

Initial Major Roads Report Strategic Transport Plan Evidence Base

Report by Jacobs commissioned by Transport for the North



Transport for the North - Initial Major Roads Report

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Foreword

About Transport for the North

Transport for the North (TfN) is empowered by a pan-Northern Partnership Board representing political and business leaders from all 11 Local Enterprise Partnerships (LEPs) from across the North, working together with Highways England, Network Rail, HS2 Ltd. and the Department for Transport (DfT). Together, with the support of business, industry, and academic communities, TfN is tasked with developing a Strategic Transport Plan (STP) for the North.

The Cities and Local Government Devolution Act is a crucial shift in governance and power to the North. The Bill will enable creation of TfN as the first Sub-National Transport Body (STB) in England.

STB status will allow TfN to develop and implement a multi-modal, long-term strategic transport plan across the whole of the North, with clear priorities focused on delivering the transport network needed to support transformational economic growth.

This document, the Major Roads Report and the related Integrated Rail Report are important contributors to the evidence base informing development of the STP.

The Major Roads Report

This report builds upon a considerable evidence base commissioned by both TfN and the Government through the *Northern Powerhouse Independent Economic Review* and *Northern Powerhouse Strategy*, as well as complementary studies on the role of roads and the economy by the Rees-Jeffreys Road Fund and Highways England. A bibliography with online links to key documents is enclosed at the end of this report.

The Major Roads Report is very much the result of collaboration between TfN, National and Local Partners, and appointed independent consultants working on the development of the TfN Strategic Transport Plan. Further work to engage with industry and business stakeholders to validate the direction of travel will commence in May 2017.

Executive Summary

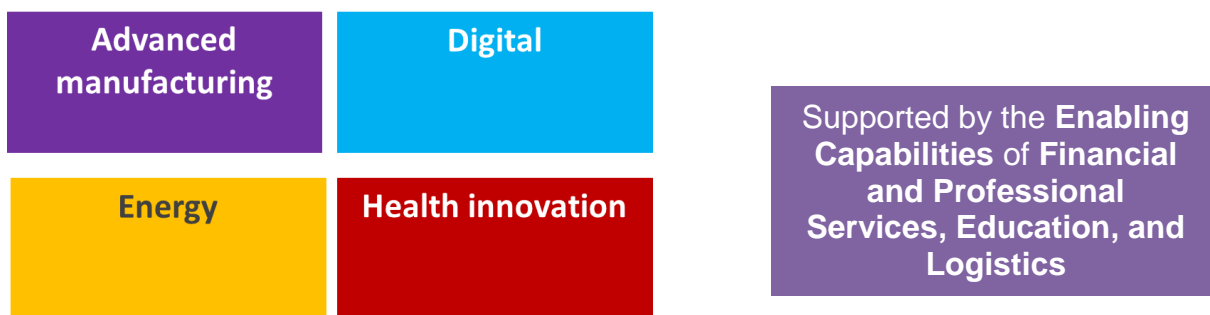
Why – The Economic Prize

The *Northern Powerhouse Strategy* demonstrated that the North's economy was worth £304 billion in 2014, similar to the whole of Belgium, and accounting for 19% of UK output.

The *Northern Powerhouse Independent Economic Review (NPIER)* demonstrates that a transformational growth scenario by 2050 could generate £97 billion Gross Value Added (GVA) increase to the Northern Economy with 850,000 more jobs than business as usual. As noted by Transport for the North's Chief Executive David Brown, this is:

“A prize worth having both for the North and for the rest of the UK”.

This involves a specific focus on four **prime capabilities** (below left) and three **enabling capabilities** (below right) that both suit the North's strengths and the opportunity for growth.



Existing devolution agreements, City Deals, funding investments and the Government's Industrial Strategy are enabling the North to make progress. Yet transformative economic growth depends on the ability of the North's transport network including its major roads to help both:

- **Rebalance the economy:** economic growth in the North needs to be at least as high as the rest of the country, to complement and act as a balance to the economic weight of London. To increase productivity to meet the levels currently only seen in London and the South East; and
- **Create a single economy in the North of England:** a world class transport system must better link up the individual cities and towns in the North, to allow them to function as a single economy and be stronger than the sum of their parts.

At the same time there is a need to recognise the importance of environmental, safety and equality objectives, so that the economy grows in a balanced and efficient way to ensure that decisions taken now support the lives of generations to come.

That is Transport for the North's (TfN's) purpose.

Why is a Major Road Network Important?

Highways England's research¹ demonstrates that sectors heavily dependent on the Strategic Road Network (SRN) employ 7.4 million people and contribute £314 billion in GVA to England's economy. These sectors are likely to grow by 35% by 2030, yet Highways England's SRN cannot cater for all of this growth on its own. The SRN only accounts for 2% of the road network in the North, and for many of the North's economic clusters it is the rest of the transport network that does the 'door-to-door' job, including those first and last miles from the SRN that can make all the difference as to whether goods or people make it in time, or as efficiently as possible. A focus on our existing SRN alone will not allow the Northern Powerhouse to achieve the connectivity and economic growth identified in the NPIER.

