heathrow Airport as the preferred airport for development of an additional runway. The paper suggests that expansion of Heathrow airport by way of a new northwest runway and complementary surface access improvements would make air transport connections from Leeds and Manchester to or via London easier and more attractive. There is no mention specifically of the role of northern airports.

2.8.3 Whilst the Final Report does not make any recommendations that would directly affect northern airports, the suggested expansion of London Heathrow would result in a release of capacity for UK internal flights, and therefore the potential for increased departures from LBA to London.

2.8.4 In December 2015 the Government announced that its decision on whether to accept and act on the recommendation of the Final Report would be delayed until at least Summer 2016 so no definitive conclusions on the impact of this on LBA can be reached at this stage.

## 2.9 FUNDING CONSIDERATIONS

2.9.1 It is not currently clear how improvements to the airport's surface access arrangements would be funded, because without scheme identification no funds can be allocated with confidence.

2.9.2 With regards to funding of airport surface access improvements, sections 5.11 to 5.13 of the Government's Aviation Policy, published in 2013 are relevant, and set out the following:

<sup>30</sup> [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/153776/aviation-policy-framework.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/153776/aviation-policy-framework.pdf)

<sup>31</sup> [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/440316/airports-commission-final-report.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/440316/airports-commission-final-report.pdf)

**5.11** All proposals for airport development must be accompanied by clear surface access proposals which demonstrate how the airport will ensure easy and reliable access for passengers, increase the use of public transport by passengers to access the airport, and minimise congestion and other local impacts.

**5.12** The general position for existing airports is that developers should pay the costs of upgrading or enhancing road, rail or other transport networks or services where there is a need to cope with additional passengers travelling to and from expanded or growing airports. Where the scheme has a wider range of beneficiaries, the Government will consider, along with other relevant stakeholders, the need for additional public funding on a case-by case basis.

**5.13** The Airports Commission has indicated that it will consider surface access needs as part of its work to assess options for maintaining the UK's international connectivity, in the context of existing and potentially new airports.

2.9.3 In addition, the House of Commons Transport Committee Report in February 2013 included in the summary section of the 'Surface Transport to Airports' report, the following:

*'The principle that airports pay for the surface access improvements from which they directly benefit should be retained, but the Government should be clearer about where the boundary lies between this and improvements to rail and road infrastructure adjacent to an airport and within its catchment area.'*

*Where there is compelling evidence that airport expansion would act as a catalyst for significant local economic development, the Government should ensure that local authorities, airports, and the national network operators can work together to identify relevant surface access infrastructure improvements and the means to fund them.'*

2.9.4 What is not yet clear is to what extent the Government would consider the surface access improvements at LBA to be beneficial to a wider range of groups and organisations than purely airport passengers and staff, or to demonstrate a catalytic effect on local economic development. Establishing this detail as part of the strategic case would be a key part of any detailed appraisal process, or formation of funding packages.

2.9.5 In addition, the role that the Commercial Hub might play in supporting the economic performance of the Leeds City Region would also be of key importance. Being able to assess the proportion of GVA uplift that would result as a consequence of the development and expansion of the airport Commercial Hub, would be an important factor in determining the extent of impact on 'wider beneficiaries'. In addition, the potential for the airport to offer enhanced connectivity as a result of an improved offer to business travellers and inbound international tourists would also be a relevant consideration.

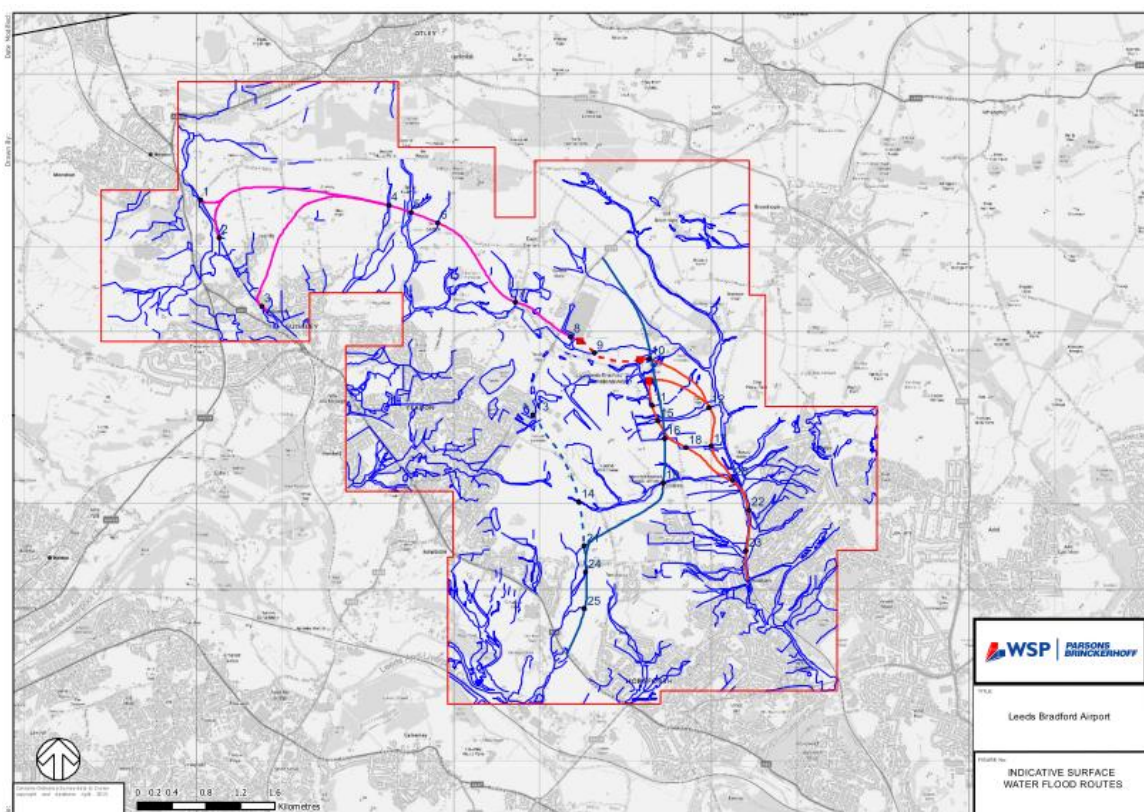
2.9.6 Any funding provided by national or local Government would also have to satisfy State Aid regulations. State Aid is considered to occur when funding is provided to a particular organisation which could be considered to give them an advantage, or to distort competition. When public funding is used, it does not automatically mean the arrangement would be in breach of the regulations, but time would have to be taken to seek advice and confirmation to ensure it is legal.

## **2.10 ENVIRONMENTAL CONSIDERATIONS**

2.10.1 In addition to the policy and funding context, detailed planning of any future schemes would have to give due consideration to their impact on the environment, and any particular local environmental conditions. Desktop searches undertaken as part of this study have highlighted two particular issues of relevance.

## SURFACE WATER RUN OFF

- 2.10.2 The Environment Agency Risk of Surface Water Flooding Map indicates 25 overland flow routes which intercept one or more of the rail or road routes proposed in this appraisal. Thirteen of these routes have a high risk rating implying an annual risk of flooding of greater than 1 in 30 (3.3%).
- 2.10.3 The identification of risk does not express the significance of the flood areas. Many will only relate to streams and their immediate surroundings. Some of these flood routes may be in channels or may already be culverted under roads or rail embankments which the flood maps do not always account for. The issues identified only become relevant during more detailed design when examining exact alignments, heights, sizing of culverts, etc.



**Figure 3 - Risk of Surface Water Flooding**

- 2.10.4 Without further assessment of detailed physical characteristics such as topography and flow volumes, it is not clear at this stage therefore whether any of these crossings indicating risk would necessarily affect the proposals and whether there could be opportunity to provide mitigation in order to control overland flow.

## LISTED BUILDINGS

- 2.10.5 A desktop assessment of other planning considerations has identified a number of listed buildings along the proposed line of route between Horsforth and the airport. Whilst these may not prevent the construction of a new fixed link, consideration will have to be given to the exact route to minimise the negative impact on these. The locations are shown in Figure 4 below.

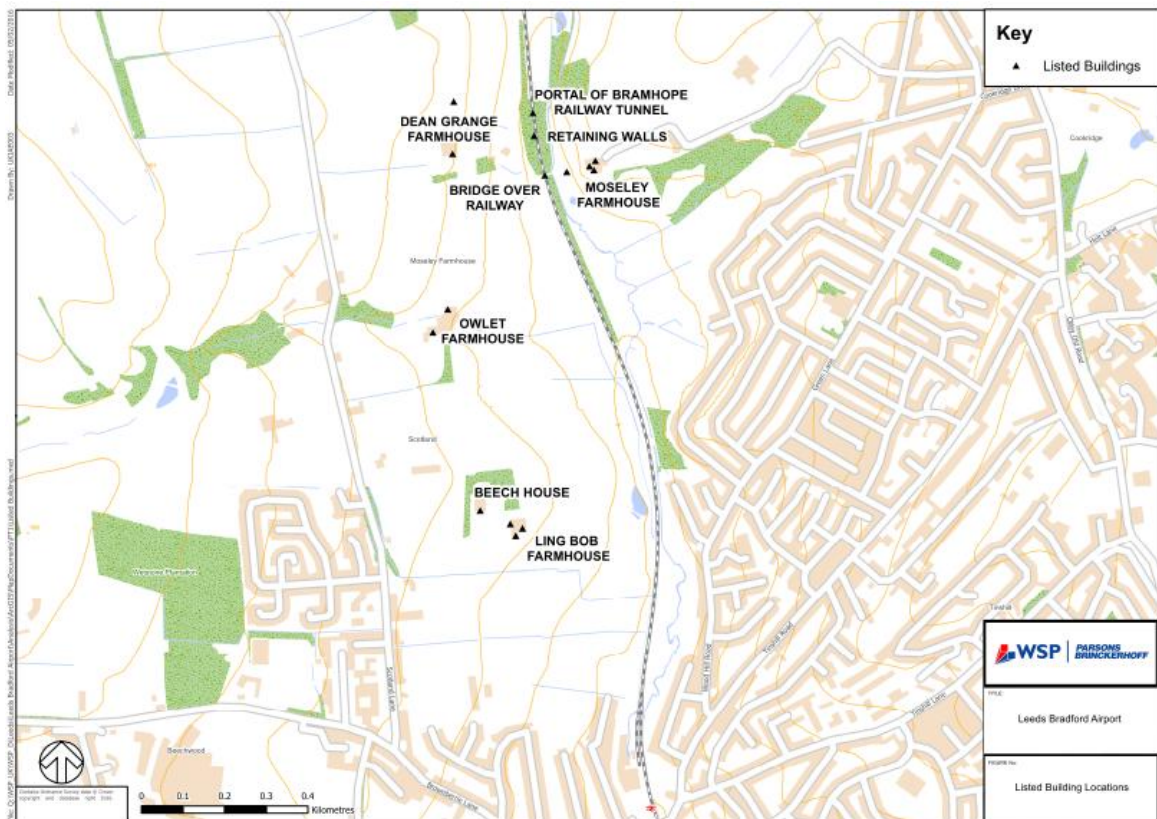


Figure 4 - Listed Building Status

## 2.11 CONCLUSIONS

- 2.11.1 LBA sits within the Leeds Local Planning Authority area but is also of key relevance to neighbouring Planning Authorities because of its wider impact. Local spatial policies and the airport masterplan note the importance and economic contribution of the airport, and the potential to improve surface access to the airport and its surrounding sites. There are, however, limited mechanisms currently provided through the planning framework to secure funding linked to future development. These could be developed over time.
- 2.11.2 Growth in the LCR, including housing supply, is anticipated to include some of the highest concentrations outside London. This in addition to the aspirations for development of a Commercial Hub and the allocation of emerging development sites within Harrogate and Bradford district have the potential to increase traffic movement in the vicinity of LBA.
- 2.11.3 Policy decisions from the UK Government on airport expansion, in particular with regards to the expansion of London Heathrow, may affect the operation of LBA and offer potential for growth of operating routes. This in turn could help to support LBA's aspiration to increase business travel from the airport and to attract businesses to locate on the proposed Commercial Hub development site.
- 2.11.4 The mix of leisure and business travel, the mix of inbound and outbound passenger, and the spatial distribution of trips at the Leeds City region end of trips accessing the airport will all be important determining factors when forecasting likely demand for public transport services.
- 2.11.5 Those factors will also be relevant in appraising the likelihood of attracting UK Government funding, or providing local funding, for surface access improvement proposals.

# 3 TRAVEL AND ACCESS

## 3.1 STAFF TRAVEL PATTERNS

- 3.1.1 The LBA 2015 Surface Access Strategy<sup>32</sup> (SAS) sets out that whilst the majority of airport staff travel from within the LCR, there are staff that travel to the airport from much further afield, both within and beyond the Yorkshire and Humber region.
- 3.1.2 The SAS details the measures that have been taken by LBA to try to reduce single occupancy vehicle trips by airport staff and notes a general increase from 13% (2010) to 23% (2014) of staff travelling by means other than single person car trips. For non-airport staff over the same period, the proportion fell from 32% to 26%, although with a much higher response rate in later years this is likely to be more representative than previous figures.
- 3.1.3 The SAS also recognises the seasonal nature of employment at the airport and notes that summer time vehicle flows demonstrate more notable peak periods than during the winter months when traffic is more evenly spread throughout the day.
- 3.1.4 It is evident that throughout the year, the 'morning peak' flows at the airport are currently much earlier than a traditional morning traffic peak, occurring around 0500hrs. This is likely to be as a result of arrivals for the early flights departing at around 0700hrs. In the summer, there is a further peak at around 1400hrs, but this is not replicated during the winter months.

## 3.2 PASSENGER TRAVEL PATTERNS

- 3.2.1 Two reports provide insight into passenger use of LBA. These reports are not entirely consistent in the way in which they report this data, partly due to one report (York Aviation) using and interpreting both 2014 and 2010 CAA data (see page 11 of the report), with the other (Civil Aviation Authority Passenger Survey) report being based on 2014 figures (primary data). Some broad conclusions can be set out based on the information within the reports.
- 3.2.2 The York Aviation Report<sup>33</sup>, (section 2.6.5) sets out the current economic impact of the airport and then uses data from the airport's Masterplan to forecast economic impacts in 2020 and 2030.
- 3.2.3 Since 1968, the Civil Aviation Authority (CAA) has carried out a survey of passengers at a number of UK airports, one of which is LBA. The latest CAA passenger survey<sup>34</sup> covers 2014 and provides the most recent data available on passenger behaviour. For this reason, this report will provide analysis on passenger behaviour only using the CAA 2014 data set.
- 3.2.4 CAA data demonstrates that the airport is currently used predominantly by leisure travellers (business travel accounted for 10% of those surveyed) and that 86% of those using the airport start their journeys within the Yorkshire and Humber region. The CAA report found that in terms of travel to the airport, 88% (of almost 2900 passengers surveyed) had travelled to the airport by private vehicle and almost 12% by public transport. There is a discrepancy here between the figures here and those stated in the LBA Masterplan (which states that 60% travelled by car, according to the 2015 LBA Travel Plan forecourt survey) (see section 2.7.7.3).

<sup>32</sup> LBA surface Access Strategy, 2015, Fore Consulting

<sup>33</sup> York Aviation, op.cit, (22) , p11

<sup>34</sup> <http://www.caa.co.uk/docs/81/2014CAAPaxSurveyReport.pdf>

- 3.2.5 The CAA only asks respondents to select private or public transport as mode, there are no further classifications. The airport forecourt survey separates out passengers who are dropped off directly at the terminal from those who have travelled via shuttle bus from one of the airport car parks. This still does not entirely explain the differing values, which may be due to samples sizes or other survey 'noise' such as differences in the way that car and public transport modes are counted (with particular reference to taxis, car park shuttle buses and minibuses) but illustrates that the two approaches are not consistent and therefore may lead to different conclusions. More comprehensive surveys may be needed to inform a robust business case into any transport scheme being taken forward in order to understand the relative revenue risks.
- 3.2.6 The CAA survey also recorded the number of modes of transport used by airport passengers to travel to the airport and noted that 95% had travelled by one mode only, 4.5% by two and only 0.5% by three or more modes (i.e. interchanging during the journey).
- 3.2.7 The CAA 2014 reports sets out that the majority (86%) of passengers using LBA come from the Yorkshire and Humber region. Of those, approximately 60% come from West Yorkshire, 25% from North Yorkshire and approximately 7% from both the East Riding of Yorkshire and South Yorkshire. The second highest proportion of passengers comes from the North East region, accounting for 8% of total passengers. Passengers from the North West region account for 4% of the overall use of the airport.
- 3.2.8 Although a large proportion of those using the airport start their journey within West Yorkshire, there is a notable 'leakage' from West Yorkshire to other airports in the north of England; one quarter of passengers using Doncaster airport originate from West Yorkshire and for Manchester airport passengers from West Yorkshire account for one fifth of the total. The number of people using Manchester airport from West Yorkshire (3.49m) is greater than the number using LBA from West Yorkshire (2.49m).
- 3.2.9 The reasons for this 'leakage' will be complex, including a range of influences such as the range and cost of (air) services provided, availability of associated services at the airport (parking, hotels, leisure and retail) in addition to ease and reliability of access by a number of modes.
- 3.2.10 The CAA reports include details of journey purpose by type (see table 19.6) which offer an insight into the business leisure split as follows:

SURVEY YEAR	BUSINESS	LEISURE	(OF WHICH, VISITING FRIENDS AND RELATIVES)
2010	16.9%	83.1%	22.5%
2014	9.9%	90.1%	25.5%

**Table 2 – BUSINESS:LEISURE SPLIT FROM CAA SURVEYS**

- 3.2.11 There are a variety of potential tourist destinations within the Leeds City Region, including Leeds and Bradford, York and Harrogate and the nearby Yorkshire Dales and North York Moors National Parks. Whilst data that specifically relates to inbound tourism via LBA does not appear to be available from Visit Britain, the Visit Britain survey<sup>35</sup> reports that in 2014, the overall value of inbound tourism to West Yorkshire was £221.4m. This figure has increased steadily since 2009. The LBA Masterplan suggests that the airport has a net tourism impact of £29m in GVA.

<sup>35</sup> <https://www.visitbritain.org/nation-region-county-data>

- 3.2.12 In addition to a variety of tourist and business destinations within the Leeds City Region, there are a large number of education and training establishments close to the airport including three large universities (Leeds, Bradford and Leeds Beckett Universities). CAA data suggests that currently less than 1% of travellers use the airport current to access educational establishments. However there are a wide variety of schools, in particular independent schools (which especially if they offer boarding facilities, such as Woodhouse Grove School in Yeadon and Fulneck School in Pudsey, may be more likely to accept international students).
- 3.2.13 Universities and Colleges in the vicinity of the airport and in particular in Bradford, Leeds, Harrogate and York will attract international students, but how many of them travel via LBA is unclear.
- 3.2.14 Leeds Trinity University (previously a teacher training college and now a fully incorporated University) is based at Horsforth. Approximately 3,500 students currently attend courses at the University. This is in addition to the Universities of Leeds and Leeds Beckett University which are based close to Leeds City centre and which together provide education for approximately 60,000 students. In addition, Bradford University is approximately 10 miles from the airport, along with Bradford College, and together they cater for around 40,000 students.

