



 steer davis gleave

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

# Leeds City Region Metro

## Final Report

West Yorkshire Combined Authority

August 2016

---

# Executive Summary

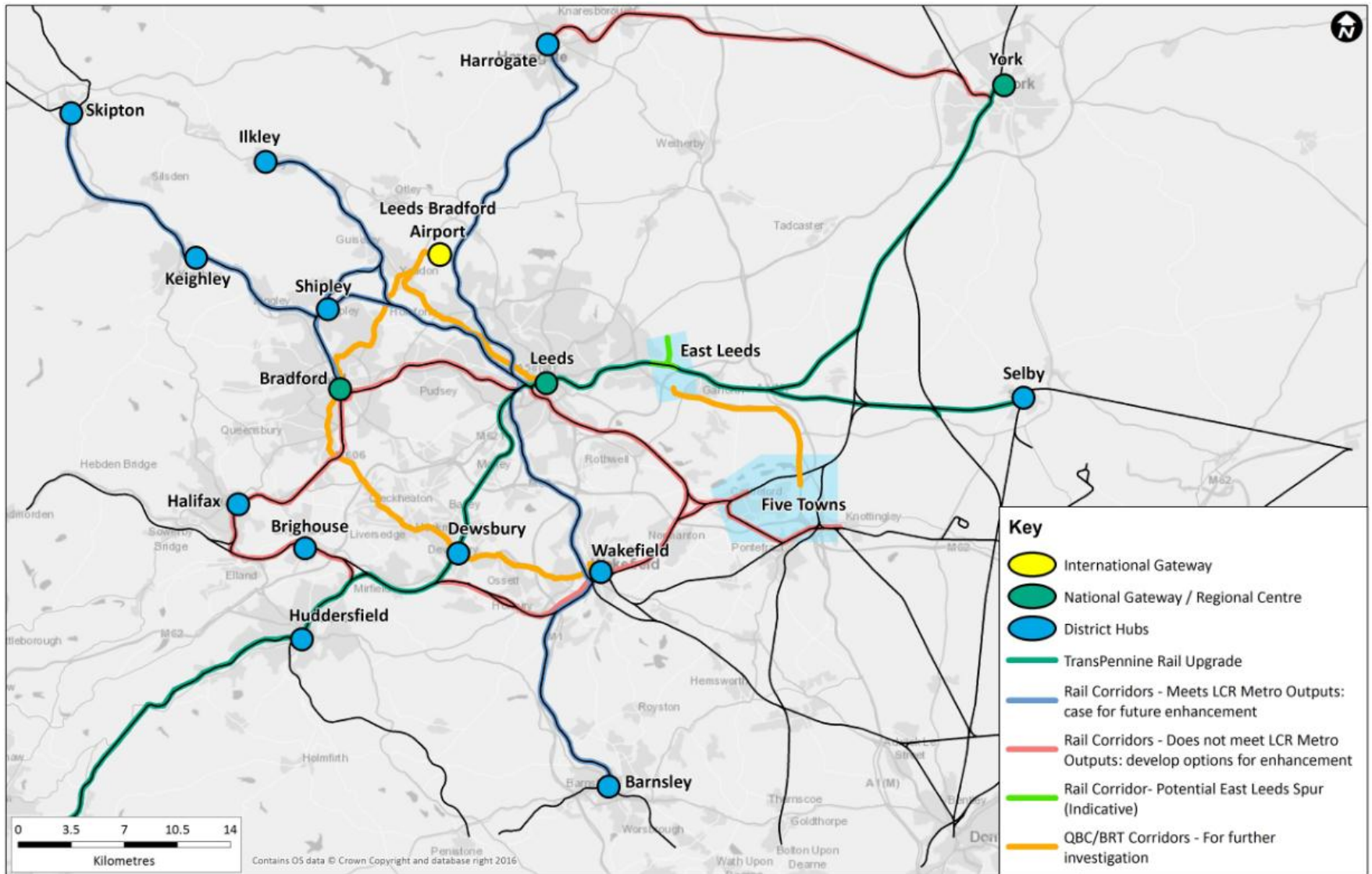
The Leeds City Region (LCR) is the largest city region economy in the North, but according to a number of economic indices its economic performance is below the English average. These measures include its productivity, as measured by GVA per head and the proportion of the workforce in the most highly skilled occupations. Economic performance within the LCR is also varied, with some areas performing markedly better than others. Improving transport connectivity within the LCR, between the LCR and the rest of the country, and internationally will support and facilitate the LCR's economic growth, as well as influence where in the LCR that growth happens and who benefits from it.

Already, significant investment is committed and planned for the LCR's transport networks. In particular, the new Northern and TransPennine Express rail franchises will lead to new trains, more frequent services and new routes. The planned Trans Pennine Route Upgrade will lead to faster and more frequent trains on the rail route serving the Manchester – Huddersfield – Leeds – Selby/York corridor. Focussed on a redeveloped Leeds station (the "Yorkshire Hub"), Northern Powerhouse Rail (NPR) will lead to further improvements to inter-regional connectivity and HS2 will support faster journeys and increase capacity between the LCR and the East and West Midlands, and to London. However and whilst welcome, these investments will not be sufficient if the LCR is to grow to meet its full economic potential. More is needed.

To support its future economic growth – and so the growth of the Northern Powerhouse – the LCR would benefit from user-friendly, fast and frequent connectivity between its principal towns and cities, and between these and economic growth areas. Collectively, these towns, cities and growth areas have been called "hubs". The LCR Metro has been identified in the West Yorkshire Transport Strategy as the way to provide hub-to-hub links. LCR Metro is not a mode of transport, nor is it a brand. Rather, using a number of modes all working together in an integrated system, it is the way that connectivity will be provided between the City Region's key hubs. It will support the strengthening and deepening of the LCR's labour markets and by providing onward connectivity, spread the benefits of NPR and HS2 across the City Region. It will complement other investments in more local transport provision.

This study has considered how the LCR Metro can be provided. It identifies a way forward. It considered how the LCR's conventional rail network could be enhanced to deliver the LCR Metro concept, along with the complementary role that can be played by Bus Rapid Transit (BRT) and Quality Bus Corridors (QBC). Each has a role to play as part of the LCR Metro. This work has also considered the potential role that new and innovative technology such as Tram-Train could play, but has concluded that on the available evidence, such approaches are unlikely to offer value for money, even if they were affordable.