Our evidence base concurs that the following economic assets are crucially dependent on the performance of the North's major road network to add value to its economy:

¹ Highways England, 2016, *The Road To Growth Discussion Paper*, https://highwaysengland.citizenspace.com/he/strategic-economic-growth-plan/supporting_documents/The_Road_to_Growth_discussion_paper_FINAL_high_res.pdf, Accessed 01 February 2017

- The North's ports and airports; supporting imports, exports and the visitor economy.
- NPIER industry clusters and enabling capabilities for the NPIER economy.
- Important Economic Centres including towns, cities, ports, airports, enterprise zones, universities and other key employment sites.
- Major centres of tourism.

There is a direct link between transforming connectivity to these economic assets and allowing the North's economy to realise its potential. For the North's major roads to fulfil this role they must in combination:

- **Enable international connectivity**, investment and trade by providing an attractive business environment and improved access routes to global markets.
- **Support agglomeration economies** by bringing firms closer to other organisations and people to help make them more productive and competitive, and in so doing help economic centres thrive and differentiate themselves on a UK and global stage.
- **Release growth in key employment and housing sites** without hindering existing network functions.
- **Increase the resilience of the economy** to external opportunities and threats.
- Enable people and firms to make the **most efficient journeys** across multiple modes.

The evidence base from Partners demonstrates that this is not consistently the case. Central to TfN's vision is therefore a resilient Major Road Network that increasingly offers improved **multi-modal options**, and more reliable journey times, linked seamlessly to local networks and the Important Economic Centres critical to achieving transformational Economic Growth.

This report has provided a strong focus on the definition of this draft **Major Road Network (MRN) for the North, that can be defined as "the road network that is most economically important to securing the North's productivity and growth; both now, and in the future."**

TfN will work with Partners to develop business cases and secure funding for investment in the MRN, with potential funding sources including National Road Investment Strategy (RIS) programmes, Combined Authority and LEP funding programmes and from the private sector.

What does this mean?

The MRN is a live network of major roads that evolves to meet the emerging needs of the Northern Powerhouse and its connectivity priorities; with associated outcomes (**Conditional Outputs**) and **Evidence Base**, defining what Partners want the MRN to deliver for its customers and why, both now and in the future.

Highways England and Local Highways Authorities will retain their current roles and responsibilities to manage and operate their respective parts of the MRN.

We have deliberately moved away from an analysis of traffic flow and other traffic engineering metrics in seeking to determine the scale of the MRN. Instead, the North's **Important Economic Centres** are the basis of this economically driven MRN.

Based on *NPIER* and current clusters of economic activity in the North, the MRN connects approximately **200 Important Economic Centres** across the North, including towns, cities, ports, airports, enterprise zones, universities and other key employment sites. It will not be a 'fixed network', but a network that will change and scale as the North's economy itself develops and progresses ahead.

Conditional Outputs whilst common to the rail industry are relatively new to highways and are a useful way to provide a vision for what a major road network should like. Our choice of them is deliberate in order to concentrate on roads' economic role rather than simply traffic statistics. Feedback from Partners has resulted in the agreement of four conditional outputs by which we can set the baseline for the performance of the MRN, with a strong emphasis on journey reliability, resilience and an efficient network (through minimised delay) as critical to that economic function. Moving forward TfN and Partners will take forward work on developing a baseline and future monitoring of the Conditional Outputs – which will be used to support them in making informed decisions on how investment in the MRN will support growth in the Northern Powerhouse.

Existing evidence identifies the following **strategic gaps** as relevant across these journey reliability, resilience and delay Conditional Outputs.

- **North-South Connectivity and East-West Connectivity** - It is helpful to conceptualise the MRN as a ladder that only provides the requisite strength for transformational growth where both axes perform. The M62 is the only continuous east-west dual carriageway road across the North, carrying half of all trans-Pennine traffic. The ability of the Northern Powerhouse to work together as one and generate the

benefits for the whole of the UK is currently heavily dependent on the successful operation of just one road. Even where north-south links have helped establish a recognisable economic spine such as the M1 and A1/A19, current and emerging pressures in terms of efficiency, reliability and resilience are evident, and constraining potential growth.