### 3.3 HIGHWAY NETWORK MODELLING

- 3.3.1 Information was extracted from the 2008 base year Leeds City Council Saturn Highway model, as part of the previous DfT Study, to provide an indication of junction operation in the vicinity of the airport. The validity of the flows from the SATURN was reviewed and the results represent a good indication of the demand on the network adjacent to LBA.
- 3.3.2 The results show that junction constraints are most significant, where the traffic volumes currently exceed capacity, at the following locations:
- A65 / A658 (Yeadon / Rawdon); and
  - A65 / A6120.
- 3.3.3 To a lesser extent the junctions are also acting as significant constraints at the following locations:
- A657 / A658 (Greengates); and
  - A657 / A6210.
- 3.3.4 A snapshot of aggregated traffic speeds on the network was undertaken as part of the same study from Streetmap Premium Traffic Data for 2013. The illustrations show areas of slow speeds on the network for any day on the network (which includes Bank Holidays and Weekends) for the following time periods:
- AM – 08:30;
  - PM – 17:30; and
  - Interpeak – 14:00.
- 3.3.5 The Figures show congestion is apparent at the following locations:
- A658 / A660;
  - E Chevin Road / Otley Old Road;
  - A658 / Bayton Lane; and
  - A658 / A65 Roundabout.
- 3.3.6 Without intervention, and with growing background traffic in addition to growth at the airport, further detriment to highway journey times and congestion would be expected. Much of the airport traffic moves outside current highway peaks (early mornings and daytime) but growth in air traffic would result in the current airport peak moving more into the existing highway peak, exacerbating current traffic congestion.

- 3.3.7 Leeds City Council is currently updating their SATURN model, with a view to a new model, rebased to 2015, being available during 2016. Junction improvements on the Leeds ring road (A65) at Horsforth and Rodley roundabouts have now been implemented, but these were incorporated in the last modelling runs undertaken for the DfT study and are therefore unlikely to result in any changes to the outputs published.
- 3.3.8 Use of the updated model is recommended for any further and more detailed appraisal and business case work, in order to remain consistent with business case work for the proposed link road.

## 3.4 JOURNEY TIME COMPARISONS

- 3.4.1 The table below shows standard journey time comparisons for current journeys based on average times from a selection of online route planners. This does provide, in some cases, quite optimistic results based on the minimum likely times assuming a perfect connection between modes (e.g. rail/bus), which is rarely possible.

ROUTE	TIME PERIOD	CAR <sup>36</sup>	BUS ONLY	RAIL THEN BUS (INCLUDING WAITING/ INTERCHANGE TIME)
Leeds Railway Station to LBA	AM	35	35	31
	IP	25	30	31
	PM	35	43	31
Bradford (Forster Square) Railway Station to LBA	AM	27	49	45
	IP	22	46	45
	PM	27	45	45
Harrogate Railway Station to LBA	AM	33	37	56
	IP	26	33	56
	PM	33	33	56

**Table 3 - Airport Journey Time Comparisons**

- 3.4.2 Figure 5 below illustrates the broad range of travel options that are available to those travelling to LBA, and that some of those journey options are direct and some will require interchange.
- 3.4.3 Generalised Journey Time (GJT) is used to provide a more realistic assessment of the attractiveness of a transport option, rather than purely taking into account the time spent travelling (as shown in Table 3, above). GJT reflects the issues of relevance that are considered when a decision is made about how to travel, including elements such as walking time, waiting time and cost and applies a penalty for interchange.

<sup>36</sup> Car driving times based on Google maps directions tool

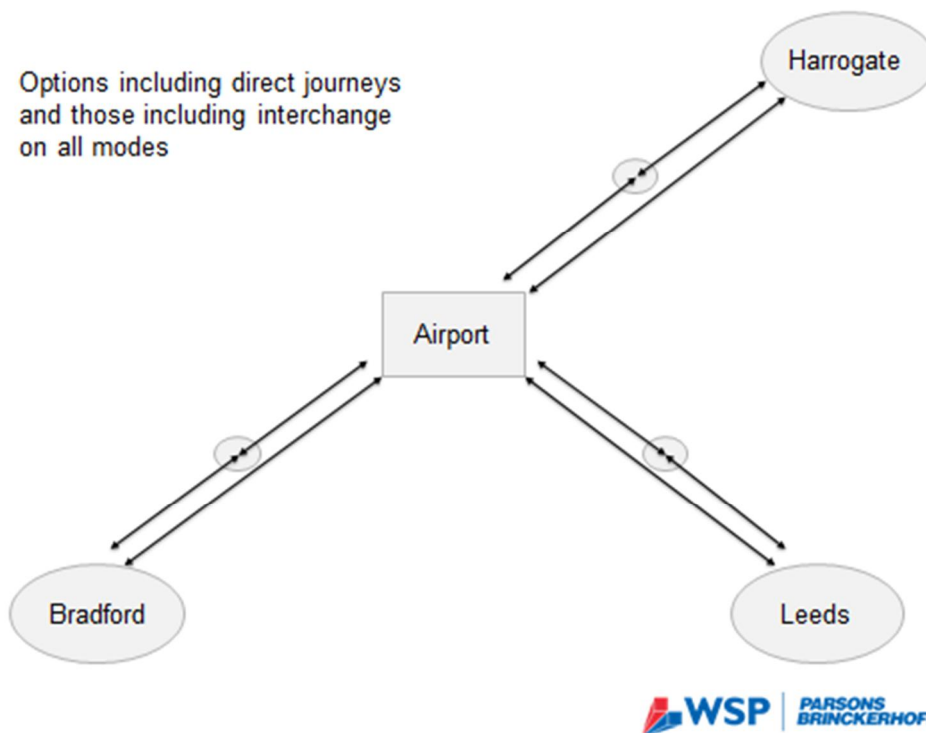


Figure 5 - Schematic of surface access options to LBA

## GENERALISED JOURNEY TIMES

- 3.4.4 A GJT comparison has been carried out to demonstrate the representation of current public transport provision from the Leeds and Bradford area to LBA, whilst also considering the opening of two new rail stations at Kirkstall Forge and Apperley Bridge as some of the options for improved access to the airport that are being considered in this report.
- 3.4.5 The GJT calculations have been applied by following the best practice example of DfT Transport Appraisal Guidance (TAG)<sup>37</sup>. A simplified formula has been applied to represent the journey time from the first mode until arriving at the airport. Full details of how the GJT were calculated, (including the formulae) are available.
- 3.4.6 The generalised journeys times have been calculated and ranked as follows, to show the most attractive to the least attractive options.

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<sup>37</sup> TAG Unit M.2 (chapter 3.1.6, p.15).

OPTION	ROUTE DESCRIPTION	GJT (MINS)
A new direct fixed heavy/ light rail link	Bradford to LBA	23.3
A new direct fixed heavy/ light rail link	Leeds to LBA	25.0
Direct Express Bus (No. 967)	Menston to LBA	36.2
A new direct NGT/ BRT route	Bradford to LBA	36.4
Direct Express Bus (No. 757)	Leeds to LBA	40.4
Direct Express Bus (No. 747)	Harrogate to LBA	43.4
NGT extension (direct)	Leeds - Holt Park - LBA	43.4
New Airport Parkway station + shuttle bus (no charge)	Leeds - P'way - LBA	44.3
New Airport Parkway station + shuttle bus (£1 charge)	Leeds - P'way - LBA	45.8
Horsforth rail station + new shuttle bus link (no charge)	Leeds – Horsforth – LBA	46.5
Horsforth rail station + new shuttle bus link (£1 charge)	Leeds – Horsforth – LBA	47.9
New Airport Parkway station + shuttle bus (no charge)	Harrogate - P'way - LBA	51.7
Direct Express Bus (No. 747)	Bradford to LBA	52.4
New Airport Parkway station + shuttle bus (£1 charge)	Harrogate - P'way - LBA	53.1
Kirkstall Forge rail station + No.757 bus	Leeds - Kirkstall Forge - LBA	55.5
Direct express bus (No.737)	Bradford to LBA	56.4
Apperley Bridge rail station + No.747 bus	Leeds - Apperley Bridge - LBA	71.4
Guiseley rail station + No. 97 bus	Bradford – Guiseley - LBA	73.5
Guiseley rail station + No. 97 bus	Leeds – Guiseley - LBA	74.4

**Table 4 - Summary of Generalised Journey Times**

- 3.4.7 The exercise of calculating GJT shows that on multi-leg journeys, although a reduction in journey time on the first leg of the trip is beneficial, e.g. taking the train to a nearby station such as Horsforth or Apperley Bridge, the interchange penalty causes the GJT to be higher overall than slower through services. This factor takes into account the actual time penalty, and the perceived penalty and inconvenience of changing modes. This is a particular issue for airport passengers who are more likely to be accompanied by luggage.
- 3.4.8 Chapter 5 sets out details of potential options to access LBA; one of the options being proposed is that of a new Parkway rail station between Horsforth and the Bramhope tunnel. This rail station would be located on the Harrogate to Leeds line which is currently operated by Northern Rail. The proposed rail station would be located approximately 1 kilometre from the airport. A shuttle bus would provide access to the airport for passengers arriving by train at this station.
- 3.4.9 The GJTs for this option are summarised in the table above for passengers boarding trains in Harrogate and Leeds, with Leeds boarders benefiting from the faster GJT. The GJT for this option was calculated using interchange from rail onto a shuttle bus service, and options were developed for both a free and £1 fare shuttle.
- 3.4.10 In addition, an illustrative GJT was calculated for journeys using the existing Horsforth station as an interchange point, then using a shuttle bus to access the airport site. This option was calculated to be marginally slower than the Parkway station option, with a 3 minute difference between the two options. This option could, in theory, be delivered now.
- 3.4.11 By analysing the GJT of the sustainable surface access to the airport, it is evident that the most attractive option in terms of GJT would be the direct rail links from either Leeds or Bradford, which are lower in terms of GJT than the next best GJT option, such as NGT from Bradford (10-12 minutes lower) and Leeds (18-20 minutes) or the direct bus services from either Leeds, Harrogate or Bradford, which produce GJTs approximately 15, 20 and 30 minutes longer respectively.

- 3.4.12 Options which require interchange perform less well because of the inherent penalty of transferring from one mode to another, but are generally more costly to deliver. The GJT calculations shown above are against a background of estimated journey times at 2015. The previous DfT Connectivity Study highlighted that at 20.5%, West Yorkshire is anticipated to experience the greatest level of traffic growth in the country. Regional traffic growth is expected to be 23.5% for Leeds, 20.9% for Bradford and 9.3% for Harrogate.
- 3.4.13 Although airport traffic currently contributes a low percentage of traffic during the peak periods, general growth in traffic will exacerbate the impedance of traffic to and from the airport and growth of airport airside departures will require a spreading of air traffic operations into the shoulders of the current peaks making journeys to and from the airport by road more difficult. This will provide a greater advantage in GJT over time for those modes that are segregated from general traffic.

### 3.5 CAR PARKING PROVISION

- 3.5.1 The LBA Surface Access Strategy (ASAS) notes that one of the first improvements undertaken at the airport will be to enhance car parking provision onsite. The ASAS recognises that whilst this has the potential to undermine public transport sustainability and given that there appears to be sufficient parking to provide capacity up to 2017, the introduction of additional car parking gives LBA the opportunity to replan and reallocate onsite parking more appropriately, and in line with its Travel Plan. The ASAS also sets out how the level of car parking is linked to the growth of LBA and will be kept under review and then implemented when necessary. The ASAS also notes car parking as part of a wider strategy to achieve a balanced surface access proposal.
- 3.5.2 The ASAS notes the impact of offsite (not managed by the airport) parking and that offsite parking is already impacting on mode split of journeys to the airport. Consideration will need to be given to how this issue can be addressed in the longer term through the planning process.

CAR PARKING AREA	TOTAL SPACES 2015	DISABLED SPACES 2015*	PROJECTED SPACES 2019	PROJECTED SPACES 2024	PROJECTED SPACES 2030
Premium short stay and Yorkshire Premier Club	87	0			
Terminal Frontage PUDO	99	5			
Short Stay 1 and Business Meet and Greet	290	28			
Short Stay 2 and mid stay	67	0			
Free one hour zone	553	10			
Long stay 1	119	0			
Long stay 2	1806	36			
Long stay 3	974	12			
	952	0			+487 (reconfiguration of existing layout)
<b>SUB TOTAL 1</b>	<b>4947</b>	<b>91</b>			<b>5434</b>
Additional long stay			+829		
Additional long stay and staff parking				+925	
<b>SUB TOTAL 2</b>	<b>4947</b>	<b>91</b>	<b>5776</b>	<b>6701</b>	<b>7188</b>
OFF SITE (private) long stay parking	3768				
<b>TOTAL</b>	<b>8715</b>	<b>91</b>	<b>9544</b>	<b>10469</b>	<b>10956</b>

*\*these figures are included in the total spaces and do not form part of the cumulative total.*

**Table 5 - Current and Future Car Parking Capacities**

- 3.5.3 The Masterplan sets out the airport's strategic growth plan and the way in which that growth will be achieved. The issue of car parking is set out in greater detail in the surface access strategy, which is a 'sister' document to the Masterplan.
- 3.5.4 In summary, the Masterplan shows additional car parking being added to the site in 2019, and a further car park being added to the site in 2024. There is also a longer term aim to offer park and ride facilities at the site.
- 3.5.5 The increase in car parking stock, whilst an improvement in relative terms, equates to the following spaces per passenger when compared to the growth forecasts (based on DfT aviation growth figures, then interpolated to provide estimates in the York Aviation report) for the airport:
- 2.3 spaces per 1000pax in 2019 (forecast 4.2m pax);
  - 2 spaces per 1000pax in 2024 (forecast 5.4m pax); and
  - 1.6 spaces per 1000pax in 2030 (forecast 7.1m pax).
- 3.5.6 These figures do not take into account the 3,768 spaces provided off site by private operators. There is potential for the future expansion of off-site private parking as demand at the airport increases, but this is outside the scope of the Airport Masterplan and would be controlled through the planning process by the relevant Local Planning Authority (depending on location).

## 3.6 PUBLIC TRANSPORT AND ACCESSIBILITY

- 3.6.1 **Bus** - Express bus services to the airport from Leeds, Bradford and Harrogate railway stations are provided by Yorkshire Tiger. The buses used for the service to the airport are of a higher specification than standard local bus services, and are modified to provide additional storage capacity for luggage and accommodate the needs of those people travelling to the airport.
- 3.6.2 In October 2015, Yorkshire Tiger changed their timetables and provided additional airport services through the night as well as journeys that operate with financial support from WYCA and LBA. Previously, the last service would leave the airport at 0035hrs and the first service in the morning would leave the airport at 0505hrs.
- 3.6.3 The new timetable provides services at half hourly intervals until 0234hrs, then hourly until 0334hrs. From 0404hrs services run at 20 minute intervals. This change in service provides additional travel options both to passengers and also to staff who need to reach the airport to times before and after the last / first flights are leaving / arriving at the airport.
- 3.6.4 **Rail** - A new railway station is under construction at Kirkstall Forge and another has recently opened at Apperley Bridge, as part of the DfT funded Rail Growth Package. Apperley Bridge, which is located approximately 4km from the airport, now provides a half hourly rail service to Leeds and Bradford, whilst the new station at Kirkstall Forge (approx. 7km by road) will provide departures every hour with connections to Leeds (5 minute journey) and to Bradford (15 minute journey time.)
- 3.6.5 Links will be available to LBA by way of interchange to bus services at Kirkstall Forge and Apperley Bridge stations. The combined journey time of bus and rail (set out in the preceding section) is unlikely to make this option attractive to airport users, unless travelling from stations further away from Leeds or Bradford (i.e. avoiding a journey into the main centres).
- 3.6.6 In December 2015 Arriva was named as the successful bidder for the Northern franchise, which includes the Harrogate line. The proposals for the line include an increase in frequency between Leeds and Harrogate to 4 trains per hour with improvements on other parts of the route. As yet it is unclear to what extent these proposals can be implemented, due to constraints around capacity in Leeds station and on the line itself. Further clarity on this is expected in due course.

- 3.6.7 An outline business case for electrification of the Harrogate line has been prepared by WSP|PB for WYCA and this would offer a 15minute saving across the line as a whole (Leeds – Harrogate – York) with time savings being split equally either side of Harrogate. Again, delivery of these improved journey times would be dependent on infrastructure investment. The introduction of any new stations on the Harrogate Line will have an impact on the business case unless the new station replaced an existing station.
- 3.6.8 **Private Taxis** – The permitted on-site taxi company is Arrow Private Hire. Arrow are the airport's contracted supplier, which enables them to pick up and drop off passengers from directly outside the terminal building. They provide an online booking service and offer discounted fares for two way journeys. All taxis are allowed to access the airport, but only Arrow PH are able to access the terminal forecourt.
- 3.6.9 LBA have a designated Travel Plan Coordinator (TPC), whose role involves promoting and monitoring sustainable travel modes to customers, staff and visitors. In addition to providing travel information, the TPC has also overseen the introduction of facilities to encourage cycling, a car sharing scheme with associated car sharing car park spaces, and a travel buddy scheme. Real time passenger information displays are provided within the terminal building.

## 3.7 CONCLUSIONS

- 3.7.1 LBA staff and passengers travel from a variety of areas, but the highest numbers travel from within the Leeds City Region, and in particular, from within West Yorkshire.
- 3.7.2 The majority of passengers using LBA currently do so for leisure purposes, with business travel and travel for personal business reasons representing a smaller, but growing proportion.
- 3.7.3 The largest proportion of LBA passengers come from within West Yorkshire with North Yorkshire providing the next highest number of passengers. In terms of passenger leakage, Manchester and Doncaster airports carry high proportions of West Yorkshire passengers, with Manchester Airport carrying a greater number of West Yorkshire passengers than LBA.
- 3.7.4 Stakeholders note the importance of providing improved transport links not only within West Yorkshire, but also to the east towards Harrogate and York forming part of the airport catchment area.
- 3.7.5 Express bus services are operated by Yorkshire Tiger between Bradford, Harrogate and Leeds and the airport, with departures through the evening and night and a good frequency daytime service. The services are operated partially under contract to WYCA and with financial support from LBA. It is not clear which particular parts of these services are supported and which could operate commercially, as the services form part of one overall contract.
- 3.7.6 Economic studies and growth plans focus not only on improved surface access as a means of improving the efficient operation of LBA, but also as a way of allowing the development of a Commercial Hub, which could provide additional employment and resulting uplift in GVA.
- 3.7.7 Analysis of the Generalised Journey Time (GJT) of sustainable surface access modes to the airport illustrate the most attractive option in terms of GJT would be improved direct links from either Leeds or Bradford. This is approximately 15-30minutes lower in terms of GJT than the next best option. This is even more apparent in the context of forecast traffic growth for Leeds (which is the highest projected in the UK) which has the potential to further increase the GJT figures for road based modes.

- 3.7.8 Parking at the airport is set to increase in real terms, but will decrease in relation to projected growth in passenger numbers. The availability of off-site private parking, and uncertainty over its future provision, means that the use of on-site parking as a demand management tool is not as effective as it could be (in terms of effecting modal shift onto sustainable modes) unless supporting planning policies could be used in conjunction with consideration of further growth at the airport and sustainable transport solutions.
- 3.7.9 Links to existing and new stations could be provided now, as a short term improvement to connectivity, with supporting promotional activity and through fares, but it is unlikely they would provide an attractive option when compared to existing direct services.

# 4 EARLY FEASIBILITY ASSESSMENT

## 4.1 TECHNOLOGY AND INFRASTRUCTURE REVIEW

4.1.1 The airport could be served by one of a variety of different modes, each of which has advantages and disadvantages, and may be complementary or competitive to each other. A summary of them, with a short commentary follows:

## 4.2 HEAVY RAIL

4.2.1 The heavy rail option would link to the existing rail network and would be the most appropriate for a high-density, medium-frequency operation. Heavy Rail is the term used to describe standard rail operations across the UK, be these local, regional or national services.



4.2.2 The operation of additional trains to serve the airport does however mean that the capacity of the network elsewhere, particularly into Leeds city station, a Bradford terminal and the routes into these centres will need to be assessed and potentially enhanced.

4.2.3 This could well involve additional track work or enhanced signalling, and potentially additional platforms on the western side of Leeds station (i.e. close to the existing Platform 1).