# Recommended LCR Metro Network



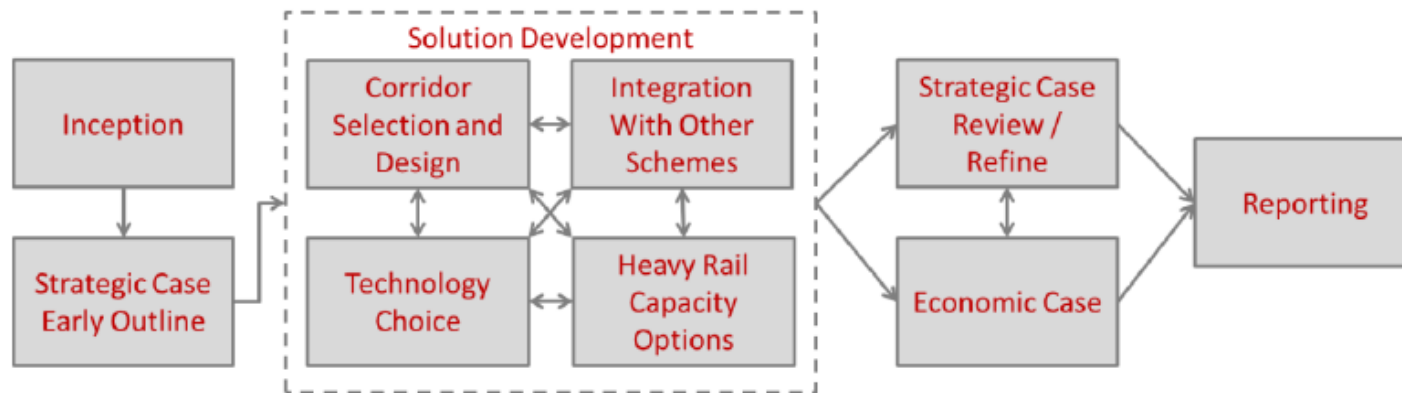


# Introduction

This is the Final Report for work undertaken by Steer Davies Gleave and WSP Parsons Brinckerhoff that has investigated the shape and form of a potential “Metro” public transport network for the Leeds City Region (LCR). As we set out later, the LCR Metro is not a mode of transport, nor is it a brand. Rather, using a number of modes all working together in an integrated system, it is the way that connectivity will be provided between the principal towns and cities, and transport hubs in the City Region.

Our approach to the work is shown in the figure below. First, we considered the need for intervention – what are the current and future transport needs of the City Region and to what extent do its existing and committed future transport networks meet this need. This showed that connectivity between towns and cities falls short of the City Region’s current and future economic needs. We then went on to consider alternative ways that these needs could be met. We looked at the different modes of transport that could potentially form part of the LCR Metro. As well as looking at the current rail network, we considered the potential role of new modes. We looked at the corridors that connect the City Region’s towns and cities and considered how the connectivity between them could be enhanced. In a way appropriate to the pre-feasibility nature of this work, we then looked at the economic case for intervention. In this Final Report we provide an overview of this work, with more detail provided in a series of companion Technical Notes.

We conclude this Final Report with our recommendations on the way forward.



# Transport and the Leeds City Region Economy

For many years the Northern economy has underperformed. It has not grown as fast as the rest of the country. The North has a smaller proportion of its population in work and those in work produce less than the rest of the country. The goal for the Northern Powerhouse is to grow the North's economy by getting more people into employment and to make those in work more productive.

Enhanced connectivity through an improved transport offer has been identified as one measure that can support the realisation of the Northern Powerhouse.

Outside of London and the South East, the Leeds City Region (LCR) is the largest of all the Local Enterprise Partnerships (LEPs) when measured by economic output. As the LCR is the largest city region economy in the North, it has the scale to make material contributions to the economic growth that the Northern Powerhouse is striving to deliver. Because of this, the future success of the Northern Powerhouse and the future success of the LCR are synonymous.

However, according to a number of economic indices, the performance of the LCR is below the English average. These include its productivity, as measured by GVA per head and the proportion of the workforce in the most highly skilled occupations. Economic performance within the LCR is also varied, with some areas performing markedly better than others.

In terms of the economic future of the LCR, the Local Enterprise Partnership (LEP) aims to achieve **“not only growth, but good growth”**. Good growth is defined in the Strategic Economic Plan (SEP) as being when **“a radical uplift in business competitiveness, productivity and profits goes hand in hand with good jobs that pay higher wages, and where all residents have access to opportunity and enjoy improved quality of life”**.

To achieve “good growth” the LEP has identified that the LCR will need excellent transport infrastructure to underpin connectivity and create the conditions that will facilitate innovation, trade, and that will attract skilled people and investment. To this end, transport occupies a crucial position in the LCR's Strategic Economic Plan to enable the LCR to become **“a globally recognised economy, where good growth delivers high levels of prosperity, jobs and quality of life for everyone”**.

To maximise the economic functionality of the LCR as a polycentric area and encourage investment, it has been identified that the LCR needs to provide **user-friendly, fast and frequent connectivity between its key centres**. The LCR Metro has been identified in the West Yorkshire Transport Strategy as the way to provide this.

# What is the Leeds City Region Metro (1)

To create the conditions for the Leeds City Region (LCR) economy to meet its full potential and to encourage investment, it has been identified that the LCR would benefit from user-friendly, fast and frequent connections between its key hubs – that is, the LCR’s town and city centres and its “growth hubs”, which are areas identified for major development.

In particular, the “Leeds City Region Metro” (LCR Metro) is a model of enhanced connectivity for the LCR for the period to 2043 to maximise connectivity of:

- Residents and businesses to transport gateways (national and international)
- Businesses to labour catchments
- Employees to job opportunities
- Business to business links

The LCR Metro has been identified in the West Yorkshire Transport Strategy (WYTS) as the way to provide this enhanced connectivity. Using the most appropriate mode, all operating as part of “One System” for public transport, LCR Metro is envisaged to be the way that hub-to-hub connectivity will be provided. It is a complement to the home-to-hub connectivity provided by active modes, the bus network and by car travel. In parallel, through the development of the West Yorkshire Transport Strategy proposals are being developed to enhance this complementary connectivity.