- **International Connectivity** from the North's ports and airports to get business and leisure passengers and freight to time sensitive locations as efficiently as possible, thereby enabling inward investment and trade. Airports such as Manchester, Newcastle, Liverpool, Leeds-Bradford and ports such as Liverpool, Tyne, Teesport and the Humber Ports amongst others can make an essential contribution if the first and last mile(s) and strategic pan-Northern links function effectively.
- **Connectivity of the North's economic hinterlands** (Scotland, Wales and the north of the Midlands) plays a critical role in realising the economic potential of the North's border areas and its neighbours.
- **Future access to the MRN to help deliver** Nationally Significant Infrastructure Projects, major employment and major local development approvals, are all key to the achievement of the UK's energy policy, Industrial Strategy and housing needs.
- **More touch points with rail stations** will provide greater multi-modal travel opportunities, supported by ongoing SMART and integrated travel initiatives.

Our analysis of the MRN's baseline performance in these terms alongside committed and proposed interventions provides a clear narrative of the pan-Northern gaps to realise the economic prize. This is defined as our initial **portfolio of strategic connectivity priorities**.

This work importantly builds on the existing Roads Investment Strategy Period 1 programme, City Deals and Local Growth Fund allocations, the existing Strategic Road Studies² commissioned by DfT and Highways England, and emerging evidence from Highway's England Route Strategies process and Local Partner Key Route Networks and studies.

Critically, our portfolio of strategic connectivity priorities are not necessarily based on congestion analysis, but are based on where transport improvements are vital to delivering transformational growth.

This is a focussed set of thirteen connectivity priorities for subsequent sequencing and study alongside complementary rail based connectivity priorities within the Strategic Transport Plan (STP) process.

It will enable us to identify and prioritise **additional investment** in the MRN for the to improve journey time reliability, efficiency, resilience and quality of the network, while being mindful of objectives centred around safety, the environment and quality of life.

How will this be realised?

The Major Roads Report, alongside its Rail counterpart and the sustainability appraisal, is a fundamental component of a long-term, sequential investment programme underpinning the STP that sets the context for investment priorities up to 2050.

The Major Roads Report will enable the STP to set out a comprehensive decision-making framework, and a consistent and coordinated regime for the strategic planning of the North of England's 'major' roads; and therefore contribute to a growing and vibrant economy across the North of England. Through this analysis TfN will be able to work with Partners to determine requirements for future studies and business case development, how interventions can be funded and unlocked, and who is best placed to deliver them.

The objective of this work is to achieve the joint ambition of the Government and TfN for the Northern Powerhouse, and to ensure a step change in economic growth. By doing this, the report will help TfN to secure the investment in roads that the Northern Powerhouse needs to realise its potential.

This Major Roads Report for the North and its constituent MRN is a first – it has been developed through a strong collaborative partnership with a consistent focus on delivering Economic growth. Importantly it will enable the North to speak with 'one voice' on strategic highway issues with partners, stakeholder and customers.

It is ambitious, as it must be if the North is to be truly competitive on the world-stage.

² Northern Trans-Pennine Routes (A69 and A66), Manchester M60 North West Quadrant, Trans-Pennine Tunnel and its interfaces

1. Introduction

1.1 Context

The success of the UK in the global marketplace, and achieving the ambitions set out in the Government's Industrial Strategy, will be dependent on transforming the economy of the North of England. To date, there has been a persistent economic gap between the North and the national average that necessitates a radical change in the economy of the North, which is home to internationally regarded assets, expertise, research and businesses. These assets are pan-Northern, highly productive and compete at a national and international scale.

The Northern Powerhouse Independent Economic Review (NPIER), published in June 2016, set out that by 2050, in a transformed economic North:

- **Gross Value Added (GVA) is projected to be 15% (£100 billion) higher than business as usual projections.**
- **Productivity would be 4% higher.**
- **850,000 additional jobs would be created.**

Specifically, the NPIER identified that improving connectivity is key to seizing the economic prize, making the North a more attractive and buoyant marketplace, and, since its publication, significant progress has been made in developing the case for strategic transport investment across the North of England. Transport for the North (TfN), with its Partners, is currently developing a multi-modal **Strategic Transport Plan (STP)** and accompanying long term **TfN Investment Programme** to support the people and businesses across the North to create a stronger, more diverse and resilient place for people to live, commute, and do business.

The STP is guided by TfN's vision to *"improve the frequency, capacity, speed and resilience of the North's transport system to make it easier for people and goods to move throughout the region. In doing so we want to create a globally competitive environment that can sustain economic growth for decades to come."*

The STP will aim to cover all aspects of TfN's activities. For roads, that encompasses the North's major road network. For rail, it will cover the entire rail network in the North of England, both long distance and local, for passenger and freight as all constituent parts of the North's rail network contribute to the delivery of the required pan-Northern connectivity.

TfN is working towards the publication of the Draft Strategic Transport Plan and TfN Investment Programme for public consultation in autumn 2017, alongside the establishment of TfN as the first Sub-National Transport Body in England. The STP, and its supporting evidence including this Report, will be used as a platform with which to agree how the Government, Network Rail, Highways England and High Speed Two (HS2) Ltd work with Northern Partners to deliver investment that can transform the economy of the North.