4.2.4 A heavy rail line would cost in the order of £15-25m per route kilometre (double track alignment) to build, and a train has running costs of approximately £12.50 per km. Construction costs vary substantially according to the topography of the route, the complexity of land purchase arrangements and the operating speed required.

4.2.5 Tunnelled sections would add a substantial cost to the project, estimated to total between £350m to £400m. This estimate of cost is made up of the following elements; tunnel boring equipment, costs to set up the site, variable costs (costs per km, per day), disposal of waste materials, provision of tunnel portals, ventilation shafts, and M&E systems.

4.2.6 In terms of traction, electric trains have far better torque than diesel powered trains, making them more suitable for lines with severe gradients, but they are still more limited than trams. Electric traction also provides better performance than diesel including faster acceleration, resulting in better journey times, and lower operating costs.

4.2.7 Design of track gradients should take account of the following factors:

- Braking and traction performance of operational and maintenance vehicles likely to use or work on the line;
- Position of signals and operational regime (for example, the likelihood of a train being required to start on the gradient or stop at a station or signal);
- Projected rail adhesion conditions, including the effect of the weather; and
- The combined effect of gradient and horizontal curvature where the gradient coincides with a small radius horizontal curve.

### 4.3 LIGHT RAIL

4.3.1 Light Rail (or Tram) has the advantage of permitting a high-frequency, high-density service, but light rail units are usually lower capacity than trains which run on the heavy rail network.

4.3.2 The signalling systems are cheaper to operate and the speed of operation is usually less, meaning that the service level can be higher. Interaction with the heavy rail network would be more problematic, and certain safety standards (such as crashworthiness) may not be met by a light rail vehicle running on a heavy rail route, so segregation would be required.



4.3.3 A light rail option may therefore mean a separate alignment being needed all the way from the airport into central Leeds or Bradford, or alternative measures being taken, such as the diversion of a light rail network away from the heavy rail alignment and then operation into the urban centres. A light rail line would cost in the order of £10-15m per route km (double track alignment) to build and a light rail train has running costs of approximately £8 per km.

### 4.4 TRAM-TRAIN

4.4.1 Tram-Trains are in use in various cities in the continent and are due to be introduced between Sheffield and Rotherham in 2017 as a trial scheme promoted by DfT to assess the feasibility of it being rolled out more widely. As their name suggests, Tram Train units can operate on a light-weight tram network and also on the heavy rail network. This provides improved flexibility in terms of routing and due to slightly relaxed operating gradients for light rail (over heavy rail). This would give greater opportunities, in terms of LBA, to provide a link onto the airport site.

4.4.2 The Tram Train unit and staff have the capability to operate under heavy rail operating conditions (including signalling systems, platform heights, etc.) when on heavy rail lines, but then run onto light rail track in order to use the benefits of tramway operation such as on street running. A tram-train alignment could potentially operate on a new tram alignment into the airport and into central Leeds or Bradford, but using the heavy rail network in between, if electrified, reducing the distance of new track required.



Taking the line away from central stations (Leeds in particular) into the urban centre would also help with platform capacity in the station itself. A light rail line would cost in the order of £10-15m per route km to build (double track alignment – assuming standards similar to light rail), and a tram-train has running costs of approximately £5 per km.

## 4.5 NEW GENERATION TRANSPORT (NGT)

- 4.5.1 The NGT system is based on a trolleybus, which is an electric bus with rubber tyres that draws power from overhead wires. The vehicles produce almost no emissions at point of use and they are much quieter than diesel buses. Depending on the size of the vehicles, the capacity of trolleybus systems is similar to bus and tram systems, but smaller than rail or light rail systems.
- 4.5.2 Unlike light rail and tram-trams, trolleybuses cannot run on heavy or light rail lines. Compared to rail-based systems, trolleybuses are slower over longer distances and have more limited acceleration. However, the rubber tyres of a trolleybus have better hill-climbing capabilities than the steel wheels running on steel tracks used by trains and trams.
- 4.5.3 In addition, the electric motor in a trolleybus is more effective on steep gradients than the internal combustion engines used in diesel buses, because of the torque delivered. Although trolleybuses can run on existing highways, the journey time savings delivered by a new trolleybus route depends on the extent to which the vehicles receive priority on the highway and the proportion of the route that is dedicated to trolleybuses. Constructing trolleybus infrastructure on existing highways is more expensive than running a new bus service, though cheaper than building a tram or railway line.



New Generation Transport (NGT) is a modern trolleybus system currently being promoted by Leeds City Council and WYCA, consisting of one cross-city line from Holt Park to Stourton. The scheme costs are £250m for 14.6km of route and the trolleybus vehicles.

Should this scheme receive government approval, an airport NGT service could be added to the city's emerging NGT network.

- 4.5.4 The nearest proposed NGT stop is just over three miles away at Tinshill/Holt Park. NGT could be extended from this point to the airport via Cookridge Lane or Tinshill Lane. The latter alignment could connect with the existing rail service Horsforth, but could be seen to duplicate these rail services. Alternatively, a new NGT route from the airport to the city centre could be constructed via the A65 on a mixture of existing roads and new alignments, including the new proposed link road. At this stage, the need for bus priority hasn't been confirmed, but clarification would be required before reaching Gateway 1 submission as part of establishing the preferred highway design standards.
- 4.5.5 At 12-14km in total, building a new city centre link would incur significant additional costs over an extension from an existing line. A further disadvantage of this option is that the vehicles would have to run on, or adjacent to, the existing highway for much of the route, though the trolleybus could use the existing quality bus corridor on the A65. To secure the powers to deliver an NGT extension, the promoters would need to obtain an Order under the Transport Works Act 1992, which can be challenging and costly, as the current NGT process has demonstrated.

## 4.6 ULTRA-LIGHT RAIL

4.6.1 Ultra-Light Rail (ULR) or Very Light Rail (VLR) is a rail-based transportation system using self-propelled units powered by internal energy storage devices (such as an electric battery) and kinetic energy recovery systems. ULR units do not require overhead wires and they are much lighter than conventional trams and heavy rail trains.



4.6.2 ULR is cheaper to install than heavy rail, light rail and tram systems and offers greater capacity and operating efficiency than buses.

4.6.3 Like light rail, ULR is suited to high frequency services, and a higher frequency would be required for more dense corridors because of the smaller vehicle size. ULR units could run on the existing heavy rail network, but like light rail, there would be problems associated with co-ordinating ULR with existing heavy rail services and ensuring ULR met safety standards. When ULR has used heavy rail lines it has done so when heavy rail services have been removed.

4.6.4 While ULR tracks could be installed on the road network for sections of the route, to derive the full benefits of the system, a new ULR alignment would have to be constructed between the existing rail line and the airport. The chief problem with ULR is that it is a largely untested technology.

4.6.5 The only ULR system in operation is a 1km service in Stourbridge in the West Midlands.

4.6.6 Although a ULR research centre in the West Midlands has received public support, private and public investment in the technology has been limited overall. The public relations benefits of ULR could be limited as the units may be perceived as “buses on rails.” The speed and capacity of ULR is more limited than heavy rail and light rail. On steep gradients, the light weight of ULR could be offset by the low power of the units. The exact costs per kilometre of ULR are unclear.



Another variation of this concept is the Urban Light Transit (ULTra) system opened at London's Heathrow Airport in May 2011. It consists of 21 vehicles operating on a 3.9km route connecting Terminal 5 to its business passenger car park.

ULTra uses largely off-the-shelf components, such as rubber tyres running on an open guideway. This approach has resulted in a system that ULTra believes to be more economical

than other similar solutions; the company reports that the total cost (vehicles, infrastructure and control systems) is between £3m and £5m per km of guideway, but is clearly self-contained and probably only suitable for short distance solutions with lower passenger flows (such as a link to and from a local rail station).

4.6.7 The vehicles themselves are electric powered (on board batteries), have four seats and are designed to travel at 40 km/h (25 mph) at gradients of up to one in five (1:5), although the company has suggested limiting operating routes to 1:10 gradients to improve passenger comfort.

- 4.6.8 One key issue with regards to ULR is that development of the necessary infrastructure would require an Order under the Transport and Works Act 1992, which would increase delivery timescales considerably.

## 4.7 UNDERGROUND

- 4.7.1 An underground heavy rail line is ideal in city centres where there are substantial flows of passengers travelling between different points, and where an alignment on the surface would be extremely expensive and disruptive to build and operate.
- 4.7.2 Depending on the nature of tunnelling the cost is extremely high, with costs in the region of £125m per route km, dependent upon the ease of access, the nature of the tunnelling and the complexity of the system fit-out. In addition, station costs would also have to be considered and could be substantial if the station was to be provided underground.
- 4.7.3 Because of the need to access the airport at the top of the hill, costs for this option would be very high and as a result, make achieving a viable business case unlikely. In addition, the capacity provided by an underground system would significantly exceed demand and as a consequence; have the potential to undermine viability.

## 4.8 MAGLEV

- 4.8.1 Maglev (meaning Magnetic Levitation) transport has generally only been used for short distance travel with a substantial flow and uses an opposing magnet to keep the vehicle vertical. A particular use of it has been at airports, to link terminals, or the terminal and the station.
- 4.8.2 There is a maglev in public service between Shanghai and its airport. Birmingham airport used to have a Maglev to/from Birmingham International station opened in 1984, but this was replaced by a cable-based people mover, which currently operates as the AirRail Link.



- 4.8.3 A maglev system is totally independent and cannot be linked to heavy rail.
- 4.8.4 Given the complexity of the technology, the costs are high, with a figure of approximately £50m per route km. A new route would need to be built all the way from central Leeds to the airport, or to link a new parkway station to the airport terminal.

## 4.9 MONORAIL

- 4.9.1 This form of transport has generally only been used for short distance travel with a substantial flow, and involves the vehicle operating on one track, rather than two. A particular use of it has been at airports, to link terminals, or the terminal and the station. A monorail system is totally independent and a new route would need to be built all the way from central Leeds to the airport. Costs are of the same order of magnitude as maglev trains.



## 4.10 HS2/TRANS NORTH SPURS

- 4.10.1 HS2 is a new high-speed railway expected to arrive into Leeds from the east. It would need to be extended up to the airport. It is not a feasible or sensible solution for long-distance high-speed trains to fulfil what is largely a local purpose of transporting passengers from the airport into central Leeds and this option is not to be pursued at this stage. The gradients involved would also make High Speed Rail operation to or from the airport virtually impossible.
- 4.10.2 Consideration should also be given to the design and specification of track on any new route to the airport, as light rail track would not be suitable for use by heavy rail trains, be these High Speed or conventional.

## 4.11 ADDITIONAL STATION PROVISION

- 4.11.1 In addition to the potential for the construction of new lines to the airport, which would require new station provision, an alternative proposal would be to construct a new station on the existing heavy rail line at a point closest to the airport.
- 4.11.2 The station would have to be situated either on the existing Leeds – Harrogate – York line, or the Leeds – Guiseley – Bradford line with a shuttle bus, or other form of shuttle link to take passengers from the station to the airport terminal. This type of operation can be observed at other airport parkway stations such as Luton or East Midlands.
- 4.11.3 Typical station construction costs for a station of this size would be between £8m - £10m (excluding land purchase), with additional costs incurred to deliver associated rail works and a highway link to Scotland Lane taking the total cost to between £12m - £15m.

## 4.12 OPERATING CAPABILITIES AND CONSTRAINTS

- 4.12.1 Rubber-tyred vehicles such as buses have incrementally better traction on dry surfaces and gradients, but significantly lower traction in wet, icy, or snowy conditions. Furthermore, light rail transit (LRT) units powered by electric traction are often capable of negotiating much steeper grades than is commonly designed and delivered in system designs, therefore building in safety margins.
- 4.12.2 The inclusion of steeper gradients on railways avoids the expensive engineering and land modification works required to produce more gentle gradients. However the maximum feasible gradient is limited by how much of a load the motive power can haul uphill. Braking when travelling downhill is also a limiting factor, particularly when considering operational aspects.
- 4.12.3 Tramways and light railways often have higher gradients than heavier railways. This is because in many cases, all wheels are powered and all wheels braked, in order to give better acceleration and stopping. Grades of one in twenty (1:20) are not uncommon on them, with some exceeding this. There is a technical trade off from the requirement for additional power, with the need to accommodate additional motors having an impact on internal floor levels (and therefore platform design) and the cost of rolling stock.
- 4.12.4 Metros and commuter railways often also permit higher gradients, over 1:25, for the same reason. High-speed railways commonly allow 1:40 – 1:25 because the trains must be strong and have many wheels with power to reach very high speeds. For freight trains, gradients should be as gentle as possible, preferably below 1:100.

- 4.12.5 The Lickey Incline is the steepest sustained adhesion-worked gradient on a British standard gauge railway. The climb is just over two miles (3.2 km), at an average gradient of 1:37 and can cause traction problems for some trains, which are mainly heavyweight diesel trains. There are some shorter sections of steep rail such as the gradient up to Blackfriars station which is 1:27 and one of the most severe examples, used by Electrical Multiple Units.



In general, it is preferable on newly constructed systems to minimise gradients wherever possible. On light railways where steeper inclines can be achieved examples include a 1:17 gradient (5.88%) on the Docklands Light Railway in London at the entrance to the tunnel from the original London and Blackwall railway viaduct to the tunnel at Bank Station.

In Sheffield, the most severe light rail gradients are observed on a short section of 1:10 and others at 1:11 on sections through Norfolk Park and Netherthorpe. All axles on the cars are powered to enable operation on such gradients. In the USA, examples are observed in San Francisco 1:11, Boston 1:12.5 and Pittsburgh 1:10. Articulated tramcars operate without any problem on these grades, every day.

- 4.12.8 Light Rail Standards<sup>38</sup> state that *'The maximum horizontal and vertical curvature, the maximum gradient, the maximum track twist on a tramway, and combinations thereof, should be established taking account of the physical constraints of the route, the capability of the tram, and the effects of speed, curvature and gradient on the passengers'*.
- 4.12.9 As a general rule, routinely designing systems with very steep gradients should be avoided, to benefit long term ongoing operations and to minimise maintenance and wear. Within reason, however, the longitudinal slope can be increased when the situation demands. Rail Standards<sup>39</sup> advise that for the design of new heavy rail systems there should be an exceptional limiting value for sections up to 3km (1.9 miles) long of 1:50 and a normal limiting value of 1:80 for running lines. This is a considerably more gentle gradient than the theoretical maximum.
- 4.12.10 Stations on steep slopes require special design considerations. The steepest it is advisable to plan for without special provisions on the platform (such as railings for the mobility-impaired) would be 1:20.
- 4.12.11 Some rail lines on steep grades have additional safety features such as catch points and trap points to stop a unit exceeding safe speed, or in the event of a runaway. With smart technology, a speed control device might do the same if the brakes are starting to overheat. Magnetic track brakes can help if the rail is treated with slip retardant.
- 4.12.12 The table below sets out a summary of the key data for the modes mentioned above:

<sup>38</sup> Guidance on tramways: Railway Safety Publication 2. Office of Rail Regulation, November 2006

<sup>39</sup> Railway Group Standard GC/RT5021: Track System Requirements, Issue 5, December 2011.

MODE	INFRASTRUCTURE REQUIREMENTS	READINESS OF TECHNOLOGY	KEY FEATURES	COSTS	DELIVERY TIMESCALES	OPERATING CONSTRAINTS
Heavy rail	Track and connection to existing network	Well used throughout UK and internationally	High density, medium frequency operation.	£15-25m/km line build costs £12.50/km operating cost	Medium to long term	Max design gradient of 1:80-1:50
Light rail	Track and connection to existing network	Used in several major UK cities as tram network, (but also including DLR in London) and internationally	High frequency, high density but smaller capacity units	£10-15m/km line build costs £8.00/km operating cost	Medium to long term	Max design gradient of 1:20 – 1:10
Tram - train	Track (light or heavy rail)	Used continentally and being piloted in South Yorkshire in 2016	Can operate on light and heavy rail tracks	£10-15m/km line build costs £5.00/km operating cost	Medium to long term	
New generation transport (NGT)	Overhead cable to power electric bus.	Scheme planned for Leeds – awaiting approval	Trolleybus style operation	£15m/km line build and vehicle cost	Medium term	Defined by highway gradients
Ultra light rail (ULR)	Self-propelled rail units, track required	Two small sections of ULR in UK	High frequency, low capacity units.	Unclear, but approx.. £3-5m/km	Medium term	Max gradient – 1:5
Underground rail	Units run in underground tunnels	Well used in UK and internationally	High frequency, high density	£60-100m/km line build costs £500m approx. station build costs	Long term	
Maglev	Self contained system	Not in use in UK, used in Shanghai (airport connection)	Short distance and high density links	£50m/km	Long term	
Monorail	Self contained system	Used internationally (ie – Bangkok Skytrain) but not used for mass transit in the UK	High frequency, high capacity	£50m/km	Long term	
HS2/Trans North spur	Heavy rail link to network	HS1 in operation UK, HS2 currently in planning, includes a link to Leeds.	High frequency, high capacity	Unknown at this stage	Long term	
Additional station provision	(Parkway station link)	Well used	High frequency, high capacity	£8-10m construction costs	Medium to long term	

## 4.13 MODE CAPACITIES

- 4.13.1 There is a direct relationship between mode and carrying capacity, both for individual vehicles and for the corridor as a whole. Depending on design, the capacity and loading speed is also dictated by aspects of design such as the number of doors. Rail or light rail vehicles for example have a number of doors, and typically have off vehicle ticketing, so that the dwell time at stops is minimised, and passengers can load and off load simultaneously. Whilst the same can be provided for buses, it is more common to have single doors and driver issued ticketing. Some airport operations however do have off bus ticketing.
- 4.13.2 For this reason, as corridor demand increases, there is a valid reason for seeking a higher capacity mode, in order to ensure that demand can be accommodated, particularly at peak times, and the service can be provided in a reliable and attractive way (in terms of passenger capacity, comfort, etc.).
- 4.13.3 Travellers accessing transport hubs such as airports also have additional demands over day to day commuters, with a greater time sensitivity (requiring absolute reliability, or a high frequency to compensate for any failures) and other space requirements such as easy access with luggage and storage on board.
- 4.13.4 To give a broad summary of corridor capacity, the table below summarises typical capacity ranges for each mode.

MODE	TYPICAL CAPACITY (PASSENGERS PER HOUR) <sup>40</sup>	FREQUENCY ASSUMPTION
Bus	600 – 720	5 minute headway (12 buses per hour)
Bus Rapid Transit	1200 – 1440	5 minute headway (12 buses per hour)
Light Rail/Tram Train	900 – 1320	10 minute headway (6 departures per hour)
Light Rail/Tram Train	1800 – 2640	5 minute headway (12 departures per hour)
Heavy Rail	1320 – 1600	15 minute headway (4 departures per hour) – 4 car class 319 electric

**Table 6 - Typical Modal Capacities**

- 4.13.5 One important consideration is the degree to which capacity can be adjusted to meet demand. Bus based systems are more flexible and able to react to changes in demand more easily, whereas rail based systems, particularly non segregated routes such as heavy rail, will have a longer lead in time because of network capacity constraints, procurement lead in times and the cost of adding additional vehicles to the operating cycle.
- 4.13.6 Demand is also flexible, so light or heavy rail systems have greater individual unit capacity, making them more suitable to peak loading situations such as Park & Ride or airport arrivals, where a large number of passengers arrive at the departure point at the same time. In terms of perceptions, rail based systems have a greater permanency and can lead to greater long term business confidence for investment.