The LCR Metro is based on three principles:

- **Full integration** of public transport within LCR, including physical interchange, timetabling and ticketing
- Focus on **Door-to-Door** journeys as part of an integrated ‘One System’
- **One System** includes all levels of rail travel (including high speed), bus, cycle, walk, plus any new technologies that may be introduced

Together, these principles and the connectivity objectives ground the LCR Metro as a **mass-transit public transport system characterised by a set of outputs that lead to a need for segregation and/or priority over private road vehicles in some way.**

# What is the Leeds City Region Metro (2)

The LCR Metro is being developed to support economic growth in the LCR and make positive contributions to the wider economy through enhanced connectivity. The LCR Metro network needs to accommodate and facilitate sustainable future population growth of the LCR through providing an attractive and sustainable alternative to travel by private car. By providing enhanced connectivity to gateway stations, the LCR Metro will complement the strategic connectivity offered by HS2 and Northern Powerhouse Rail (NPR) for access to London and the East and West Midlands, and the wider North respectively.

The outputs that define the LCR Metro are:

- **Quality rolling stock** and vehicles
- **Frequencies and network capacity** to deliver capacity to meet demand
- **Reliable, punctual and resilient services**
- Timetables and timetable **integration** within rail and between rail and other modes
- **Quality Transport Hubs** and intermediate stations/stops which are fit for purpose as the entry points to the Metro and wider One System network, including their location and ease of access to them
- An **integrated ticketing strategy**
- **Journey planning** and travel information for pre-journey and throughout journeys

As part of the approach to deliver these, this study has given consideration to innovative engineering solutions and new infrastructure where existing facilities cannot be upgraded to meet the needs of the LCR Metro network. This includes an assessment of modern and innovative technology options that provide connectivity in ways that traditional conventional rail and bus solutions are unable to. This study has also examined the rail network across the LCR and considered how in the future it can contribute to the LCR Metro concept.



# Leeds City Region Metro – Potential Modes

As part of this work a comprehensive review of available technology and modal options was undertaken. This concluded that there are a number of transport modes that should be considered when thinking about a future LCR Metro system. These are: **conventional rail**, **tram-train** and conventional bus as part of **Bus Rapid Transit (BRT)** or **Quality Bus Corridors (QBC)**. Consideration was given to other modes such as: hybrid light rail; personal rapid transit; ultra-light rail; battery powered rail; monorail ; and, maglev. However, these were all dismissed because they were deemed unsuitable for mass transit, or unproven and so too high risk and/or too expensive. Here we describe the headline characteristics of the modes considered by this study. (We also consider tram/light rail, but as no potential LCR Metro corridors were identified as suitable for tram/light rail, while considered in a Technical Note it is not described further here.)

## Conventional Rail

- Extensive network serving much of LCR. Committed enhancements
- Segregated system
- Very high capacity vehicles operated at medium frequency.
- Modern vehicles are high quality – can be diesel or electrically powered
- Station spacing and operating speeds means well suited to longer distance journeys in the City Region
- Route capacity a complex function of mix of types of rolling stock, stopping patterns, signalling and alignment. Can increase capacity with longer trains.
- Vehicles and infrastructure are expensive to build and operate
- Clear operating models



## Tram-train

- Operation in France and Germany. Trial operation soon in South Yorkshire (Sheffield – Rotherham)
- Can operate as conventional rail, on own segregated alignment, or with traffic on-street
- Can penetrate town and city centres
- Medium capacity vehicles
- High quality vehicles, but with high proportion of maximum load anticipated to stand – usually electrically powered, but some systems have diesel/electric bi-mode vehicles
- Maximum operating speeds slower than conventional rail. Suited to medium to longer distance journeys in City Region
- Vehicles and infrastructure are expensive to build and operate
- Novel and potentially complex operating models



# Leeds City Region Metro – Potential Modes

## Bus Rapid Transit

- Several UK systems with BRT features
- Can operate with traffic, using on-street bus priority or on dedicated alignments (potentially with guidance)
- Can penetrate town and city centres
- Can share stops with existing bus services, or have dedicated stops
- Lower capacity vehicles – can be single deck, double deck or articulated
- Modern vehicles can provide high quality, but typically not perceived as attractive by customers as rail-based systems
- Diesel powered or hybrid drive trains. Stored energy (e.g. battery, super capacitor) being introduced
- Operating speeds dependent on priority and stop spacing. Well suited to short to medium journeys
- Lower cost vehicles and infrastructure
- While access to dedicated alignments can be limited, would currently operate in deregulated environment



## Quality Bus Corridors

- Applications across UK
- Can operate with traffic or using on-street bus priority
- Can penetrate town and city centres
- Potentially higher quality shelters
- Typically implemented on a corridor wide basis. Can have dedicated branding.
- Lower capacity vehicles – can be single deck, double deck or articulated
- Modern vehicles can provide high quality, but typically not perceived as attractive by customers as rail-based systems
- Diesel powered or hybrid drive trains. Stored energy (e.g. battery, super capacitor) being introduced
- Operating speeds dependent on priority and stop spacing. Well suited to short journeys
- Lowest cost vehicles and lowest cost infrastructure of modes considered
- Currently would operate in deregulated environment



# Leeds City Region Metro - Gateways, Regional Centres and District Hubs

The LCR is a Functional Economic Market Area. The geography of the LCR is well defined and we have adopted this for our analysis. It includes the five districts within West Yorkshire (Bradford, Calderdale, Leeds, Kirklees, Wakefield), in addition to the adjoining districts of Craven, Harrogate and York to the north, Selby to the east and Barnsley to the south.

To help progress the development of a LCR Metro network, we have defined:

- **National and International Gateways** - locations where regular direct and fast services to other city regions in the UK are available and/or there are connections to international destinations. In the LCR these are **Leeds** and **York**, as well as **Leeds Bradford Airport**.
- **Regional Centres** - a Regional Centre has some or all the following characteristics:
  - A focus for employment, retail and other essential service provision
  - Large in terms of population and employment opportunities relative to other areas
  - A level of inbound flows greater than outbound flows to it
  - Provides regional connectivity to other internal and external (pan-northern) hubs across a range of destinations making them important nodes on the network

As well as being National and International gateways, **Leeds** and **York** are Regional Centres. **Bradford** is also a Regional Centre.