In developing the STP, TfN has commissioned a significant amount of new evidence, as illustrated in **Figure 1.1**, and summarised below:

- Economic Growth and Transport Demand Analysis.
- Integrated Sustainability Appraisal.
- Integrated Rail Report.
- Major Roads Report.
- Enhanced Freight and Logistics Analysis.
- Independent International Connectivity Commission Report.

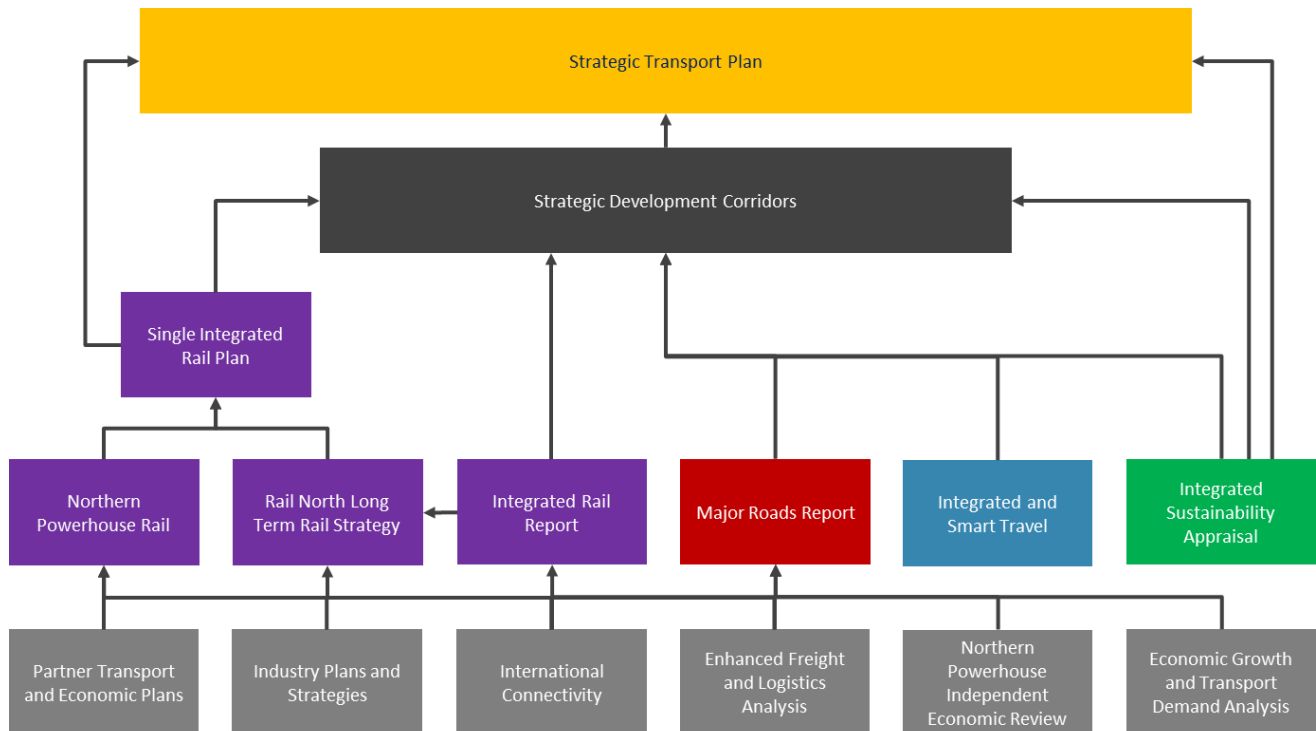


Figure 1.1: The Strategic Transport Plan and its Evidence Base

This Major Roads Report outlines the means by which the North's major road network will need to develop to facilitate the aspirations for transformational economic growth, as established by the NPIER. The aim of this initial report is to identify the connectivity priorities that will inform the STP and the TfN Investment Programme, complementary to more localised strategic interventions, as shown in **Figure 1.2**.



Figure 1.2: Identification of pan-Northern connectivity priorities

At this stage, the Report necessarily concentrates on road in isolation. The STP will ensure that the evidence is brought together to develop the long term, multi-modal TfN Investment Programme for the North's pan-Northern strategic transport network. This Report should be read in conjunction with the Position Statement on the Strategic Transport Plan, along with the accompanying Integrated Rail Report (IRR), the emerging work on the enhanced Freight and Logistics Analysis, the International Connectivity Commission Report, Northern Transport Demand Model Summary, and Integrated Sustainability Appraisal Position Statement, in order to get a full picture of the evidence base supporting the STP.