<sup>40</sup> Adapted from Urban transport XVII : urban transport and the environment in the 21st century, A Pratelli; C A Brebbia (2011)

## 4.14 CONCLUSIONS

- 4.14.1 The early feasibility assessment above considers a wide variety of mass transit options and considers their operating features and constraints. Modes currently used extensively in the UK; heavy rail, light rail and bus, offer potential to transfer larger number of passengers onto the airport site.
- 4.14.2 NGT (Trolleybus) and Tram Train are currently being developed in the UK and could provide links to the airport should the necessary infrastructure be in place from which to extend a link to the airport site.
- 4.14.3 Other modes including Ultra Light Rail, Maglev and Monorail have been discounted at this stage for a number of reasons including their cost, inability to integrate with existing networks, or the availability of tried and tested systems.
- 4.14.4 Consideration of operational gradients has shown that in the context of the UK, heavy rail only operates on existing lines at inclines that are no steeper than 1:25 (heavy rail). Current design standards would normally require much less severe gradients of between 1:50 and 1:80 particularly for extended distances.
- 4.14.5 For light rail the theoretical maximum would be between 1:20 to 1:10 and there are a number of UK examples of systems with these gradients constructed in the past 20 – 25 years. The following chapter sets out how these theoretical maximums might impact on the potential to operate services in the vicinity of the airport.

# 5 OPTION IDENTIFICATION

5.1.1 The list below sets out the long list of options that were agreed at the Officer Working Group in July 2015 to be incorporated into this study.

LIGHT RAIL/TRAM TRAIN	HEAVY RAIL	ROAD AND BUS BASED
Link to LBA from Harrogate line, including north-facing chord (aka Arup option.)	Spur from Harrogate line on a new alignment. Look at north-facing chord	NGT as an A65-LBA link road option
LRT along A65 and using LBA link road	New station on Harrogate line – parkway station	NGT as an extension to north route from Holt Park
On-street running in Leeds centre – better penetration	Onward link from LBA station to Guiseley/Bradford	NGT as route serving Bradford
Onward link from LBA stop to Guiseley/Bradford	New route from Airedale/Wharfedale line in Calverley area	Shuttle bus from local rail stations – Horsforth, Guiseley, Apperley Bridge, Pannal – plus Parkway option
Cross-Bradford Link (Bradford Forster Square to Bradford Interchange), plus Spenn Valley	Potential link northwards to provide a Bradford – Harrogate – York corridor	Introduce bus priority as part of LBA link road, plus wider A65 enhancement measures
Calverley-LBA as tram-train – use of A65 link road	Onward link from LBA to Menston.	Express bus: Bradford, Halifax, York etc.
Harrogate line conversion to Harrogate/Knaresborough		
As part of a wider regional network (i.e. cross-Leeds links to AVL Leeds)		
Ultra-light rail option from Horsforth/Harrogate line		

**Table 7 - Summary of Options Considered**

5.1.2 The list covers light rail, heavy rail and road based options (including improvements to existing public transport services) and demonstrates the wide range of options that will be considered.

5.1.3 LBA is sited on top of a large hill and as a consequence the area around the airport, and the potential and existing routes to it, are challenging with regards to gradient and topography. The topography in the area may not preclude access by any particular modes, but it will make delivery of infrastructure significantly more challenging and at greater cost.

## 5.2 ROUTE MAPS

5.2.1 The plans below set out the wide range of potential rail route alignments, based on understanding and interpretation of the best possible alignments, taking into account issues of topography and gradient. A larger version of these maps is available in **Appendix A1**.

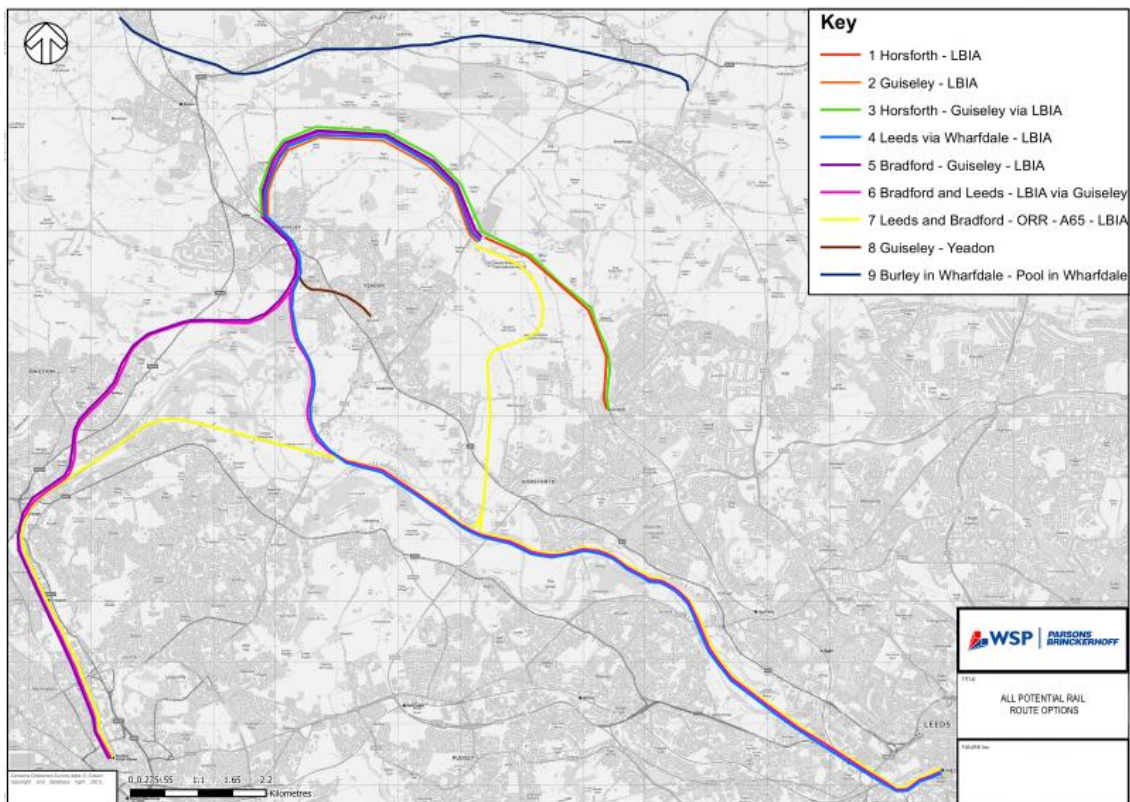


Figure 6 - All Potential Rail Route Options (from previous studies)

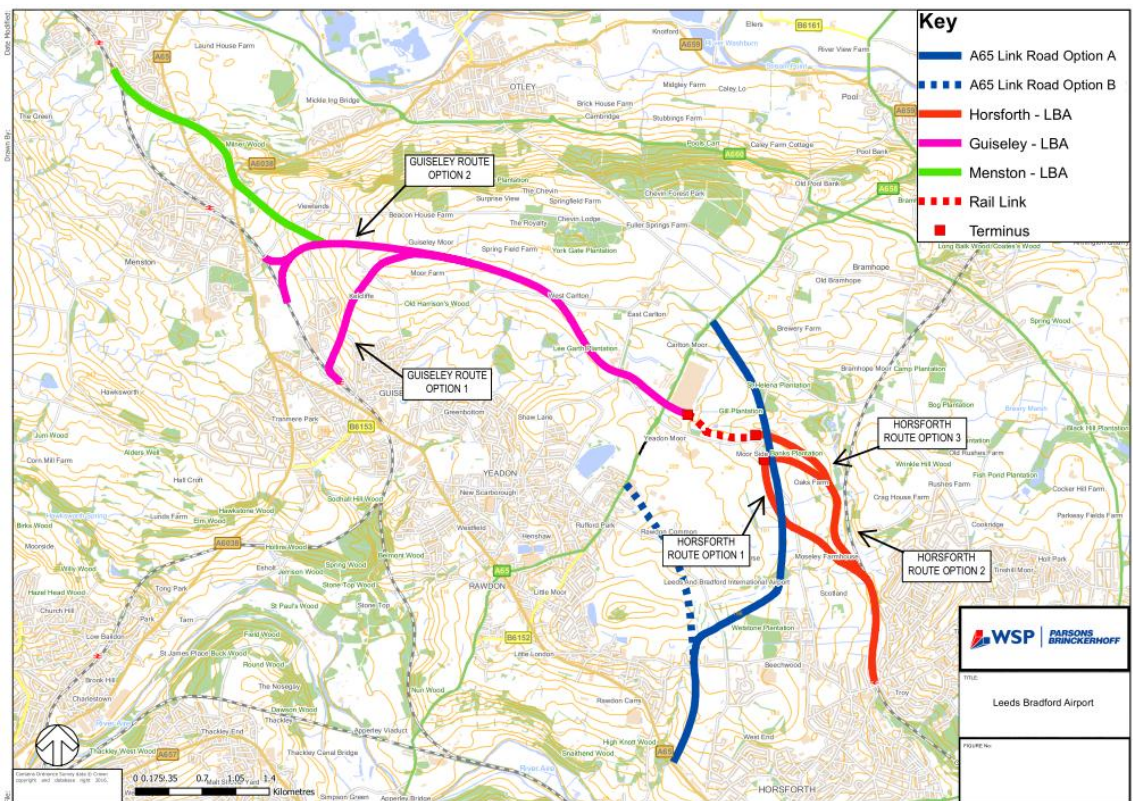


Figure 7 – Alignments Considered in Detail (this study)

- 5.2.2 From the larger number of rail route options in Figure 6, a more defined and realistic series of potential alignments has been examined in Figure 7, based on an initial assessment of a number of criteria, including removal of duplication, land availability, topography and interfaces with the existing highway and rail network (taking constraints into account such as station locations, tunnels and cuttings).
- 5.2.3 As can be seen from the indicative plans, there are several interdependencies between road and rail. To the east of the airport, Leeds City Council is currently consulting on options for a proposed new link road between the A65 and the airport. The road and rail proposals are intended to meet different needs, linked not only to the growth of the airport, but also to reduce traffic congestion and provide access for new development around the airport itself. The road and any new rail link would need to cross at some point, either by way of tunnelling or bridging and each would need to take account of the other in its design, potentially increasing the cost of both. As the design and delivery timescales for each scheme are different, it is therefore important that proposals are developed in parallel in order to ensure that, if required and wherever possible, passive protection is included in each scheme.
- 5.2.4 When analysing the indicative routes, the contour mapping on the plan at Figure 7 shows the extent of the gradients that exist. Ordnance Survey data and a Geocontext Profiler<sup>41</sup> have been used to produce gradient profiles for the routes indicated. The contours were used to influence route variants in order to try and minimise the level changes and gradients being observed.
- 5.2.5 The following graphs at Figure 8 to Figure 12 show the vertical height changes and resulting gradient profiles for the various route options. The first of each route options also shows comparative profiles for absolute maximum heavy and light rail elevations.