- **District Hubs** – District Hubs are the other towns and cities in the City Region that are focal points of the transport network. To these we have also added a number of locations cited for strategic employment, housing and mixed use development. The following have been defined as District Hubs: **Barnsley; Brighouse; Dewsbury; East Leeds; Five Towns; Halifax; Harrogate; Huddersfield; Ilkley; Keighley; Selby; Shipley; Skipton; Wakefield.**

The Leeds City Region



# Leeds City Region Metro - Corridors

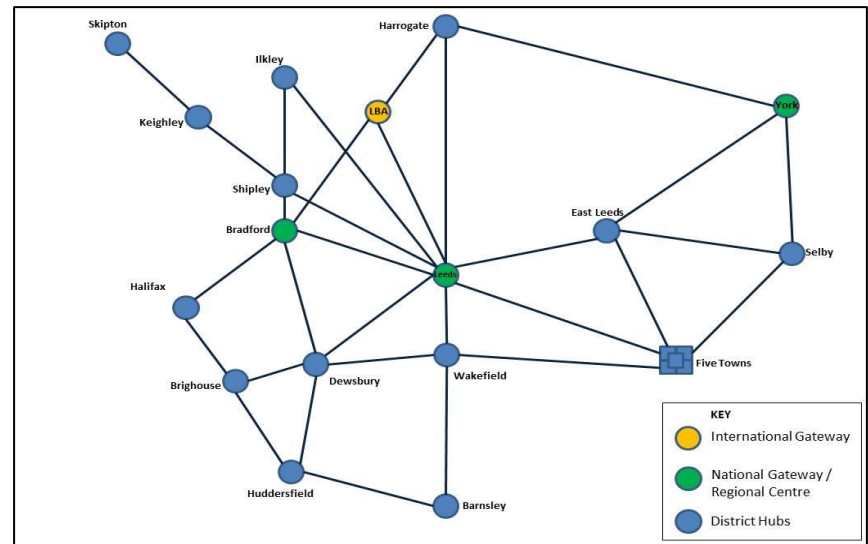
The gateways and hubs have been used to define a set of corridors. It is these corridors that have been the focus of this study, with the question being what are the public transport options for these corridors that meet the LCR Metro aspiration for enhanced connectivity between them.

A number of criteria were used to establish a desirable **minimum level of connectivity** between hubs:

- Rail travel times less than 75% of the off-peak drive time
- A minimum of 2 off-peak trains per hour between hubs.  
The nature of the LCR rail network means that this minimum standard means that many hub-to-hub movements have a higher frequency than 2 trains per hour
- Minimised rail to rail interchange times
- Consistent station quality with minimum standards
- Minimum rolling stock quality
- Adequate capacity to accommodate future demand

These minimum standards all refer to the rail network. While they have been used to assess the scale of potential benefits to be had should these outputs be delivered, they are not a set of targets per se. In due course, a detailed specification of outputs that can be delivered with an affordable and value for money case will need to be developed on a corridor-by-corridor basis as part of the implementation phase of work.

Corridors Between District Hubs, Regional Centres and National and International Gateways



Some of the corridors are not served by rail and these have been a focus of study: what are the options to serve these as part of a LCR Metro? Others are served by rail, but do not meet the minimum standards. The question is then: is rail the best way of serving these corridors, or are there alternative approaches? Even when a rail corridor does meet the minimum standards, it does not necessarily mean that current and committed service provision is adequate for a LCR Metro. In such cases enhancement options have been considered.

# Leeds City Region Metro - Potential Enhancement Options

There are a number of corridors in the LCR where conventional rail currently does not meet the minimum connectivity standards that we have set as part of this work. For these, we have investigated alternative ways of meeting the LCR Metro standard. This investigation considered all the modes that we identified as potential components of the LCR Metro and their suitability to meet potential demand different corridors, as well as engineering feasibility. Consideration was also given to how the different corridors could be operated as a network – that is operated in a way that maximises LCR-wide benefits, while seeking to minimise operating costs.

Very quickly, it was concluded that free standing light rail (tram) is not an option to meet the LCR Metro standard for any of the identified hub-to-hub corridors and that the focus should be on considering the potential roles of Tram-Train, BRT and Quality Bus Corridors, as well as enhancements to the existing rail network. This is because light rail is not well suited to meet the connectivity requirements of the particular corridors where conventional rail is not necessarily the preferred Metro solution.

To explore the case for alternative options, two broad approaches were adopted. The first looks to make best use of existing infrastructure – the road and rail network – and is therefore focussed on enhancing conventional rail and introducing Quality Bus Corridors. In the second approach new infrastructure would be provided to introduce Tram-Train or Bus Rapid Transit on some corridors, as well as more extensive enhancements to conventional rail. Importantly, neither of these two network options is put forward as a putative recommendation for what a LCR Metro should look like. Rather they have been used to allow us to explore the potential demand, revenue and benefits of different options, and hence their likely value for money.

# Leeds City Region Metro – The Role of Rail (1)

## Enhancements to Rail in the LCR are Committed and Planned

Conventional rail already provides an attractive option for travelling between many of the Leeds City Region's hubs. Over the last two decades the use of rail in the LCR has grown significantly. On-train crowding is now a significant problem. Already, through the re-franchising of the Northern and TransPennine Express franchises, capacity enhancements are committed. These include new rolling stock, higher frequency services and new routes. The planned Trans Pennine Route upgrade will bring further enhancements to the Manchester – Huddersfield – Leeds – York/Selby corridor through enhanced frequency and shorter journey times.

## Further Enhancements will Support and Facilitate Economic Growth

Strategic pan-regional documents, such as the Yorkshire Rail Network Study and Rail North's Long Term Rail Strategy, set out the important contribution that a range of further enhancements to rail services could make to the economies of the North in general, and the Leeds City Region specifically.

In addition, there are further significant enhancements planned to the City Region's rail network which will create further opportunities:

- **HS2:** Scheduled for completion in 2032/33, HS2 will provide faster journeys and greater capacity between the Leeds City Region and Sheffield City Region, the East and West Midlands and London. HS2 will serve **Leeds** and **York** directly. LCR Metro will play a central role in ensuring that the benefits of HS2 are fully felt across the City Region.
- **Northern Powerhouse Rail:** This will enhance east-west connectivity and will provide faster journeys and greater capacity for journeys to the Manchester and Liverpool City Regions, Manchester Airport, as well as to the Humber and the North East and Sheffield. NPR will also improve connectivity between Regional and District Hubs within the LCR, which will directly complement LCR Metro. As with HS2, LCR Metro will play a central role in ensuring that the benefits of NPR are fully felt across the City Region.
- **Yorkshire Hub:** A redeveloped and expanded Leeds City Station that will be a national and regional transport hub, catering for HS2 services, inter-city and inter-regional services as well as LCR Metro services, creating the opportunity for integration of high speed, classic line longer distance services and LCR-focussed services.