1.2 Purpose of the Report

The purpose of the **Major Roads Report** is to provide the supporting evidence base for the TfN STP by drawing together existing sources and undertaking primary research into its core concepts. Its key objectives include:

- **Development of, and agreement on the North's major road network.**
- **Development of pan-Northern Conditional Outputs for the agreed network.**
- **Strong evidence base including development of process to provide baseline assessment and performance monitoring of the agreed network.**
- **A portfolio of interventions across the network – developed and agreed with Partners.**

Similar to the STP, the Major Roads Report comprises a clear narrative around the 'why', 'what' and 'how', as illustrated in **Figure 1.3**:

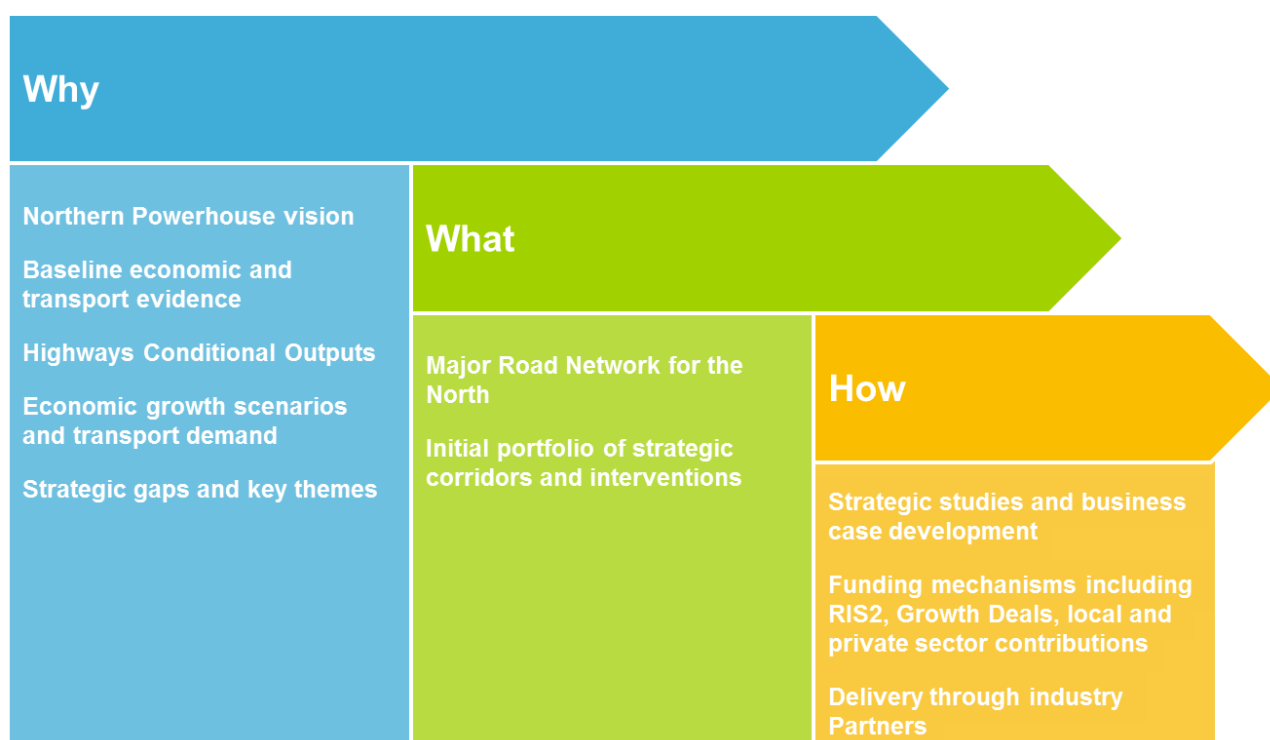


Figure 1.3: The Why, What and How of the Major Roads Report

1.2.1 The Why

There is a direct link between transforming connectivity and allowing the North's economy to thrive. The existing capacity of our transport networks is a significant inhibitor of demand. Poor connectivity has been identified as limiting the economic potential of the North. Better transport links leads to greater agglomeration, which helps to link businesses and grow labour markets. Agglomeration benefits apply within city regions and LEP areas, but also between city regions and LEP areas on a pan-Northern scale, so that economic centres can thrive and specialise.

Alongside the rail network the North's major roads play a critical role in creating the conditions in which people and businesses can thrive.

To maximise the contribution transport can make to achieving growth it is essential that investment is based on an integrated, ambitious, and compelling evidence base, to provide both the rationale and a consistent and coordinated approach to determining TfN's priorities.

This report includes a strong focus on the definition of a **Major Road Network (MRN) for the North**; that is a network of major roads that evolves to meet the emerging needs of the Northern economy and its connectivity priorities, both now and in the future; with associated **Conditional Outputs** and **Evidence Base (referenced in Appendix A)**³. Defining what we want the MRN to deliver for its customers and why. This will help us guide its strategic development both now and in the future.