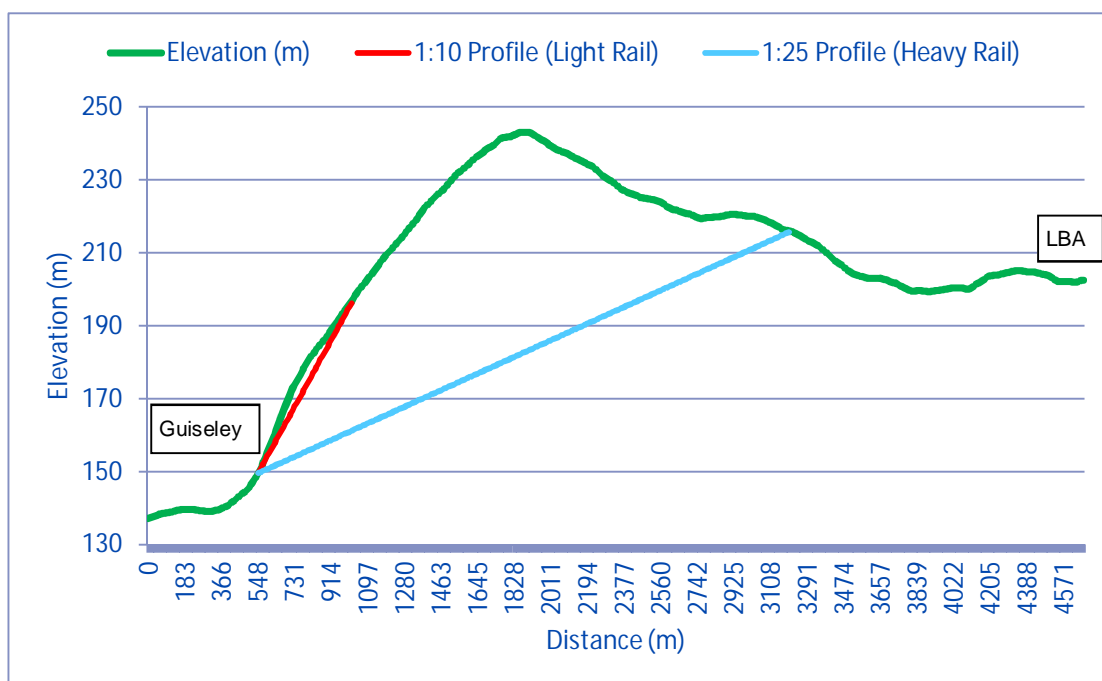


Figure 8 - Gradient Profile for Guiseley Route Option 1

<sup>41</sup> <http://www.geocontext.org/publ/2010/04/profiler/en/>

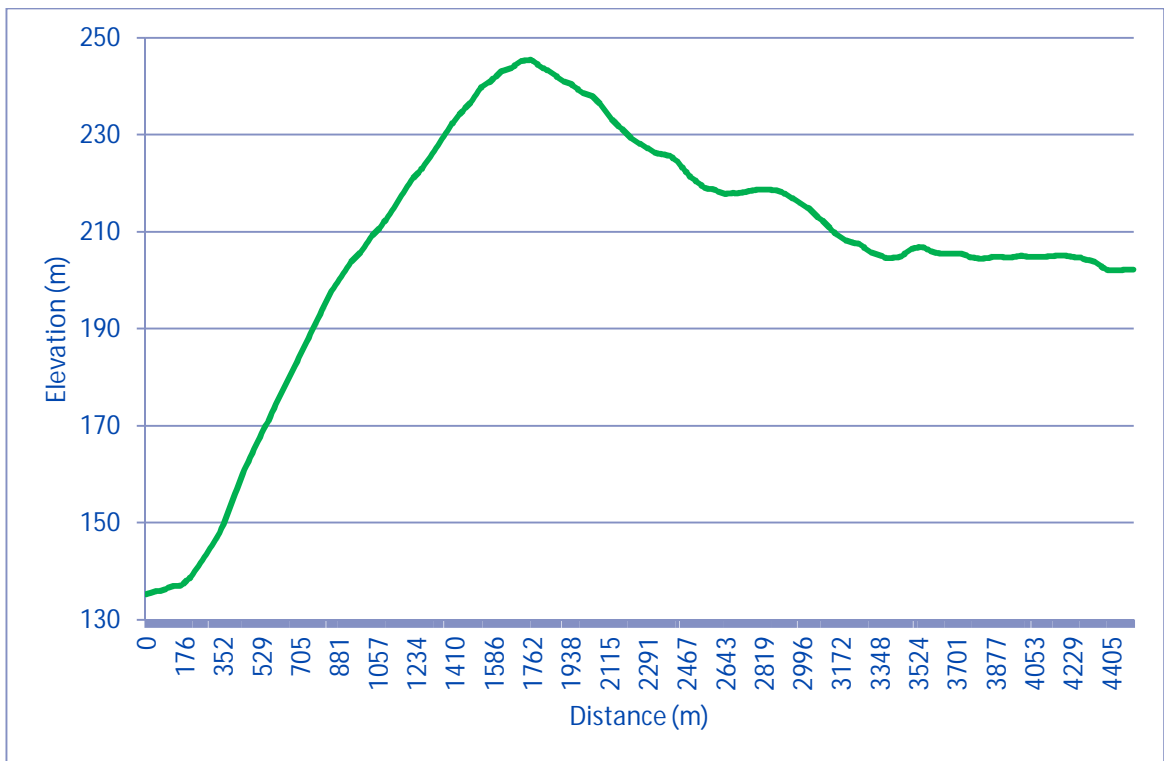


Figure 9 - Gradient Profile for Guiseley Route Option 2

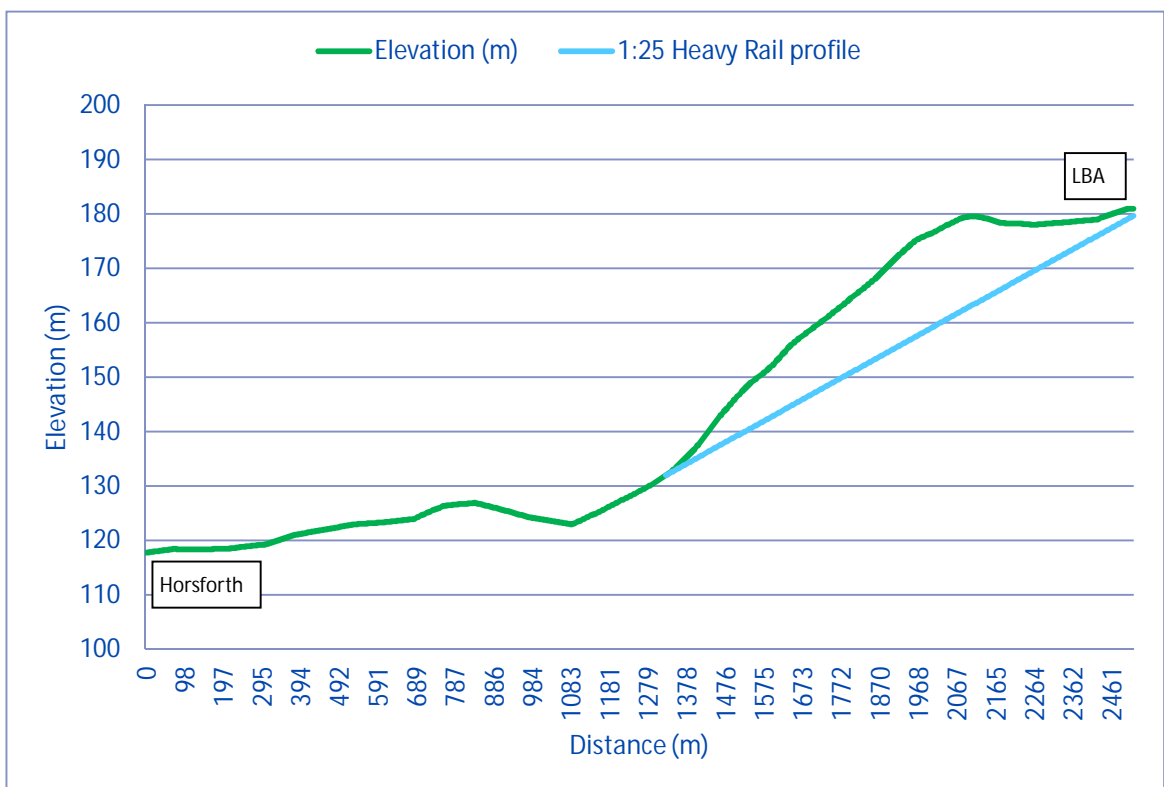


Figure 10 - Gradient Profile for Horsforth Route Option 1

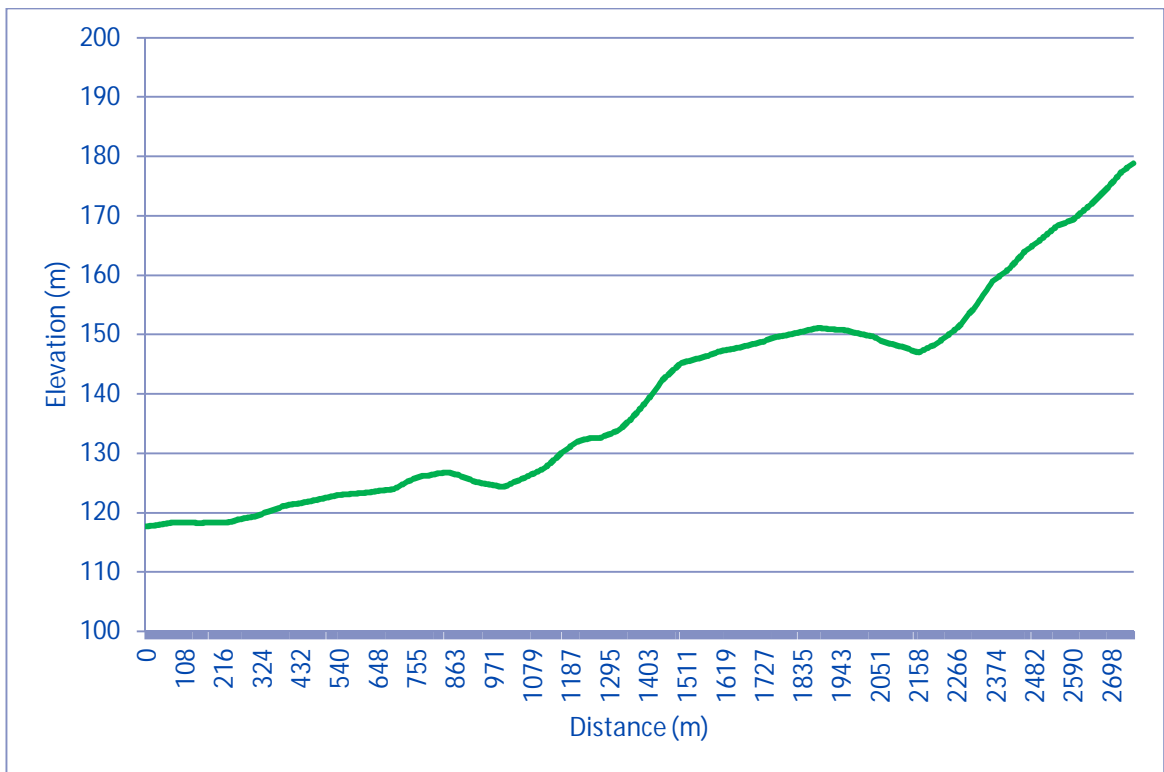


Figure 11 - Gradient Profile for Horsforth Route Option 2

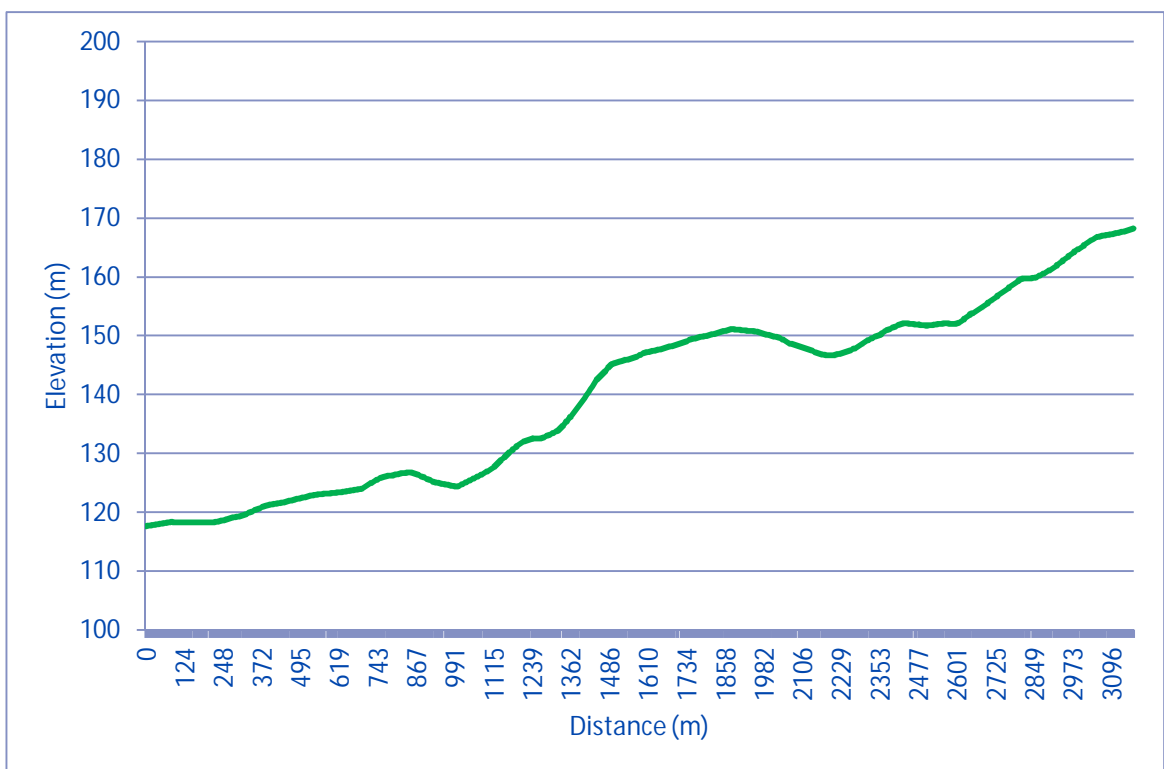
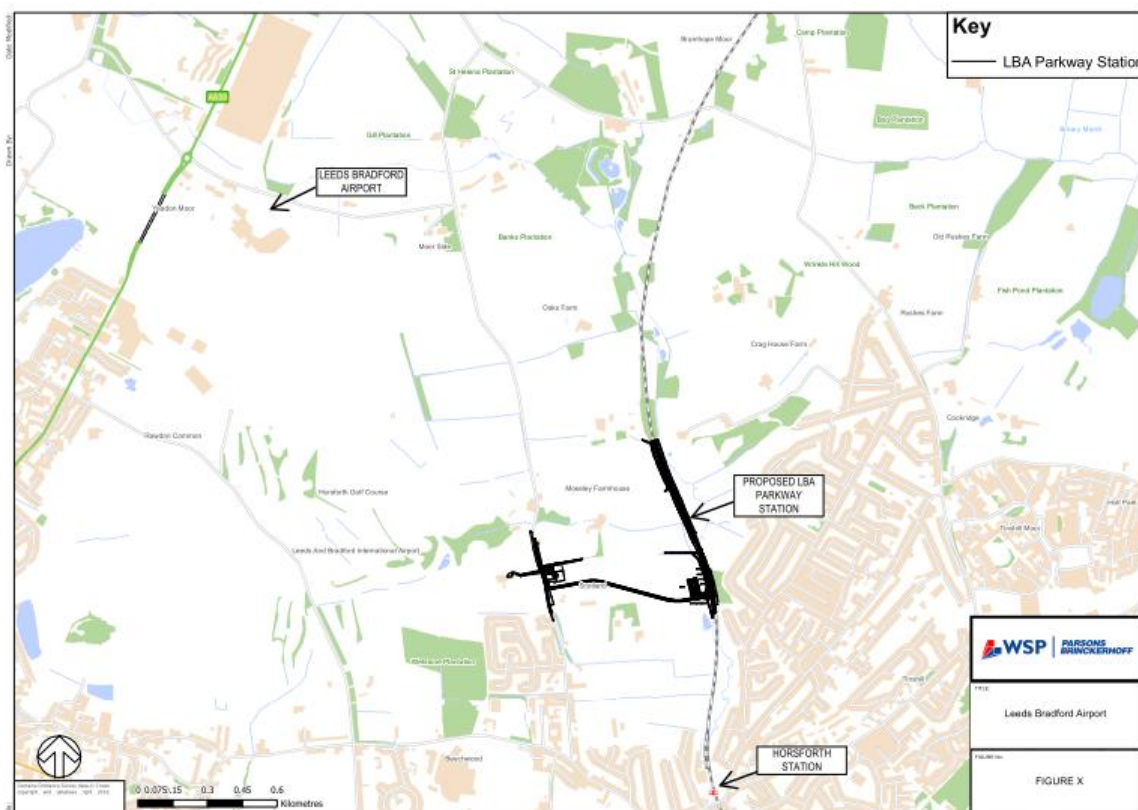


Figure 12 - Gradient Profile for Horsforth Route Option 3

- 5.2.6 As stated above, the theoretical maximums that technologies have been known to operate at are 1:25 for heavy rail (but less for current design standards) and 1:10 for light rail. It is unlikely that it would be practical to deliver or operate a heavy rail line at a sustained gradient any greater than 1:37 (2.65%) – this being the most severe sustained incline on the current UK rail network. All of the route options being considered exceed this gradient over significant sections, despite proposed alignments being set out in such a way as to reduce the extent of the gradient as far as possible. The detailed data for the gradient profiles is included in a separate technical appendix.
- 5.2.7 For light rail, gradients of up to 1:15 are achievable, and 1:10 under certain circumstances, but in general are used for shorter stretches or climbs rather than for prolonged uphill sections. Where more extensive gradients have been incorporated, such as at Netherthorpe and Norfolk Park on the Sheffield Supertram route, the units used on the route have been designed and manufactured specifically to be able to cope with climbing and have additional braking and driving axles. This additional mechanical capability results in a heavier weight design and additional costs both in terms of initial capital outlay and also in terms of longer term maintenance liabilities.
- 5.2.8 It should also be noted that gradients on a curve result in greater resistance with the gradient effectively acting at a steeper level than it would do on a straight section. This effect may only be marginal, but on more severe gradients or curves, could be a defining factor.
- 5.2.9 The majority of the route options on the eastern side of the airport (towards Horsforth) are at the highest gradient of any light rail system in the UK. The routes on the western side of the airport (towards Bradford) involve gradient profiles which are in excess of any current UK light rail system and which climb for a significant distance. Both of these issues introduce specific technical and operational challenges.

### 5.3 NEW RAIL STATION

- 5.3.1 In addition to new lines and services directly onto the airport site, one option may be to introduce a new rail station as close to the airport as possible. Proposals for such an Airport Parkway station, situated between the existing Horsforth Station and the Bramhope tunnel are shown in the figure below. The station on the Harrogate line would link to the airport by way of a shuttle bus and would be located only 1km away from the airport. For outline design purposes, 150 parking spaces have been illustrated on site.



**Figure 13 - Parkway station relative to airport and Horsforth railway station**

- 5.3.2 In addition to highway links onto Scotland Lane to serve the airport, there is potential to provide a highway or pedestrian link into the Parkway station from the nearby communities of Tinshill/Cookridge, but this would be subject to gaining an understanding of the emerging local authority planning sites and allocations for these areas as some of the land that would be required may be allocated for housing.
- 5.3.3 Subject to more detailed assessment of operational feasibility and rail engineering constraints, there appears to be sufficient land available to accommodate the required platform length and highway access arrangements, subject to land acquisition. The highway network adjacent to the station site, particularly Scotland Lane, would need improvement and may be unsuitable for the higher flows of traffic generated by a station with car parking. This would need further investigation when the future of the proposed link road is more defined.
- 5.3.4 An initial assessment using RailSys rail performance software, indicates that the penalty for stopping a train at an additional station at this location, including dwell time of 60 seconds for airport passengers with luggage, would be around 97 seconds (using a Class 158 as a performance measure) which would be rounded up to 120 seconds (2 minutes). With electric traction, the penalty may be slightly greater due to a loss of speed advantage through the additional stop.

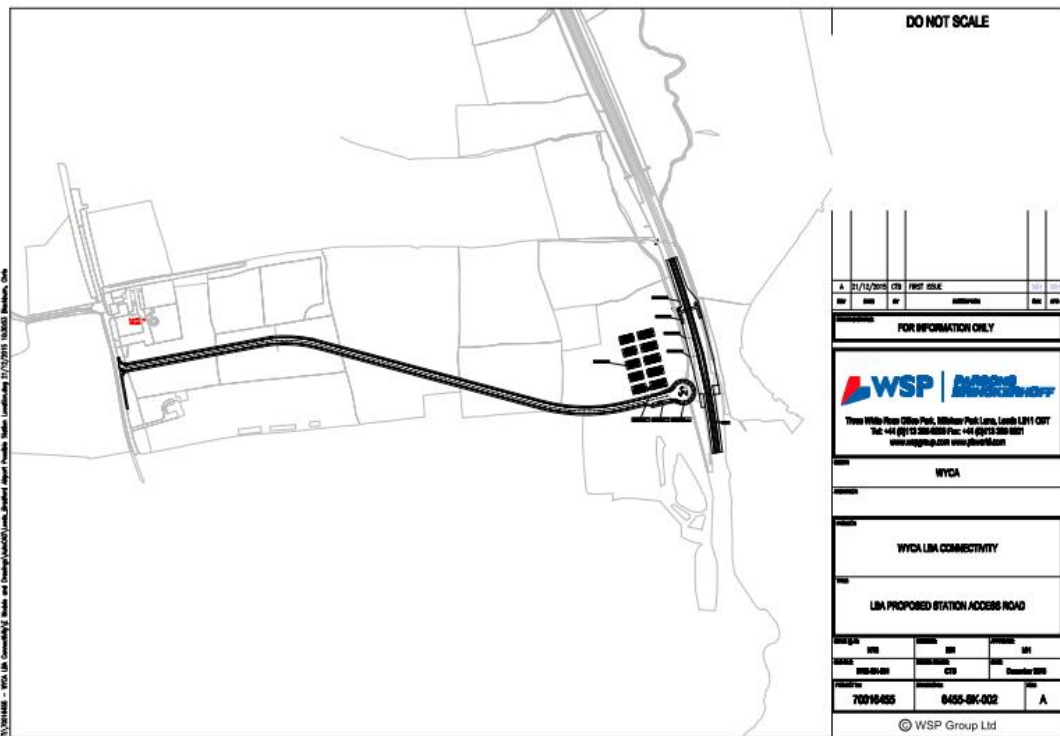


Figure 14 - Possible Station Location and Connection to Scotland Lane

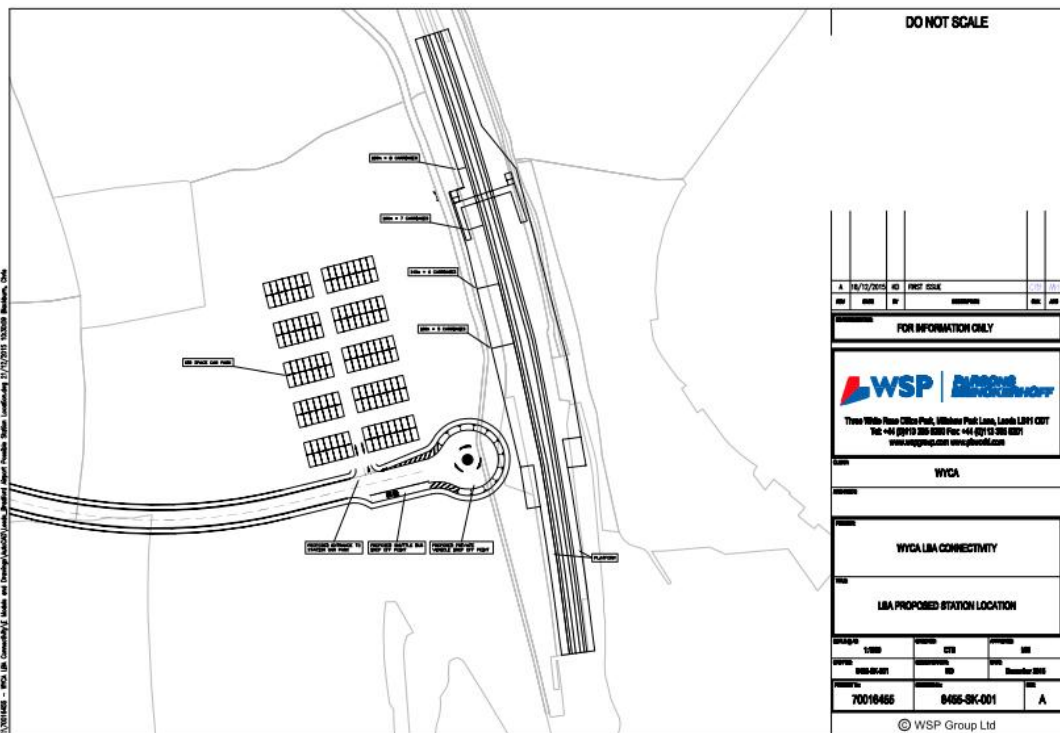


Figure 15 - Possible Station Location and Illustrative Car Park/Drop off Areas

5.3.5 The likely cost of delivering such a station at this location would be between £8-10m, excluding highway works, but not including any further rail operational costs needed to accommodate the station (such as signalling or telecoms changes). The total cost is estimated to be £12-15m.

- 5.3.6 Of relevance in considering the delivery of the Parkway station, is the interface with the proposed link road and Scotland Lane. As yet, it is unclear as to how the two routes would intersect, but it is apparent that there may need to be a structural solution in terms of bridging or tunnelling if 'at grade' junctions are not provided.

## 5.4 STAKEHOLDER VIEWS

- 5.4.1 To inform this study the former Stakeholder Reference Group (SRG) from the previous study was reformed. Meetings with the stakeholders were held on 2<sup>nd</sup> December 2015 (Senior Officer Group meeting) and 8<sup>th</sup> December 2015 (Stakeholder Reference Group). At these meetings, the long list of options along with the study methodology and findings so far were discussed. Stakeholders were given the opportunity to comment on the progress so far and also to suggest any further options that might not yet be considered. Comments at each group were as follows:

### COMMENTS/KEY ISSUES RAISED AT SENIOR OFFICER GROUP

COMMENT	WHO	RESPONSE (WYCA/WSP   PB)
Highlighted issues around Kirkstall Road and how this would struggle to accommodate some of the options, most notable on road running of light rail/tram train due to limited highway capacity.	LBA Consultative Committee	Agreed that highway capacity constraints could be a significant barrier to some solutions.
The capacity constraints at Leeds Station and the role of HS2 and its potential impact were highlighted.	WYCA	Agreed that the potential for space to be freed up in Leeds Station would be beneficial in terms of any heavy rail connectivity. This would be noted in the report.
Key consideration needs to be where the economic growth is coming from and what is generating traffic. It currently isn't clear whether the growth is being driven by increased tourist passenger growth, or growth in the business travel market, or whether the aspiration is more around the growth of the airport as a business hub in itself.	WSP PB	Agreed. Breakdown of demand to be included as part of this study.
Staff travel might also be a relevant consideration. Dependant on the source of the growth, the geographical base for these target markets may vary.	NYCC	Agreed. Again, this will be included as a breakdown of demand.
Not aware of a study that shows any large economic benefits of a leisure airport. In general, seeking to promote generation of additional aviation carbon without a strong business case is troubling. With the development of HS2/HS3 and northern powerhouse into/out of Leeds city centre isn't this going to make Manchester airport even more of an attractive option?	FoE	The process of assessing each option must be undertaken, to ensure robustness of any future decision-making. This is not an economic study, per se.
Transport Select Committee had set out that in the case of London Heathrow Airport expansion, the costs of necessary surface access improvements should be borne by the airport. The opportunity cost of this scheme should be considered through this process.	FoE	Agreed that all funding options must be fully explored.
Request for a link from Menston be considered in addition to the link from Guiseley.	CBMDC	Agreed that this will be considered in proposals.
Local Member had suggested that there was a site at Calverley which could be used as a location for a station.	WYCA	WYCA to check whether this has been or could be part of the new station study process. WSP PB reported that links from Calverley would be challenging due to topography and gradient.

Northern Rail franchise from 2017 shows a link between Bradford and Manchester airport. The Virgin East Coast franchise shows a link between Bradford Forster Square to London from 2017.	WYCA	Noted. This could have an impact on resulting demand for LBA.
Bradford Council recognises the strategic importance of both LBA and Manchester Airport and see the two sites complementing rather than detracting from each other.	CBMDC	Noted.
Important to consider how people travelling from York and the east of the airport make their journeys.	WYG (LBA)	Noted. The option for an airport parkway station on Harrogate line would help to support journeys from this area.
Question as to whether there is a link to HS2 in terms of site allocations and business development.	LCC	All agreed that HS2 has significant potential to change the way in which people travel to the airport and around the area in general.