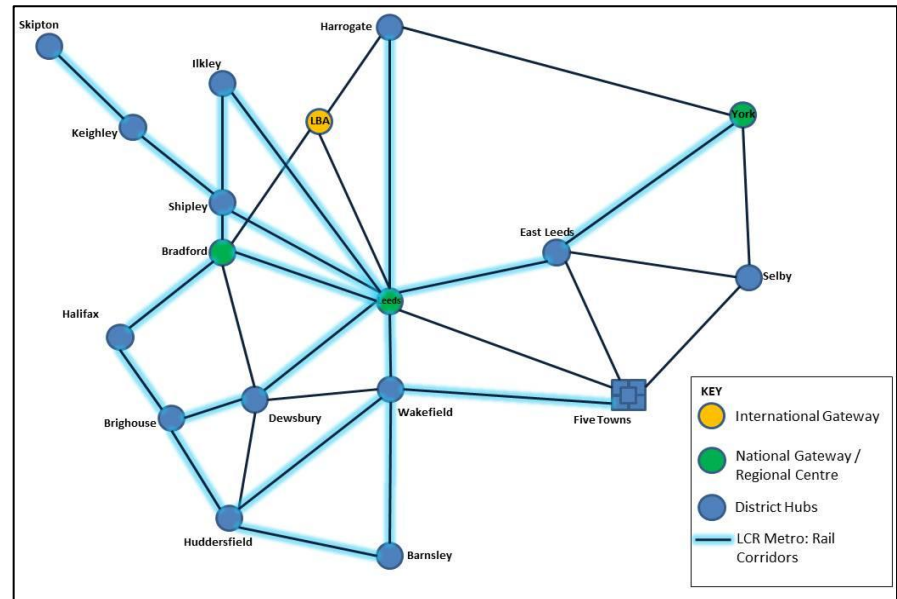
# Leeds City Region Metro - The Role of Rail (2)

To help focus this work, we defined a set of minimum connectivity standards that rail in the LCR should offer. Where rail falls short of these standards we looked for enhancement opportunities. Even when rail currently meets the minimum standards that we have used in this work, options have been considered to enhance rail over and above what is currently committed and to take advantage of the opportunities within the LCR offered by HS2 and NPR. These include faster and more frequent services, and while particular options have not been explicitly examined by this work, new stations.

In particular, this work identifies the integral role of rail as part of the wider LCR Metro system on the following corridors:

- Leeds to: Bradford, Skipton, Ilkley, Harrogate, York, Selby, Five Towns, Wakefield, and Dewsbury/Huddersfield/Brighouse
- Bradford to: Halifax, Huddersfield, Ilkley and Skipton
- Wakefield to: Five Towns and Huddersfield
- Huddersfield to: Brighouse and Halifax

## Corridors where Conventional Rail is the Preferred Metro Solution



# Leeds City Region Metro – The Role of Rail (3)

## Further Enhancement will Deliver Further Economic Benefit

What the economic analysis undertaken for the work shows is that there is significant additional economic benefit to be had by further enhancing the connectivity the City Region's rail network provides. This can be achieved through increased frequency of services, faster journey times and more opportunities for direct hub-to-hub services, particularly on the corridors that will not benefit directly from those investments that are currently committed and planned. Such services are provided by train operating companies via a franchise specified by Rail North and DfT on track owned and operated by Network Rail. What this work confirms is that in corridors currently served by rail, enhancing rail should always be the default option to provide LCR Metro connectivity. If it were to be pursued, any alternative approach would need to demonstrate a better strategic and value for money case than the conventional rail option.

Our analysis identifies a case for up to an additional £515m PV capital investment in conventional rail over and above what is committed through the new franchises and currently planned with Trans Pennine Route Upgrade . The scale of this investment is comparable to the current committed Northern Hub programme. This investment would support faster and more frequent journeys. While passenger capacity improvements will be needed if the full potential benefits of rail to the LCR's economy are to be realised, passenger capacity benefits have not been valued by this analysis.

Schemes to enhance City Region connectivity should continue to be delivered through established industry processes, that is implemented by Network Rail, funded through the quinquennial Control Period process supplemented by local funding, all guided by Rail North and WYCA. There is an opportunity to bring forward targeted LCR Metro related enhancements as part of the investment programme for Control Period 6 (2019-2024). Our analysis shows that a principal challenge to making the case for further investment will be to grow revenue in line with (or in excess of) the growth in operating costs that enhancement options will entail. This will require careful consideration of phasing, targeting investment first in the corridors with the strongest potential for demand growth.