1.2.2 The What

Through analysis of the MRN's current performance, future demands, committed and proposed interventions we provide a clear narrative of the pan-Northern gaps for road investment to support economic growth in the North of England over the next 25 years. This is defined as our initial **portfolio of connectivity priorities**.

This work importantly builds on the existing Roads Investment Strategy (RIS) Period 1 programme, City Deals and Local Growth Fund allocations, the existing Strategic Road Studies⁴ commissioned by DfT and Highways England and emerging evidence from Highway's England Route Strategies process and Local Partner studies. Critically, our portfolio of strategic investments are not necessarily based on congestion analysis, but are based on where transport improvements are key to delivering transformational growth.

The Major Roads Report, alongside its Rail counterpart and the sustainability appraisal, is a fundamental component of a long-term, sequential investment plan underpinning the STP that sets the context for investment priorities up to 2050.

1.2.3 The How

The Major Roads Report will enable the STP to set out a comprehensive decision-making framework, and a consistent and coordinated regime for the strategic planning of the North's 'major' roads; and therefore contribute to a growing and vibrant economy across the North. Through this analysis TfN will be able to work with Partners to determine requirements for future studies and business case development, how interventions can be funded and unlocked, and who is best placed to deliver them.

The objective of this work is to achieve the joint ambition of TfN and Government for the Northern Powerhouse, and to ensure a step change in economic growth. By doing this, the report will help TfN to secure the investment in roads that the North needs to realise its potential.

1.3 Scope of the Report

The Major Roads Report has been developed in full collaboration with the 11 Combined Authorities (CAs) and Local Economic Partnerships (LEPs) that constitute the TfN geography. Dialogue has been conducted via monthly "Highways Working Group" sessions encompassing all partners, plus Highways England and the Department for Transport (DfT).

The development of the report has also included a significant degree of Partner and stakeholder involvement and engagement through the Highways Working Group, 1-2-1 meetings and workshops and correspondence.

TfN is extremely grateful for the level of effort and contribution provided by all partners to help make this work a reality.

1.4 Structure of the Report

The Major Roads Report consists of ten chapters, including this introduction. The content of the remaining sections reflects what it seeks to achieve, both for roads and in the wider context of the STP, drawing upon an extensive review of baseline information; gaps in the network emerging from consolidated national and local priorities to inform the pan-Northern position;

- **Chapter 2** defines the "Economic Prize", and the means to which transport connectivity can contribute to rebalancing northern England within the UK context.

³ The Evidence Base listed in Appendix A includes documents from 130+ strategic and locally led transport, land use and regeneration led strategies and implementation plans from across the 11 LEP geographies.

⁴ Northern Trans-Pennine Routes (A69 and A66), Manchester M60 North West Quadrant, Trans-Pennine Tunnel and its related commission around the interfaces

- **Chapter 3** identifies the specific contribution that roads can make to delivering economic growth.
- **Chapter 4** presents the MRN for the North.
- **Chapter 5** includes the vision and Conditional Outputs for the MRN.
- **Chapter 6** presents the baseline position for the MRN in the North, encompassing the key future requirements of the MRN if the North is to achieve transformational economic growth.
- **Chapter 7** identifies future network requirements for the MRN.
- **Chapter 8** identifies the current commitments in terms of the MRN's short-term enhancement and ongoing development work for Road Investment Strategy 2 and Large Local Major schemes.
- **Chapter 9** identifies strategic gaps in connectivity which are then used as a guide to help define our portfolio of pan-Northern interventions.
- **Chapter 10** identifies a portfolio of strategic corridors and interventions to be taken forward for subsequent sequencing and further development within the STP. It also concludes the report and provides a summary of appropriate next steps.

The Integrated Rail Report and Major Roads Report will consider the pan-Northern connectivity that will be essential to fulfilling those economic outcomes from the NPIER and securing a radical change to the economy of the North. The IRR, the Long Term Rail Strategy Update and the Major Roads Report will be brought together in the STP to form a single comprehensive policy document.

2. Building the Northern Powerhouse

2.1 Economic Challenges

The North of England is home to 16 million people (nearly one quarter of the UK population) and 7.2 million jobs, and generated an economic output of around £290 billion of Gross Value Added (GVA) in 2015, about one fifth of the UK's total. The area has a wealth of high profile and growing businesses, and rich sets of expertise, creativity, and assets.

But, there remain persistent gaps in GVA per capita and productivity performance compared to the rest of the UK. For the last 30 years, the North's economic value per person (measured as GVA) has been consistently about 25% below the average for the rest of England, and 10-15% below the England average (excluding London) as shown in **Figure 2.1**. A persistent economic gap exists between the North and the national average that necessitates a radical change in the economy of the North.