**Table 8 - Summary of Senior Officer Group Comments**

#### COMMENTS/KEY ISSUES RAISED AT STAKEHOLDER GROUP

LEVEL OF IMPROVEMENT NEEDED	FUNDING SOURCES	INTERVENTION REQUIRED
Connectivity city centre to airport	Airport	Parkway station – is it being considered?
Seamless travel	Private sectors	Park and ride option
Journey time reliability	Northern/TransPennine franchises	NGT – more flexible
High frequency (15 mins?) and rapid journey time (20 mins from Leeds centre.)	Harrogate Chamber of Commerce	Facilitate growth – integration with HS2/HS3 – create the right conditions for growth to happen
Is predictability of journey times and integrated network (ticketing and physical links) more important than actual reductions in journey times?	Devolution – local growth funding/lobbying – needs to be clear guidance on where this sits in the list of priorities	Ensuring that we understand the potential market
Role of LBIA as a regional hub		Effecting a modal shift
		Accessibility analysis
		Maximum number of interchanges people will make
		Better connectivity for businesses in the city centre

**Table 9 - Summary of Stakeholder Working Group Comments**

- 5.4.2 From these comments, and other lobbying comments received as part of the study process, it appears there is no clear scheme preference, and no clear conditional outputs that can be defined to inform scheme selection at this stage. There does however appear to be a consensus amongst stakeholders that seamless journeys and consistent, reliable journey times are important.
- 5.4.3 What is also clear is that any scheme that is taken forward must be clearly linked to future needs and demand, be this market based or geographic, and be supportive of economic growth. This is, to some extent, still undefined because of the stage of development of surrounding land use plans and the airport Masterplan itself and the varied origins and destinations of passengers.

5.4.4 However, as noted in section 2.3 previously, the Leeds Local Plan SAP and Core Strategy set out the employment and housing sites to be brought forward during the lifetime of the plan. These recognise the high level of housing growth in the district and also the aspirations of LBA to develop a c.58 hectare Commercial Hub adjacent to LBA.

## 5.5 ADDITIONAL OPTIONS

5.5.1 In stakeholder meetings an option of a fixed link from Menston was suggested. This was considered and the further alignment shown in green on the figure below was developed:

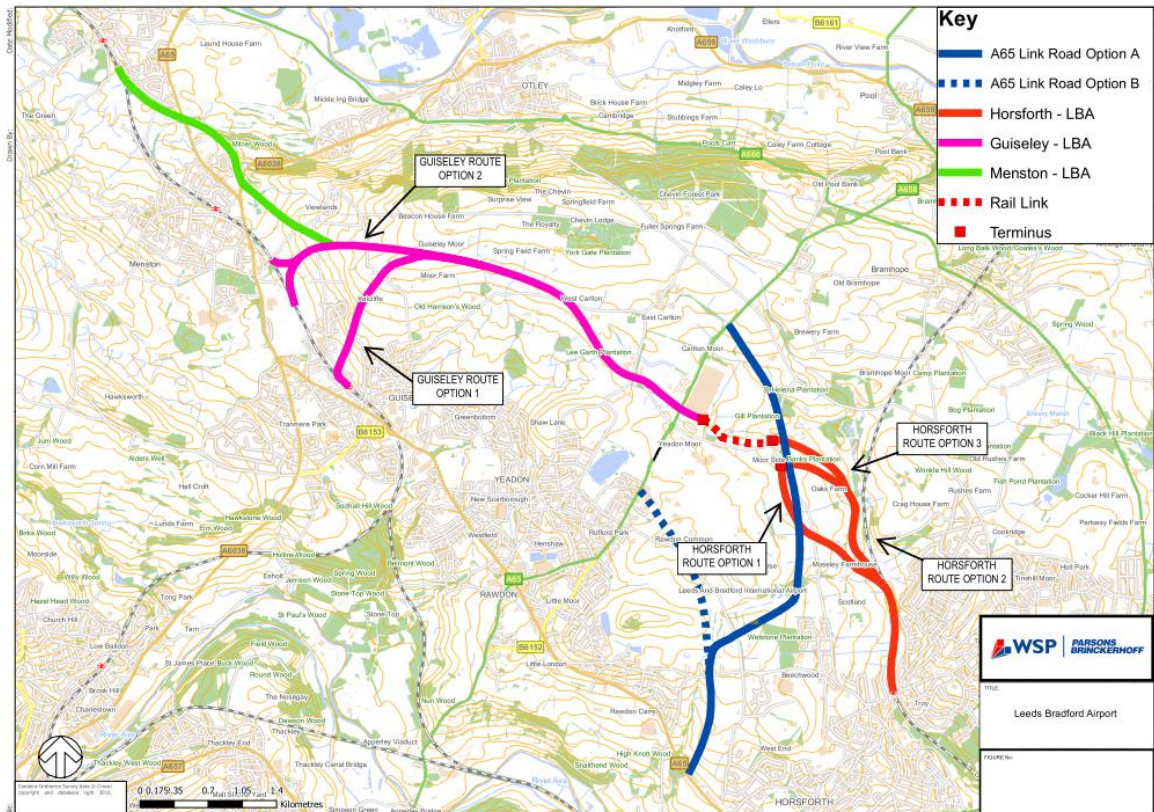


Figure 16 - Possible fixed link route from Menston

5.5.2 There are some notable constraints with regards to this route, in particular, the gradient issues which arise in Guiseley are equally evident in Menston, despite efforts to find the least steep route available.

5.5.3 There are also constraints with regards to the existing built environment in the vicinity of the proposed route. Menston is a residential area with dense housing in parts. This reduces the potential routing options available.

# 6 OUTLINE DEMAND ASSESSMENT

## 6.1 INTRODUCTION

- 6.1.1 In order to provide a more detailed assessment of future growth and potential demand for public transport, a number of components should be examined. This will provide a more realistic demand forecast than previously provided through the DfT Connectivity study, which was constrained only to airport passenger demand.
- 6.1.2 From an assessment of future development around the airport, and the wider economic aspirations of the City Region, the following build-up of demand has been assessed:
- Baseline demand (2015); Plus
  - Background growth from TEMPRO; Plus
  - Growth in airport patronage;
  - Wider changes in land use (concentrated additional housing and employment); plus
  - Airport related commercial development; Plus
  - Airport Transport hub development.
- 6.1.3 This approach is described in the following paragraphs, and summarised in Table 12 at the end of the section.

## 6.2 BASELINE DEMAND AND BACKGROUND GROWTH

- 6.2.1 Baseline demand is taken from reported airport patronage, employment numbers and modal split from CAA passenger surveys or staff travel surveys.
- 6.2.2 There has been a degree of difficulty in determining detailed future land use plans, due mainly to two of the adjacent authorities (Bradford and Harrogate) not having adopted plans, or preferred site allocations at this stage.
- 6.2.3 Expected future land use information supplied by the relevant local planning authorities has been summarised previously in section 2.3, and as this is spatially dispersed, would be expected to be picked up through TEMPRO (background) growth rates in any future appraisal, other than the expected impact of the Commercial Hub development at the airport itself, an assessment of which is included in the following sections. Consideration should be given to concentration in certain corridors however, as there is demonstrable development potential relevant to certain schemes.

## 6.3 GROWTH IN AIRPORT PATRONAGE

- 6.3.1 Current patronage at the airport stands at 3.469m (2015). DfT Aviation forecasts provide a normal and high growth scenario for the airport through to 2050 with milestone forecasts at 2030. By this point, the 'normal' growth forecast is for 6.40m passengers per annum (ppa), with the 'high' forecast set to deliver 7.1m ppa. Interpolating this growth to intermediate years provides the growth profile shown below.



Figure 17 - LBA Current and Future Passenger Growth

6.3.2 Using the current modal split targets included in the airport’s own Masterplan, these being 20% arriving by public transport by 2024 and 25% by 2030, a breakdown of likely public transport patronage can be derived from the normal growth forecasts. This accounts for patronage from passengers and airport employees.

YEAR	AIRPORT PASSENGERS	% USING PT <sup>42</sup>	NUMBER USING PT	% USING BUS ONLY	NUMBER USING BUS ONLY	EMPLOYEE NUMBERS	EMPLOYEE PT TRIPS
2015	3,469,819	14.8%	515,110	6.85%	237,525	2,700	162,000
2024	5,227,928	20%	1,045,586	12.00%	627,351	4,068	244,083
2030	6,400,000	25%	1,600,000	17.00%	1,088,000	4,980	298,805

Table 10 - Airport Modal Split and Patronage Forecasts

6.3.3 It is seen from this that demand would grow from the current level of just over 500k by public transport, to 1.04m by 2024 and 1.6m by 2030. In addition employee trips by public transport would grow from the current level of 162k to 244k and 298k respectively.

6.3.4 In addition, it is important to understand the degree to which associated economic growth around the airport is expected to increase the potential for public transport demand above that from direct airport traffic. This is shown below.

6.3.5 Adding additional services on the Leeds to Harrogate line has potential to improve the attractiveness of the line overall and therefore to increase demand. By offering additional connections and improved links to additional destinations, it is likely that demand for use of the line between Horsforth and Leeds would increase. This would be picked up in any future business case work through the use of MOIRA, the rail industry standard forecasting software.

<sup>42</sup> Public Transport includes those arriving bus buses, minibuses and coaches

## 6.4 AIRPORT RELATED COMMERCIAL DEVELOPMENT

- 6.4.1 The airport Masterplan, which has recently been updated, includes proposals for the development of an Economic Hub on land immediately around the airport. This is likely to have a contributory impact on future demand for transport to the airport, and in order to deliver growth sustainably it would be important to maximise the use of sustainable modes.
- 6.4.2 Trip generation as a result of the potential expansion of LBA, focussed on the Commercial Hub, have been calculated. The calculations used information derived from the Commercial Hub Assessment Report<sup>43</sup> alongside mode share data from Luton Airport as a comparator for Leeds Bradford Airport, due to its similar characteristics having similar levels of commercial development in the vicinity of the airport, adjacent to an urban area. This comparison is used only for the commercial development aspect, not passenger forecasting.
- 6.4.3 Figures were calculated for potential public transport trip generation based on the possible development plans for the airport and included hotel sites, a mixed use commercial centre providing accommodation for activities directly and intrinsically related to the airport - including food retail. They also included trip generation for potential staff based at businesses which would form part of the Commercial Hub.

USE TYPE	GROSS JOBS	PT MODE SPLIT (%) <sup>44</sup>	STAFF USING PT (PER DAY)	STAFF USING PT (PER ANNUM) <sup>45</sup>
Office	5,013	10	501	126,829
Industrial	1,329		133	47,445
R&D	1,188		119	42,412
Logistics	276		28	9,853
Hotel	80		8	2,920
Retail	155		16	5,534
<b>Total Annual PT Patronage</b>				<b>234,993</b>

**Table 11 - Summary of Economic Hub Demand Breakdown**

- 6.4.4 Assuming a 10% mode split by public transport, as at Luton, this generates public transport patronage of 234,993 per annum.

## 6.5 SPATIAL INFLUENCE ON DEMAND

- 6.5.1 Mapping has been undertaken using CAA data to gain a better understanding of the spatial distribution of airport passengers.
- 6.5.2 This section is redacted as it includes home postcode data

<sup>43</sup> DTZ (2014)

[http://democracy.leeds.gov.uk/\(X\(1\)S\(fkn0jfigeevz5oferbipk55\)\)/documents/s133968/LBIA%20DTZ%20Report%20-%20Growth%20Hub%20Assessment.pdf](http://democracy.leeds.gov.uk/(X(1)S(fkn0jfigeevz5oferbipk55))/documents/s133968/LBIA%20DTZ%20Report%20-%20Growth%20Hub%20Assessment.pdf)

<sup>44</sup> Mode split obtained from MSOA Luton 014, within which sits Luton Airport and the surrounding ancillary industrial/employment areas. Luton Airport benefits from bus and rail links and is situated within an urban area. As such this is considered to be a similar situation to that proposed at LBA.

<sup>45</sup> Staff per day using PT assumes all staff on site every day (Office Mon-Fri 253 days, Hotel 365 days, Other uses every day but bank holidays)

## 6.6 AIRPORT TRANSPORT HUB DEVELOPMENT

- 6.6.1 As part of the wider development of a Leeds City Region 'Metro' style network, there is an aspiration to develop the airport as a regional transport hub, widening its role beyond that as a destination alone<sup>46</sup>. If this was to be taken forward, one logical step would be to develop the role of Park and Ride at the airport, to provide the opportunity for interchange and interception of road based trips going towards Leeds and Bradford.
- 6.6.2 In order to provide an assessment of the likely potential for Park and Ride patronage, a demand forecast has been completed using a traffic interception analysis.
- 6.6.3 The process involves extracting traffic flows on adjacent highway links from the most appropriate validated transport model, in this case using the Leeds Transport Model (LTM), and defining the number of 'in scope' trips – those with a destination which could be served by a Park and Ride service. Assuming either rail or bus services to Leeds and Bradford centres, those trips with a destination within the urban centre have been selected. The process is summarised in Figure 21 below.



Figure 18 - Process for Park & Ride Demand Forecast

- 6.6.4 There are two additional issues to be resolved when considering the operation of the service; the fare levels and the method of ticketing. Both are fundamental to the successful operation of the service. This is because:
- Fare levels are linked to the generalised cost of the journey, and therefore demand for the service; and
  - The ticketing system needs to remain as simple as possible, but still provide a means of enforcing parking control at the site, and to provide a means of linking 'entitlement' to use the P&R service. This is particularly important on this service because of the site proximity to the airport and its car parks, but also has an impact on VAT charging.
- 6.6.5 At this stage however, demand has been tested using current assumed rail fares for the journey to the airport.
- 6.6.6 The high level forecast demand for 'non-airport' Park & Ride is 155 cars or 196 passengers. This equates to an annual demand of 48,648 based on an annual factor of 248 days and would be in addition to the parking space required for air passengers.

<sup>46</sup> WYCA Leeds City Region HS2 Connectivity Study. Atkins 2015

## 6.7 DEMAND CONSIDERATIONS

- 6.7.1 Consideration of CAA data in research papers<sup>47</sup>, has provided further detail on the possible factors that might influence public transport demand specifically for airport sites. Analysis of data found that in building demand cases for airports, there are a variety of relevant factors.
- **Mode:** systems which demonstrate permanence like rail, light rail, trolleybus or high quality bus rapid transit are considered to be more attractive to users, particularly visitors;
  - **Public transport service frequency can influence, and be influenced by, airport passenger numbers:** higher passenger numbers requires a higher service frequency and vice versa;
  - **Service quality:** services need to be better equipped to meet airport passenger needs i.e. able to carry large luggage, have good provision of ticketing machines etc.;
  - **Presence of a substantial number of foreign passengers in the passenger mix** appears to be a strong determinant of PT uptake. However, it is not the only relevant consideration;
  - **Foreign vs. local passengers:** foreign passengers are more likely to travel to into city centres and therefore, to use PT;
  - **Conversely, domestic passengers are more likely to have more dispersed destinations,** which may not readily lend themselves to PT use;
  - **Trip Purpose:** business passengers are often more time constrained and hence more likely to choose the quicker mode such as (rental) car or taxi;
  - **Catchment area / origin of local passengers:** often too far from nearest PT access route to airport; and
  - **Type of passenger:** budget airline passengers may be more sensitive to the cost of onward travel and therefore may be more willing to consider PT as an option over, for example, a taxi or hire car.
- 6.7.2 All of the above suggests that the number of inbound, foreign and business passengers has a strong influence on demand for passenger transport as a mode of onward travel from the airport terminal. Airports which can provide a high frequency, quality public transport option are likely to see higher passenger numbers than those which rely on using services which do not provide an enhanced level of customer service. Business customers may be more time constrained and will have a higher value of time than leisure customers, so will be more likely to be tempted by fast direct options, such as private car and direct transport links.

## 6.8 DEMAND CONCLUSIONS

- 6.8.1 Taking into account the various demand components considered as part of this assessment the overall levels of demand forecast at the airport have been calculated and are shown below:

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<sup>47</sup> Fly by bus, fly by train: identifying and quantifying the factors supporting the use of public transport in the United Kingdom for travel to and from airports, Clark, 2012.  
<http://abstracts.aetransport.org/paper/index/id/4050/confid/18>

DEMAND COMPONENT	PUBLIC TRANSPORT PATRONAGE		
	2015 BASELINE	2024 FUTURE DEMAND	2030 FUTURE DEMAND
Airport Passengers	515,110	1,045,586	1,600,000
Airport Employees	162,000	244,083	298,805
Commercial Hub Employees	0	117,496	234,993
Regional Hub (Park & Ride)	0	24,304	48,648
<b>Totals</b>	<b>677,110</b>	<b>1,431,469</b>	<b>2,182,446</b>

**Table 12 - Summary of Demand Breakdown**

- 6.8.2 The future demand figure of **2,182,446** represents total demand for public transport, dependent on the airport meeting its mode share targets, and all demand drivers (housing growth, airport development and airport passenger growth) being delivered.
- 6.8.3 As demand will be spatially distributed across the entire catchment area of the airport, only a proportion of this total demand would be attracted by a new fixed link to any of the adjacent urban centres. An illustration of how this could be broken down is as follows:
- The vast majority of the demand relates to airport passengers and employees, which is a 365-day-a-year market but with seasonal peaks. Hence the daily average would be 2.2 million / 365 = 6000 approx. daily. Assuming a peak summer day of maybe 50% above average, this would represent 9000 one way trips (with other days being lower).
  - Of the 9000 daily trips, the vast majority are airline passengers who will arrive or depart at most hours of the day. Say they arrive at the airport 0400-2200 (18h day) or leave 0900-0100 (19h day), hence an average of 9000 / 18 = 500 per hour per direction.
  - Even at a non-hub airport, aircraft tend to arrive and depart in waves ('rotations'), and the passengers follow suit. Assuming there is a peakiness to the passenger demand, allowing for peaking, and assuming the peak hour is 3 times the average, gives us 1500 trips in the peak hour in the peak direction (on a peak summer day).
  - As the CAA passenger data has demonstrated the travel market is diverse, with around 30% coming from each of Leeds and Bradford, with some passengers from other areas travelling through each of these centres. As a broad rule of thumb, it is likely that no more than 50% of all public transport passengers would come from or via Leeds using rail. Bradford performs more of a local hub function.
- 6.8.4 750 people (50% of 1,500) on 4 tram trains from Leeds in a peak hour or a peak summer day is around 190 per unit. This looks quite reasonable but (a) there may be some conservatively high assumptions, (b) off-peak numbers would of course be much lower.
- 6.8.5 450 people (30% of 1,500) from Bradford is 4-6 buses per hour at a good load factor (approaching 100%). This fits in the capacity range of such a bus service (particularly BRT). The same caveats would apply regarding assumptions and the actual profile of passenger flows.
- 6.8.6 These are intended to be illustrations of how demand could break down by time and geography, and do not represent accurate forecasts, per se. It is also worthy to note that around 0.67m of the total public transport patronage is existing use, and the introduction of a new mode would significantly impact upon trip making, abstracting from existing services.

# 7 OPTION ASSESSMENT

## 7.1 INTRODUCTION

This report has considered a variety of options for improving access to Leeds Bradford Airport. A wide range of technology options have been considered in section 4.1, also taking into account the views and suggestions of stakeholders. In addition, the topographical issues which affect the potential to implement various potential fixed link alignments have also been considered.

- 7.1.1 In order to assess each option, a variety of criteria and data sets were used, including option characteristics (technology review), route options, high level demand and scheme costs to inform the most suitable solution, and to establish those which are unlikely to be deliverable.