# Leeds City Region Metro – the Tram-Train Option

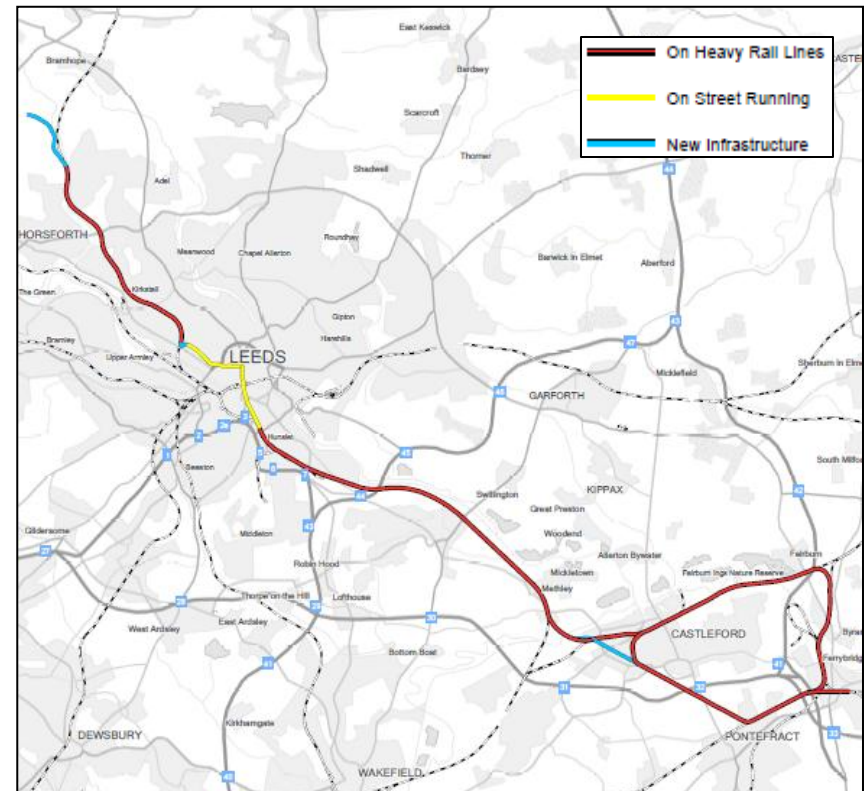
Tram-train has been identified as a potential option to provide LCR Metro connectivity for the corridors between Leeds Bradford Airport (LBA) and Leeds, and between the Five Towns and Leeds<sup>1</sup>. As well as providing connectivity between these two hubs and the regional hub of Leeds, operated as a network running on-street through Leeds city centre. With the provision of stops on the on-street section, this option also offers greater penetration of the city centre than conventional rail, as well as new cross-Leeds connectivity.

The Tram-Train option considered by this study would require:

- The construction of a new Tram-Train only spur between the Leeds-Harrogate railway and LBA
- The electrification of the Leeds-Harrogate railway line between where the spur would join it north of Horsforth and where Tram-Train would leave the route close to Burley Road<sup>2</sup>
- The construction of an on-street running section through the City Centre
- The electrification of the Hallam/Pontefract Line to the Five Towns<sup>2</sup>
- Structures including to provide the links between the street running sections and the Leeds-Harrogate and Hallam/Pontefract Lines, and to cross the Inner Ring Road.
- A depot for storage and maintenance of the Tram-Train fleet.

In present day prices, the cost of this option has been estimated to be £990m.

Tram-Train Option



<sup>1</sup> Previous work undertaken for WYCA has shown that there no option to serve LBA directly by conventional rail that is considered feasible in engineering terms. That work did, however, identify a potential tram-train link to the Airport from a point north of Horsforth station on the existing Leeds to Harrogate railway line. The same work also showed that a tram-train link from the Airport to Bradford was not feasible in engineering terms.

<sup>2</sup> As there is currently no commitment or plan to electrify the Leeds-Harrogate and Hallam/Pontefract Lines, this cost must be associated with the option.

# Leeds City Region Metro – Advantages of Tram Train

The Tram-Train option considered by this study offers a number of advantages.

These include:

- the ability to provide a fixed rail link to Leeds Bradford Airport
- increased frequency on the Leeds – Harrogate railway line between Horsforth and the City Centre and compared with the current and committed rail services, increased frequencies between the Five Town and the City Centre
- penetration of Leeds City Centre
- enhanced rail connectivity around the Five Towns

In addition:

- the construction of an on-street tramway section through the City Centre creates potential for further tram routes to areas not currently served by rail, for example to East Leeds or the Aire Valley
- it also creates the potential for new on-street sections in the Five Towns, for example linked to redevelopment and regeneration opportunities

The Tram-Train option considered by this work also creates an opportunity to remove some rail services from Leeds City Station – in this case those that serve the Five Towns. This could either reduce the need for future capital works at City Station (noting that come what may, the view is that the station’s capacity will have to be increased from its current provision to meet the Northern Powerhouse Rail requirements), or alternatively, that capacity could be used for other services.

# Leeds City Region Metro – Disadvantages of Tram Train

The Tram-Train option also has a number of drawbacks.

As well as being expensive to construct, building an on-street section through the City Centre would be highly disruptive over a two to three year period. It would involve the construction of full height (c. 1 metre high) platforms in the City Centre and these would each have to be around 80 metres in length. There would be a need to re-model the road network, with some roads closed to private vehicles or all traffic.

In addition, the assumed Tram-Train frequency would result in the Harrogate rail line operating at or close to its operational capacity. Because of this, Tram-Train vehicles would need to present at the access to the rail network within a narrow time frame, which would be difficult for a system that involves on-street running. This may provide a practical limit on the frequency of Tram-Train services. It would also limit the potential to further increase the frequency of conventional trains serving Harrogate.

The Tram-Train option has been subject to a high level costing exercise and economic appraisal. This shows that over a 60 year appraisal the capital and operating costs of the option exceed the revenue and benefits that it would generate, that is the option would not be economically worthwhile. This said, it should be recognised that the assessment of costs and benefits has been undertaken at a level commensurate with the requirements of this work and more detailed study could show that the costs are less than has been assumed and/or the benefits are higher.

In our view, for the costs to be substantially lower the option would need to be re-specified, for example by using bi-mode diesel electric Tram-Train vehicles that would obviate the need for rail route electrification. While there are currently no plans to do so, electrification of the Harrogate and/or Hallam/Pontefract lines by Network Rail as part of its enhancement programme would reduce the costs of Tram-Train. However, the need for a costly on-street running section through the City Centre would remain, as would the need for substantial structures to access the conventional rail network and these would also be costly. A greater concentration of development and regeneration opportunities along the route could increase demand, benefits and revenue.

It is noted that the option considered by this study is in contrast to the approach that has been taken to Tram-Train in continental Europe, where the prevailing approach has been to make the best use of poorly performing railway lines by linking these to a pre-existing tram network that penetrates city centres. Because of this, these continental approaches are substantially lower cost than the approach that has been suggested for the Leeds City Region. The success of European tram-train options cannot be taken as an indication that such approaches would also be successful in the Leeds City Region.

# Leeds City Region Metro – The Role of BRT and QBCs (1)

For a number of LCR Metro corridors, Quality Bus Corridors (QBC) and Bus Rapid Transit (BRT) have been considered. QBC and BRT are well suited to corridors which inherently have lower demand than conventional rail corridors or for corridors where there is no established conventional rail connection.