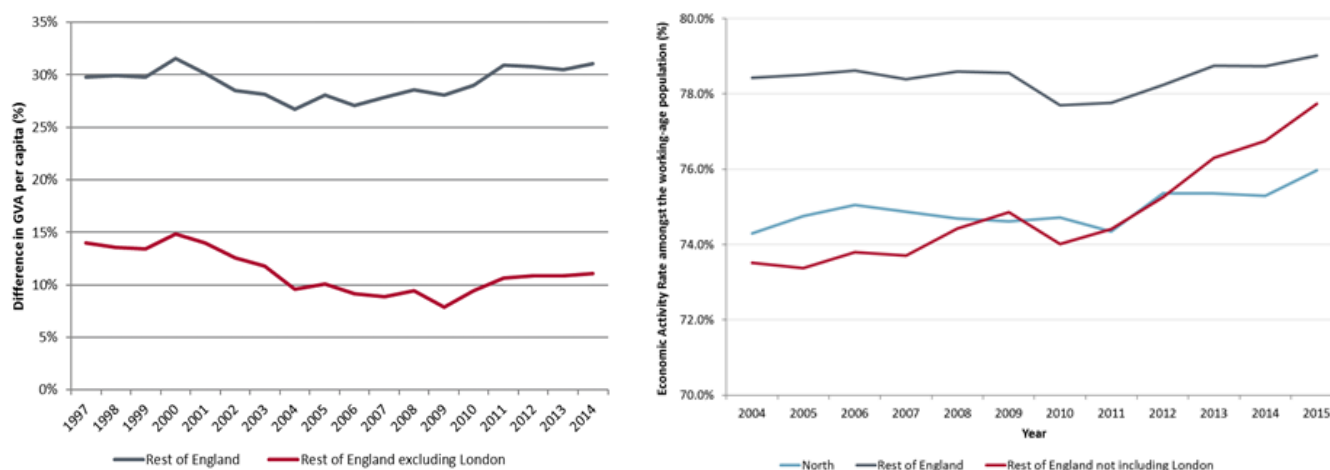


Figure 2.1: The North's Prosperity Gap (in GVA per capita) with the Rest of the UK. Data Source: Regional Gross Value Added Statistics, Office for National Statistics

The NPIER attributes this economic performance gap to two features of the Northern economy:

- Productivity: The relatively low productivity of employees.
- Employment: The relatively low proportion of working age residents in work.

The NPIER also identifies the main factors driving the productivity gap as:

- A lack of high-skilled workers and too many low-skilled workers.
- Not enough exploitation of innovation and technology.
- Lower levels of investment.
- Lower levels of enterprise.
- Lack of agglomeration.
- Sub-optimal transport links and underinvestment in transport.

The need for TfN to produce a STP is derived from the need to support a transformed economic future for the North through addressing the identified pan-Northern transport connectivity and agglomeration challenges.

2.2 Transforming the North

The headlines of a transformed future for the North explored through the NPIER were included in the introduction to this report - a 15% increase in GVA, almost £100 billion, compared with business as usual, and creating an additional 850,000 jobs. This will allow the North to narrow the performance gap, in part through the promotion and growth in the North's distinctive offer of four Prime Capabilities (Advanced Manufacturing, Energy, Healthcare innovation and Digital), supported by three Enabling Capabilities (Financial and Professional Services, Logistics, Higher Education). The capabilities are international class assets. They are

high skilled, valuable sectors that are genuinely distinctive for the North, highly productive, and can compete on the national and international stages.

These capabilities are located right across the North, as illustrated in **Figure 2.2**.