## 7.2 OPTION ASSESSMENT

LIGHT RAIL/TRAM TRAIN	OUTCOME OF ASSESSMENT
Link to LBA from Harrogate line, including north-facing chord	Included in detailed assessment. North facing chord unlikely to be deliverable because of topographical constraints and limits on radius. Gradients thought to be too steep to allow light rail to operate around the curve.
LRT along A65 and using LBA link road	Discounted because of significant cost and issues of road space reallocation along main highways. Routes are constrained and are main arterial routes and therefore very heavily used, making road space reallocation difficult.
On-street running in Leeds centre – better penetration	Outside scope of this study. Being assessed in greater detail by the LCR Metro Connectivity Study.
Onward link from LBA stop to Guiseley/Bradford	Included in detailed assessment – unlikely to be deliverable due to topography. The hills around Guiseley are particularly steep and far exceed the accepted gradients for light or heavy rail in the UK.
Cross-Bradford Link (Bradford Forster Square to Bradford Interchange), plus Spen Valley	Outside scope of this study. Being assessed in greater detail by the LCR Metro Connectivity Study
Calverley-LBA as tram-train – use of A65 link road	Discounted because of issues of road space reallocation, and issues relating to gradient (see above).
Harrogate line conversion to (tram train) Harrogate/Knaresborough	Being undertaken as part of planned Harrogate line improvements - Being assessed in greater detail by the LCR Metro Connectivity Study
As part of a wider regional network (i.e. cross-Leeds links to AVL Leeds)	Being assessed in greater detail by the LCR Metro Connectivity Study
Ultra-light rail option from Horsforth/Harrogate line	Discounted because of gradient, low speeds and limited capacity of passenger units. Limited experience of UK operations make this a potentially high risk option.
HEAVY RAIL	OUTCOME OF ASSESSMENT
Spur from Harrogate line on a new alignment. Look at north-facing chord	Included in detailed assessment. Not thought to be feasible due to gradients and topography.
New station on Harrogate line – LBA Parkway	Included in detailed assessment. Considered to be deliverable.

Onward link from LBA station to Guiseley/Bradford	Included in detailed assessment. Not thought to be feasible. Gradient in this area far exceeds any known heavy rail gradient in the UK. Alternatives such as tunnelling would result in subterranean stations or costs which would prove to be unviable.
New route from Airedale/Wharfedale line in Calverley area	Discounted due to issues relating to topography and gradient. As above.
Potential link northwards to provide a Bradford – Harrogate – York corridor	North facing chord unlikely to be deliverable because of topographical constraints. As above
Onward link from LBA to Menston.	Discounted due to issues relating to topography and gradient. As above.
<b>ROAD AND BUS BASED</b>	<b>OUTCOME OF ASSESSMENT</b>
NGT as an A65-LBA link road option	Discounted at this stage as Tram Train appears to provide a more effective solution when considering direct connectivity.
NGT as an extension to north route from Holt Park	Technology aspects considered as part of the technology review. Also being considered as part of the LCR Metro Connectivity study. Generalised journey time is relatively favourable. Would form part of an extension to the proposed NGT core network.
NGT as route serving Bradford	Technology aspects considered as part of the technology review. Could form a future conversion of the existing bus service and an alternative to rail..
Shuttle bus from local rail stations – Horsforth, Guiseley, Apperley Bridge, Pannal – plus Parkway option	Shuttle from closest rail stations considered as part of the GJT calculations. These do not perform particularly well, due in part to the interchange penalties incurred as part of the change from train to bus and also due to the length of the journey time on the second part of the journey. Could be delivered now however with no additional infrastructure.
Introduce bus priority as part of LBA link road, plus wider A65 enhancement measures.	Included in previous study as a recommendation for inclusion in the Link Road study.
Express bus: Bradford, Halifax, York etc.	Whilst there are existing express bus services the GJT is relatively high due to the distance covered and this makes the services not as attractive as competing other options. There may be potential to increase journey speeds through routing changes in order to improve the GJT.

**Table 13 - Summary of Option Assessment**

## 7.3 OPTION SUMMARY

- 7.3.1 A summary of potential costs to deliver the options which, following outline assessment, appear to be deliverable, is shown in the table below. In terms of the delivery timescales, broadly, long term refers to a 10 years plus time horizon, medium term refers to 5-10 years and short term refers to delivery within a 5 year timescale.
- 7.3.2 These assessments have been based on experience and industry knowledge of programme capacity and delivery timescales. The build-up of demand at and around the airport over time may mean that some of the short to medium term interventions may not become financially sustainable until later years.

OPTION	DESCRIPTION	COST ESTIMATE	DELIVERY TIMESCALE
Tram Train Link to LBA from Harrogate line including station at LBA	Tram Train link from Horsforth to LBA (4.8km)	£70-£140m	Long Term (15-20 years)
Light Rail Link to LBA from including station at LBA	Light Rail LBA to Leeds (13.2km)	£180-£360m	Long Term (15-20 years)
New station on Harrogate line – Parkway station close to Bramhope Tunnel	Heavy rail station	£12-15m	Long Term (10-15 years)
NGT as route serving Bradford	NGT	£130m	Long Term (10-15 years)
NGT as an extension to north route from Holt Park	NGT	£55-60m	Medium Term (5-10 years)
Shuttle bus from local rail stations – Horsforth, Guiseley, Apperley Bridge, Pannal – plus Parkway option	Bus	£70-100k per bus per annum	Short term (0-5 years)
Express bus: Bradford, Halifax, York etc.	Bus	£160k per bus per annum	Short term (0-5 years)

**Table 14 - Summary of Potential Costs**

## 7.4 EMERGING FINDINGS

- 7.4.1 The demand forecasts built up through this study demonstrate strong growth over the 15 year period to 2030, with a total future public transport patronage of just over 2.1m passengers per annum. This would be dependent on airport passenger forecasts being reached, commercial development being delivered and occupied and mode share targets being achieved. This figure is also linked to additional Park and Ride demand, although this forms a small percentage of overall demand.
- 7.4.2 Several options to travel by express bus to LBA already exist. These are currently provided by Yorkshire Tiger on a partially commercial basis, with a level of subsidy being provided by WYCA and LBA. Express bus services from York have operated in the past, but were deregistered due to insufficient patronage. However, as noted previously, the method for calculating GJT does not take account of high forecasted traffic growth in the area around the airport, which could result in road based modes becoming less attractive over time, because of the unpredictable and variable journey times.

- 7.4.3 The new 'Parkway' station option produces a GJT which is comparable with, but slightly better than, an option of providing a shuttle bus link and Interchange point at Horsforth station. Having to interchange onto a shuttle bus brings an interchange penalty in terms of GJT (and actual inconvenience) and makes the services less attractive. There would be significant costs involved in the delivery of a new station (£12-15m) which when located on an existing rail line, would provide only minimal benefit in terms of GJT and attractiveness to passengers and also could possibly lead to abstraction from the existing stations at Horsforth and Apperley Bridge.
- 7.4.4 In terms of GJT and direct connectivity, provision of a fixed link (i.e. a fixed rail link to the LBA site) would be the most attractive solution to users. There are fundamental constraints around the ability of heavy rail to operate on gradients such as those around LBA. There are no heavy or light rail lines in the UK operating at gradients such as those that would be necessary for provision of a rail link from the western side of the airport (from Guiseley), and current rail standards would make the design of any compliant scheme very challenging and costly, because of the engineering works required.
- 7.4.5 There is greater potential for a link from the eastern side (from Horsforth), but even this would be technically challenging and very costly to deliver due to the significant gradients on that side of the site. Light rail or tram train is likely to be the only feasible option for this route. The business case and value for money case will need to consider the relative revenue and cost implications of each option.

## 8 CONCLUSIONS

- 8.1.1 This study was commissioned with a view to establishing and understanding the latest evidence and policy relating to improving access to Leeds Bradford Airport. This has been undertaken as a follow on to the 2014 DfT study and also with a view to assessing the demand that might be generated as a result of passenger growth and the creation of a Commercial Hub at LBA.
- 8.1.2 The study has considered a variety of options for improved access to the airport and assessed their potential in terms of technological and operational aspects, infrastructure delivery issues and likely demand. In addition, local conditions such as the planning policy framework and aspirations for growth have been considered.
- 8.1.3 Whilst local spatial policies note the role of the airport, there is little suggestion of how improved access to the site might be delivered. Currently there are no clear mechanisms proposed to provide funding for improvements to surface access to LBA. However, there are a variety of mechanisms which could potentially provide funding for the improvements noted above, including planning gain, business rate retention, central government funding, or more innovative funding sources made available through devolved decision making. Some options may only become available, or deliverable, with a locally elected mayor.
- 8.1.4 Stakeholder involvement to date has not expressed preference for any particular mode/option. However, stakeholders have repeatedly stated the need for a travel option which is integrated and reliable. Consensus amongst stakeholders will be important in taking forward an integrated package of surface access improvements, because of the multi-authority nature of all schemes, and the level of funding involved.
- 8.1.5 A fixed link (rail) service provides the most attractive option in terms of generalised journey time. It also provides the greatest potential for reliability and direct connectivity. Heavy and light rail derivatives offer the greatest potential to provide the capacity and frequency (in terms of fixed link options) and integration into the existing rail network.
- 8.1.6 It is unlikely that the delivery of a heavy rail solution would be feasible in view of the gradients involved in the vicinity of the airport, and there are currently no heavy rail links in the UK which operate on gradients as steep as those around LBA. It is likely that these issues would make delivery of a heavy rail link very challenging and too costly to be viable.
- 8.1.7 The most viable option for a fixed link would therefore appear to be based on light rail and tram train technologies. Light rail is able to operate on steeper gradients than heavy rail and therefore offers options in terms of delivery of a link to LBA. Our consideration is that the gradients on the western side of the airport would make delivery of light rail towards Bradford very challenging. Gradients to the east of the airport are slightly less steep and therefore offer potential for a light rail or Tram Train link towards the existing Harrogate Line via Horsforth.
- 8.1.8 Where light rail technologies are not viable, due to gradient or technological constraints, NGT or some form of BRT might offer a potential solution.
- 8.1.9 When estimating future demand, the likely flow and profile of demand to the airport and surrounding development appears to be in the range that would require light rail or high frequency BRT services, considering the nature of peak demand (seasonal and daily).
- 8.1.10 Bus services currently operate to the airport from a number of local centres, some with a degree of financial subsidy. Increasing patronage at the airport, and further associated commercial development would be likely to improve viability for these services in the short term.

- 8.1.11 The introduction of the link road would reduce bus journey times from Leeds (and potentially Bradford). In the longer term however, demand at the airport is likely to result in the need for a higher capacity mode (either BRT or light rail) and increased traffic congestion may make road based options less attractive.
- 8.1.12 Any fixed link route to the east of the airport would interact with the proposed airport link road. This would also introduce technical challenges in terms of bridging or tunnelling. There is a possibility that BRT/NGT provision could be incorporated in the link road proposal. There is also opportunity to build in measures to ensure the link road scheme is future proofed should light rail / Tram Train be pursued in the future. This, however, will have cost implications (potentially on both road and rail schemes).
- 8.1.13 Because of the interaction between all transportation schemes (including existing services, with new road and rail based solutions), access to the airport must be viewed as an integrated solution, rather than a series of independent schemes. Road and rail solutions will serve different markets and deliver different benefits, and are not mutually exclusive. Any new public transport services that are introduced will have an abstractive effect on existing services, even with growth, and the impact on some of the existing local bus services must be included in any future appraisal.

## 8.2 NEXT STEPS

- 8.2.1 To inform more detailed assessment of the options shortlisted through this study, there are a selection of additional tasks, which may be beneficial in terms of providing a clearer strategy for progress:
- Ongoing stakeholder engagement to reach a preferred and integrated connectivity package;
  - Commissioning of a set of topographical and ground condition surveys to provide a better understanding of potential engineering and construction challenges;
  - More detailed assessment of likely construction costs and technical constraints; and
  - Consideration of options in the context of further development of the Leeds City Region Metro project. This will allow a better appraisal of the potential for extensions to LBA from proposed modes such as NGT and tram train as part of an integrated network.
- 8.2.1.1 In addition to technical aspects, consideration of possible funding options and methods for levering in contributions should be further investigated. This will be critical to give a better understanding of viability, value for money and deliverability.



# Appendix A

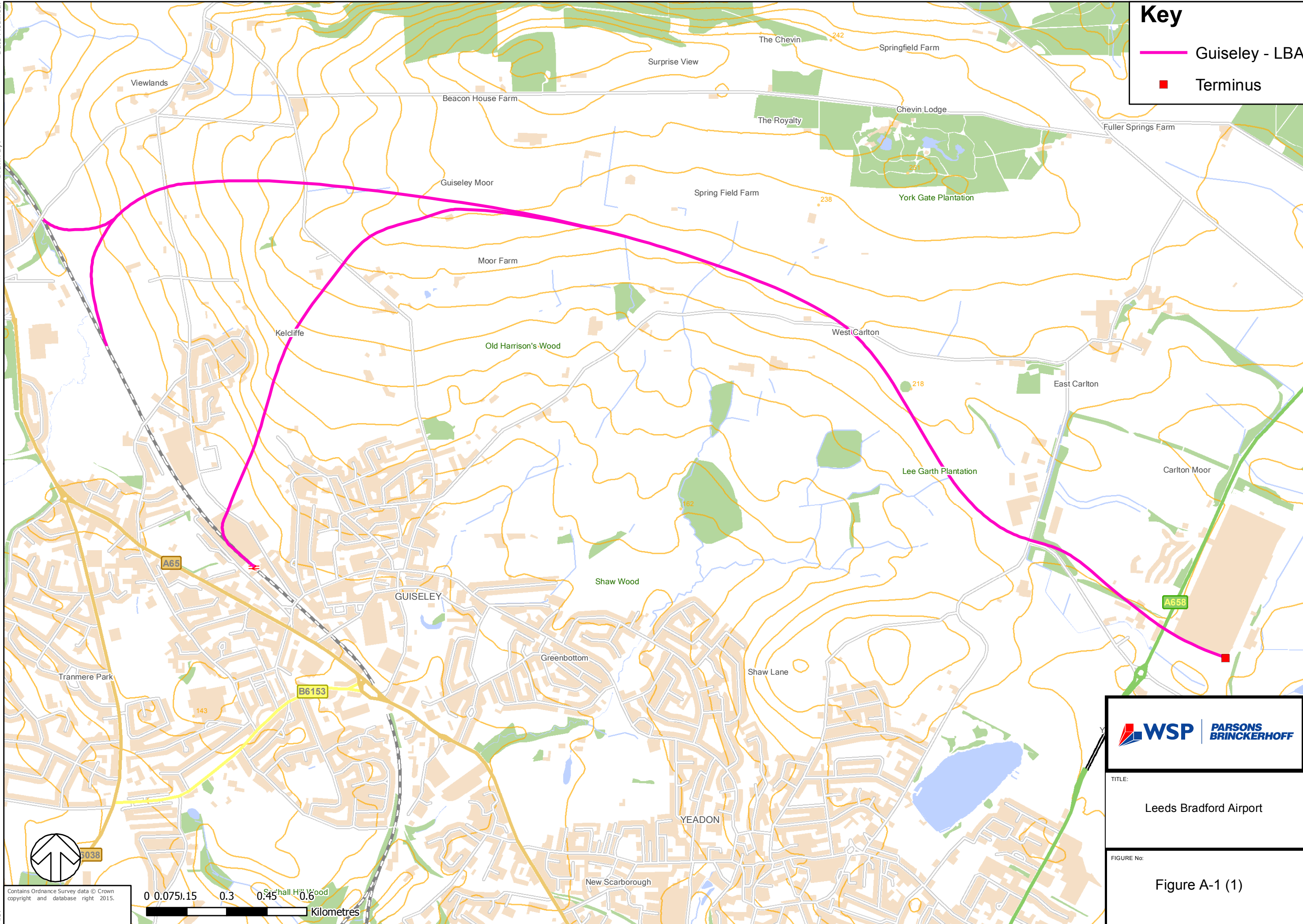
APPENDIX A-1  
**ROUTE OPTIONS**

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### Key

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-  Terminus



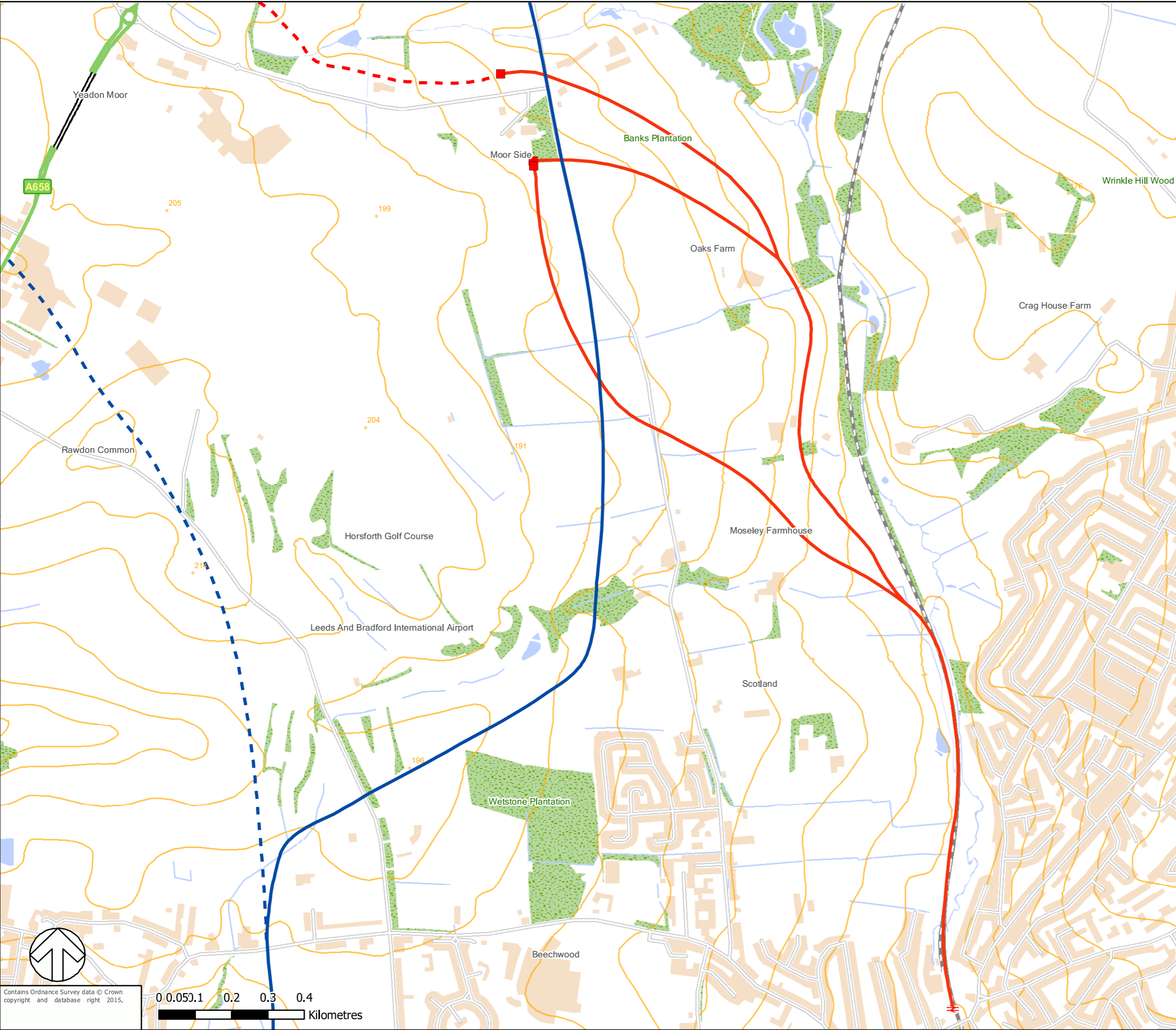
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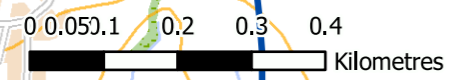
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- A65 Link Road Option A
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- Horsforth - LBA
- Rail Link
- Terminus