A QBC is an identified corridor where a package of measures is delivered, aimed at improving the whole traveling experience and also the conditions for pedestrians and cyclists. QBCs are often used by a number of bus routes. Physical bus priority is often an integral part of a QBC, and priority can also be provided through urban traffic control systems. QBCs are implemented within the existing highway boundary.

BRT bridges the gap between conventional bus services and tram/light rail. Typically, a BRT would have more physical priority than a QBC. BRT can include off-highway sections that may require land purchase, as well as need bespoke powers to build (eg Transport & Works Act Order). Buses with rubber tyres are used to operate services along a route or network of routes, which are largely segregated from general traffic, complemented by high quality infrastructure.

QBC has been identified an option for the following corridors:

- Bradford to Leeds Bradford Airport
- East Leeds to Five Towns
- Wakefield to Dewsbury and Dewsbury to Bradford

QBC also offers an alternative to Tram-Train options considered by this study to link Leeds to LBA. Options have also been identified to introduce BRT to the Dewsbury to Bradford and Bradford to LBA corridors as a higher quality alternative to a QBC. These two corridors could potentially be operated as a single integrated corridor.

# Leeds City Region Metro – The Role of BRT and QBCs (2)

QBC and BRT options offer a number of advantages:

- they are well-suited to corridors with lower demand that cannot support a rail based option
- they can be implemented relatively quickly
- they can be implemented incrementally, for example taking advantage of funding opportunities or opportunities presented by re-development
- typically, bespoke depot facilities are not needed and QBC/BRT vehicles operate from existing depots

QBC and BRT also have the potential to be implemented in partnership with bus operators and the Bus Services Bill currently before Parliament will strengthen the partnership options available.

However, in the UK context QBC and BRT cannot provide high capacity operating at average speeds that are comparable to or better than car alternatives. This is in contrast to conventional rail and to a lesser degree, tram or Tram-Train. In addition, and all other things being equal, QBC and BRT are not perceived as attractive to car users as rail-based alternatives and so do not attract the level of demand abstraction from car that rail-based systems can.

The high-level economic analysis that we have undertaken for this study indicates that in the main, the QBC and BRT options we have considered have the potential to deliver worthwhile benefits in excess of their estimated capital costs. There remains scope to optimise each of the corridors to maximise the benefits that they deliver. Furthermore, commercial considerations – that is the need for incremental revenue to exceed incremental operating costs – suggests a need for careful planning of the phasing of QBC and BRT, including how their introduction can be coordinated with development and regeneration opportunities.

# Leeds City Region Metro – Way Forward (1)

## Introduction

The Leeds City Region is already served by an extensive commuter rail network that provides hub-to-hub connectivity. Some of these rail routes currently provide the minimum level of connectivity that we have defined necessary to part of the LCR Metro concept, but this does not mean that there is not benefit nor scope for their further enhancement. Other corridors fall short of the Metro connectivity standard and we have explored options for their improvement, whether by rail or using alternative modes. A third group of corridors are not served by rail at all and we have considered how these can be part of a future LCR Metro network.

## Rail

Significant enhancements are already committed and planned for rail services in the LCR through franchise commitments, the Northern Hub programme and the Trans Pennine Route Upgrade, which will focus on the Huddersfield – Leeds – York/Selby corridor. The Northern Powerhouse Rail (NPR) proposal will create further opportunities, both for connections within and across the City Region and by providing additional capacity. HS2 will serve Leeds and York by 2032/33. Enhancing onward connectivity using the conventional rail network will be integral for the benefits of NPR and HS2 to be fully felt across the City Region.

This work has identified substantial additional economic benefit from further enhancing rail connectivity. The immediate focus should be on those corridors that provide the highest additional benefits over and above the investment that is already committed, or is planned to be implemented in the short to medium term (ie in advance of HS2 and NPR). This is because it is these corridors that offer the greatest potential to deliver benefits to the LCR economy, in no small part because they are likely to have the strongest economic and financial cases for investment. This said, there will still be the need to optimise on a route-by route basis the outputs and the associated enhancements that are being put forward and to make a compelling economic and financial case.

On this basis, the focus for future scheme development should be reducing journey times and increasing frequency on the Calder Valley route linking the hubs of Halifax, Bradford and Leeds; on reducing journey times on the Harrogate to Leeds corridor and on enhancing the Leeds North West corridor (Leeds/Bradford to Ilkley/Skipton). The implementation of the planned Trans Pennine Route Upgrade creates potential opportunities for further enhancement of City Region corridor east of Leeds, potentially with a new terminus station for cross-city services located on the existing rail route or elsewhere in the East Leeds growth area.

Elsewhere, the focus should be on smaller scale enhancements targeted at increasing demand and revenue. This in itself will benefit the LCR economy and will build the foundations for more extensive investment in the future.

# Leeds City Region Metro – Way Forward (2)

## Tram-Train

This work has looked at a Tram-Train option to link Leeds Bradford Airport with Leeds City Centre, and Leeds City Centre with the Five Towns. The analysis undertaken for this work does not support Tram-Train being part of the LCR Metro. With the current view on growth and development and its projected costs, the Tram-Train option considered would not offer value for money. The option we have considered has a projected cost of £990m in current prices. Even if there were a value for money solutions, there would be a question whether it is affordable.

This leaves a question on how the Airport and the Five Town can be linked to Leeds as part of the LCR Metro network. The focus of effort should be on serving Leeds Bradford Airport with bus-based options providing both direct links to hubs and onward connectivity through interchange with conventional rail. Options for enhancing conventional rail between the Five Towns and Leeds should be explored, but it is noted that revenue on this corridor is relatively weak and developing a financially sustainable solution will be challenging. A programme of incremental enhancements which supports a growing rail market and strengthens revenue would be a way forward.

## Quality Bus Corridors and Bus Rapid Transit

In the absence of a value for money and affordable rail-based option to serve Leeds Bradford Airport, bus-based options are the only way forward to enhance the Airport's public transport connectivity to other hubs in the City Region.

This work has identified a corridor connecting Dewsbury and Bradford and Bradford and Leeds Bradford Airport that has the potential for BRT treatment. As well as connecting a number of hubs, this corridor also serves a number of locations cited for redevelopment and regeneration, including the Canal Road corridor in Bradford and development sites around the Airport itself. It could also provide a transit link across Bradford City Centre. Its implementation could be phased. This study has considered the case at a pre-feasibility level and further work would be needed to prove the concept as well as establish its business case. In addition, opportunities to deliver the scheme in partnership with bus operators should be explored. The case for BRT between Bradford and LBA would be greatly enhanced if it were integrated with development and regeneration opportunities in the corridor.