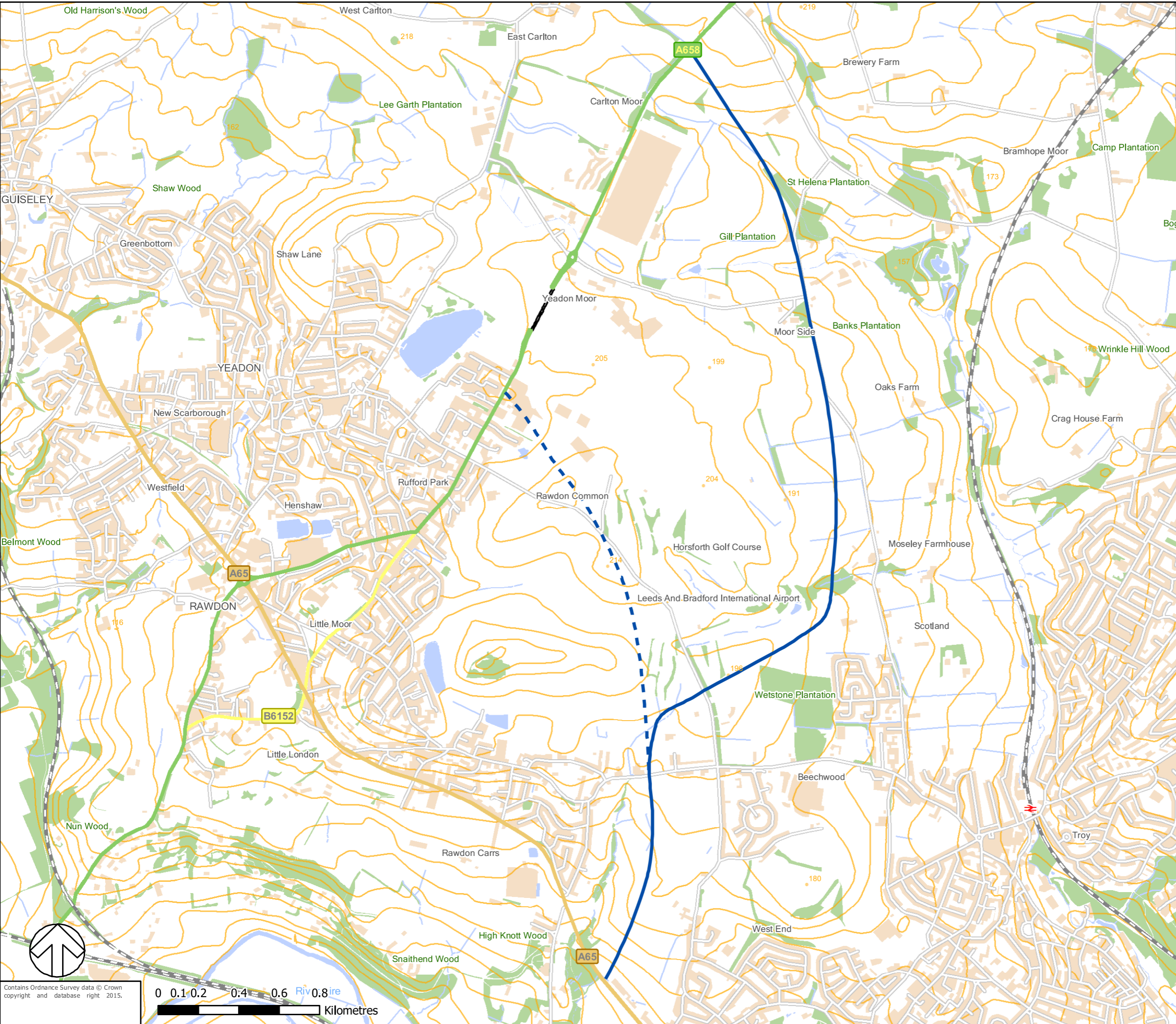
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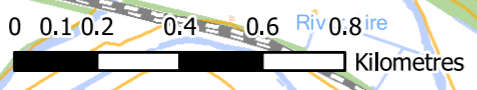
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**Key**

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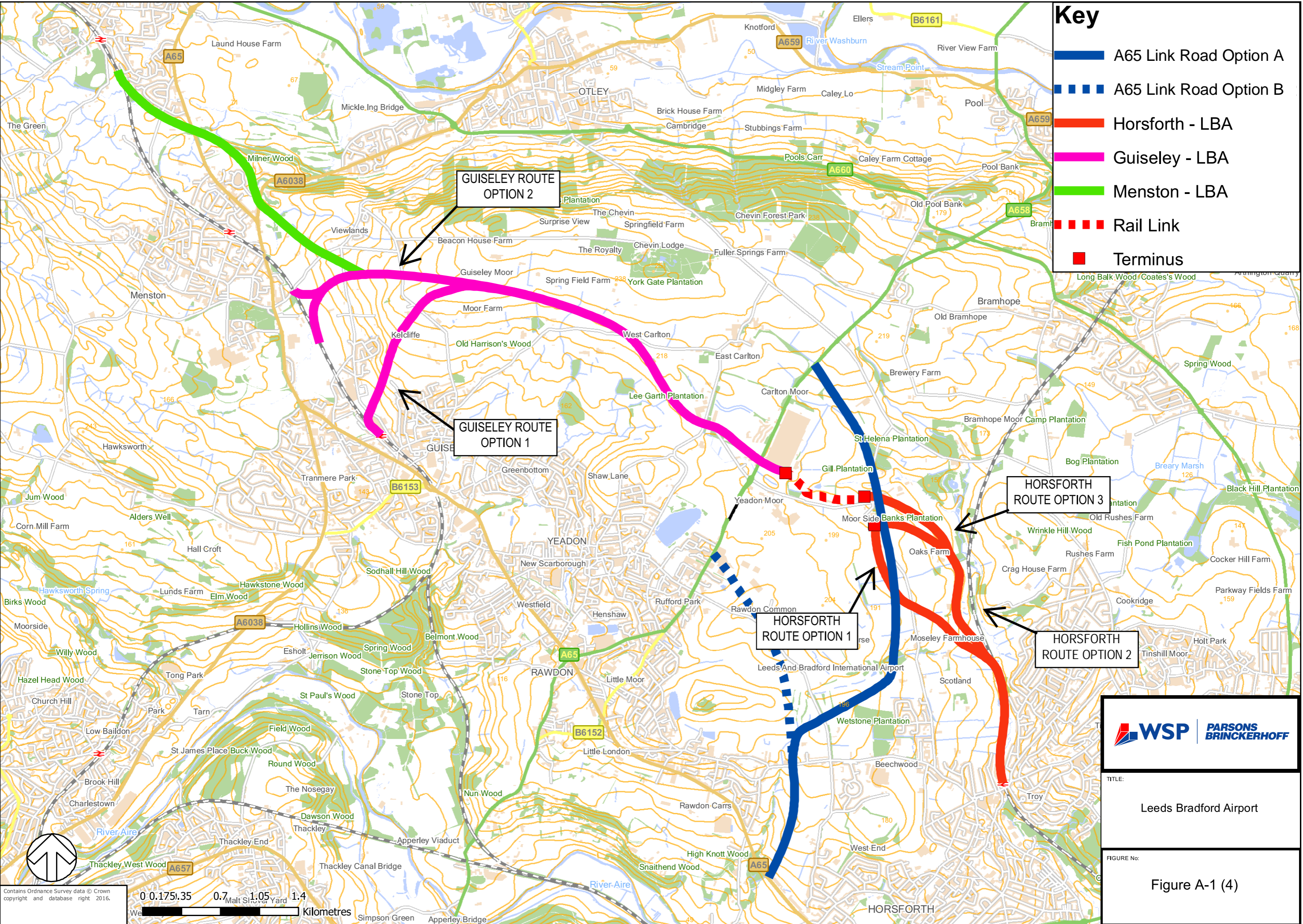
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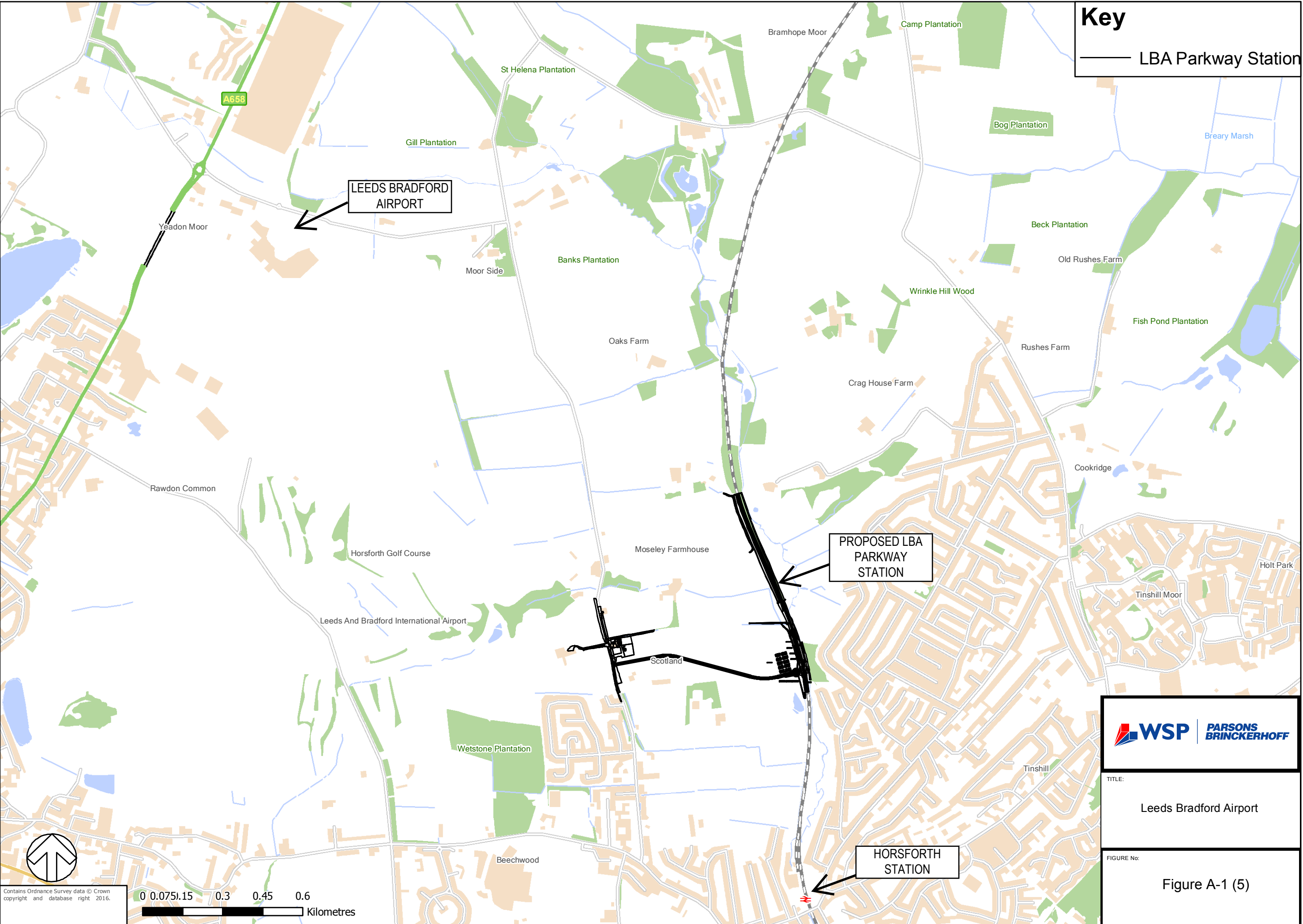
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**Key**  
—— LBA Parkway Station

**WSP** | **PARSONS BRINCKERHOFF**

TITLE:  
Leeds Bradford Airport

FIGURE No:  
Figure A-1 (5)

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Figure A-1 (6)



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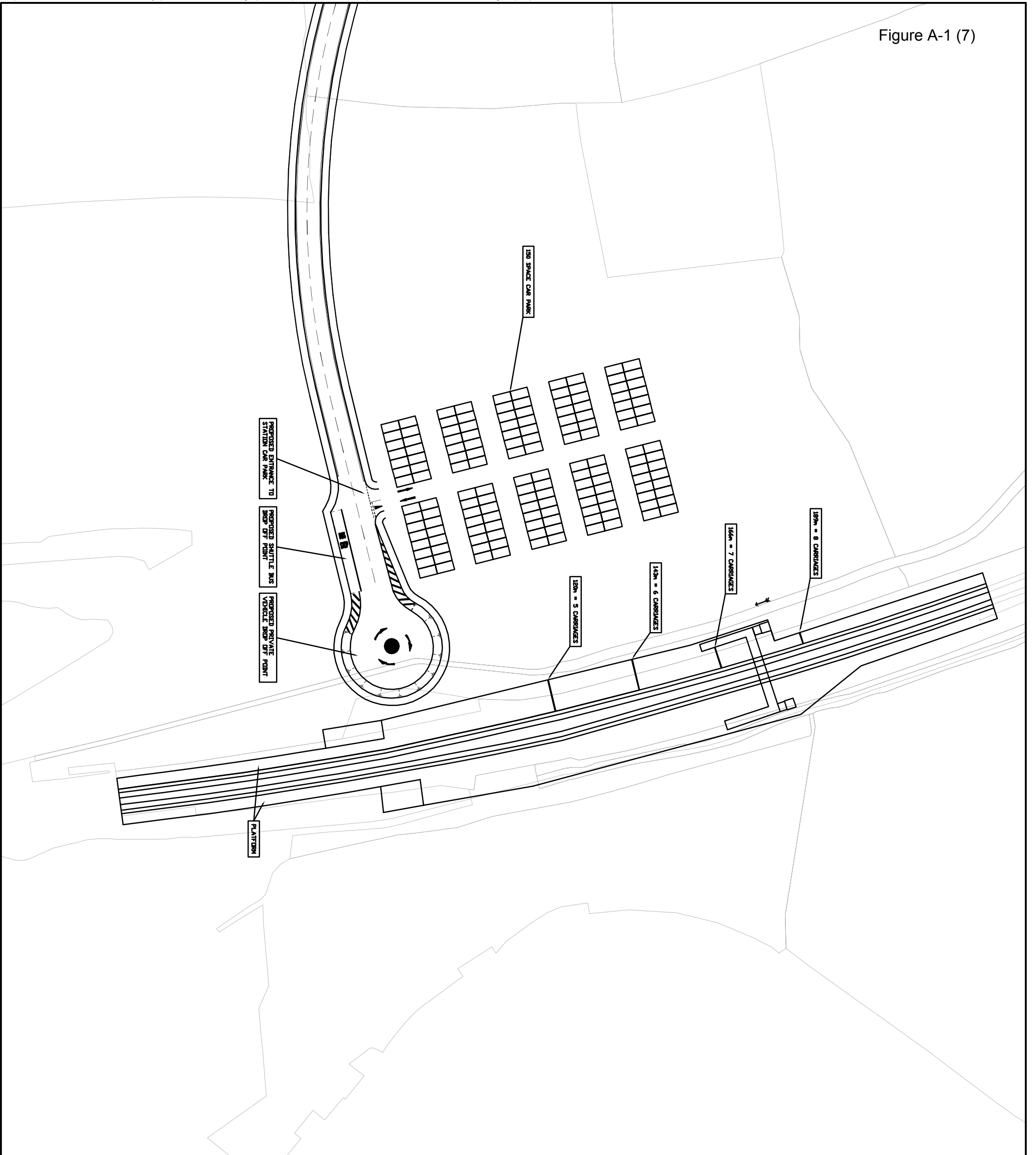
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6455-SK-001	CTB	December 2015
PROJECT No:	DRAWING No:	REV:
70016455	6455-SK-002	A

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Figure A-1 (7)



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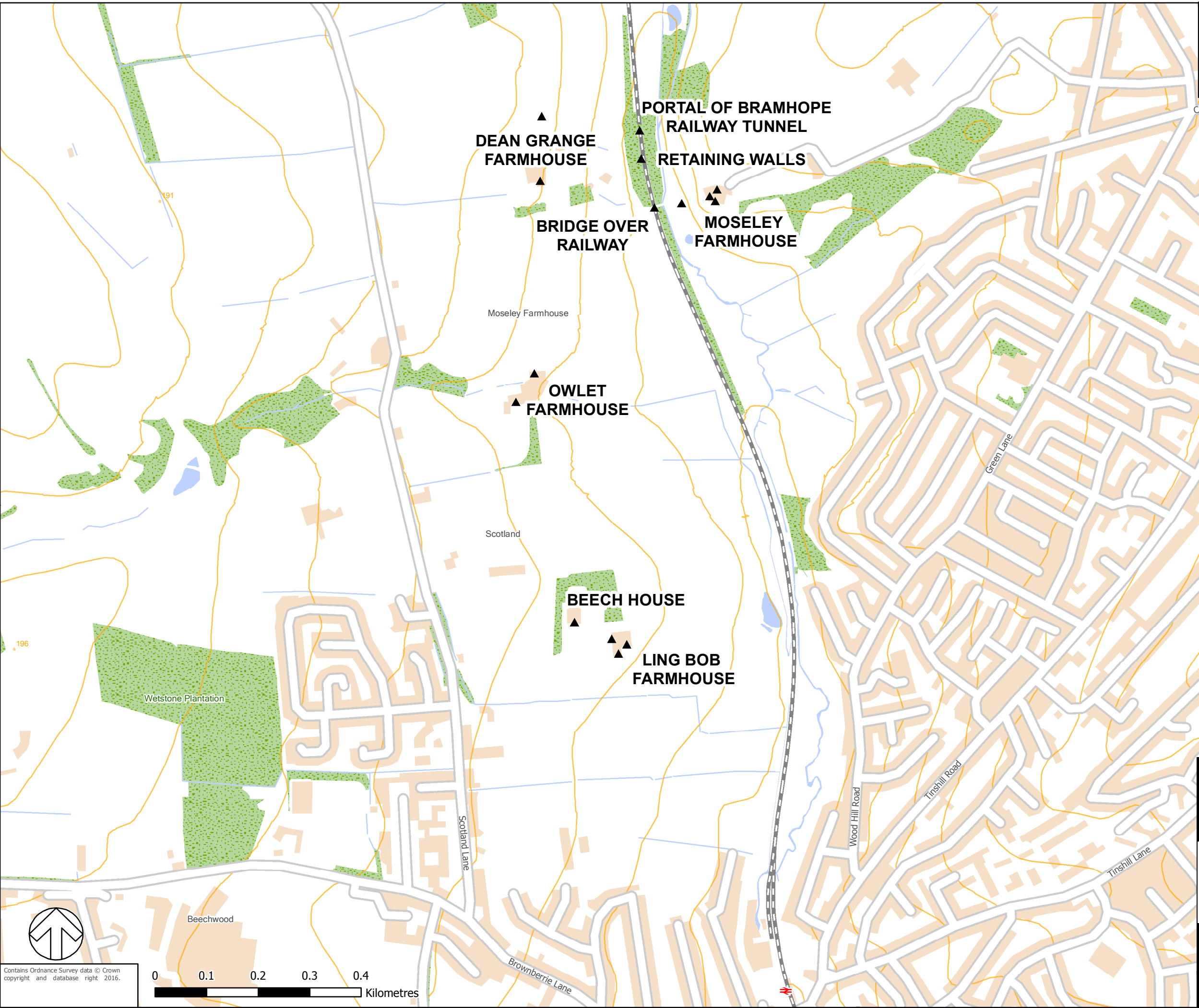
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TITLE: LBA PROPOSED STATION LOCATION

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PROJECT No:	70016455	DRAWING No:	6455-SK-001	REV:	A

**Key**

- ▲ Listed Buildings



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TITLE:  
Leeds Bradford Airport

FIGURE No:  
Figure A-1 (8)

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APPENDIX A-2  
**LBA PASSENGER ORIGIN MAPPING - REDACTED**