# Leeds City Region Metro – Way Forward (3)

## Quality Bus Corridors and Bus Rapid Transit (cont.)

In contrast to the Bradford to Airport corridor, no opportunities have been identified to introduce BRT between Leeds and Leeds Bradford Airport. QBC is the recommended way forward for this corridor.

There is also merit in exploring the introduction of Quality Bus Corridors between Wakefield and Dewsbury, and between the Five Towns and East Leeds. The case for the Five Towns to East Leeds QBC will be strongly dependent on the rate, scale and mix of development that comes forward for East Leeds, as well as the timing and scale of housing development in and around the Five Towns. Integrating bus links into the East Leeds masterplan will offer the greatest potential to deliver viable bus links to the Five Towns. However, QBC approaches have the advantage of being able to be introduced at relatively low cost and in a phased way.

For QBC and BRT options, high quality vehicles and priority will maximise attractiveness vis-a-vis car. Exploring opportunities to provide onward connectivity through interchange to rail should be an integral part of their development.

## Other Corridors

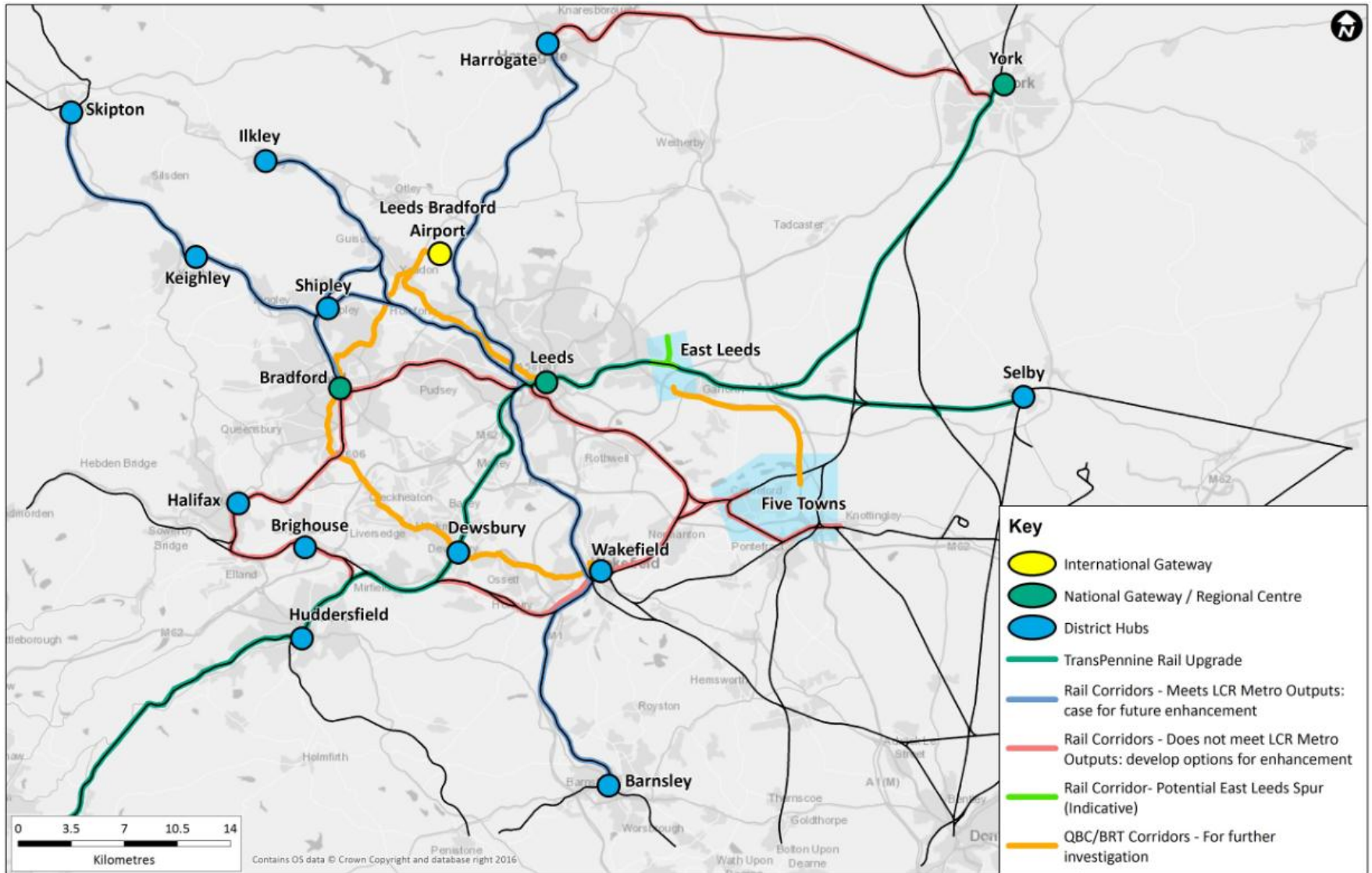
There are a number of other corridors for which we have not made explicit recommendations. Options to enhance the rail route between Huddersfield and Barnsley (and on to Sheffield) have been the subject of previous study and their feasibility and case is understood. The demand for travel between the Five Towns and Selby and between Selby and York is considered to be too low to warrant LCR Metro treatment.

## Recommended Way Forward

The recommended way forward set out here for each hub-to-hub corridor is summarised on the map over the page.



# Leeds City Region Metro – Way Forward (4)



# Technical Notes

This Final Report is a summary of the findings of five more detailed Technical Notes. These are:

- TN1: Early Outline Strategic Business Case
- TN2: Technology Choice Technical Note
- TN3: Network Design Technical Note
- TN4: Rail Capacity Technical Note
- TN5: Economic Case Technical Note

Technical Notes are bound separately

DISCLAIMER: This work may only be used within the context and scope of work for which Steer Davies Gleave was commissioned and may not be relied upon in part or whole by any third party or be used for any other purpose. Any person choosing to use any part of this work without the express and written permission of Steer Davies Gleave shall be deemed to confirm their agreement to indemnify Steer Davies Gleave for all loss or damage resulting therefrom.