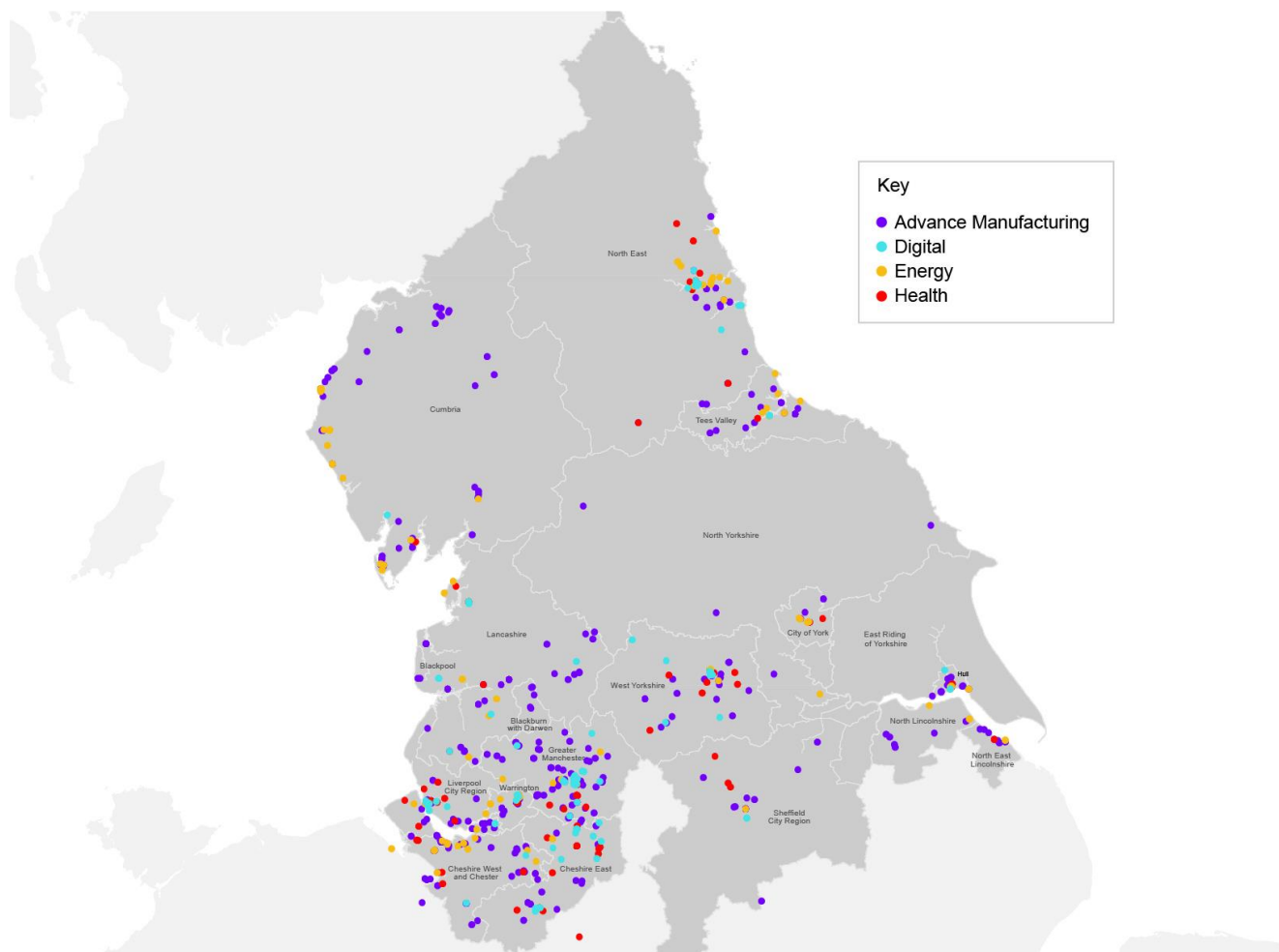


Figure 2.2: Sample Locations of Key Assets of the NPIER Prime Capabilities

The current contribution of Prime and Enabling Capabilities to the North is:

- 2.1 million jobs.
- Over £100 billion in GVA.
- 30% of all jobs in the North.
- Around 35% of total GVA generated by the North.

TfN is committed to supporting industrial growth by providing the strategic transport and infrastructure required; supporting business growth and opening up labour markets to businesses to attract the skills they require. The STP can also support the Government's Industrial Strategy and encourage trade and inward investment in to the North by improving links to the North's ports and airports, creating an attractive offer for business to invest and be based in the North.

2.3 Transport and the Economy

There is a direct link between transforming connectivity and allowing the North's economy to thrive. The existing capacity of our transport networks is a significant inhibitor of demand. Poor connectivity has been identified as limiting the economic potential of the North. Better transport links leads to greater agglomeration, which helps to link businesses and grow labour markets.

Transport improves productivity by:

- Attracting and retaining highly skilled workers to live and work in the North.
- Opening up opportunities in the labour market by allowing longer distance commuting trips.
- Providing sufficient capacity to meet long term demand, and to improve resilience and reliability across the network.
- Supporting current investment, and attracting foreign direct investment.
- Helping businesses to collaborate closely, and improve their access to their supply chain.
- Reducing operating costs.
- Enhancing the user experience.
- Enhancing trading opportunities.
- Enhancing the quality of life for all people living in the North.

The NPIER set out an achievable trajectory of what a transformed northern economy could look like. In doing so it developed two important forecast scenarios for the North's economy - the business as usual scenario that envisages the economy of the North continuing to grow at its current rate and a transformational scenario for what would happen if the Northern Powerhouse vision was achieved:

- Business as Usual – This scenario reflects both historical experience and expected UK trends, notably in the performance of sectors of the British economy and in population changes. Business as usual implies the same scale of investment as in the past, set in the present and future context for the North.
- Transformational – This scenario assumes that progress is made in tackling the wide range of factors that are responsible for the performance gap observed in the past. The transformational scenario will only come about if there are improvements in the transport system. Under such a scenario it will be easier for firms and their employees to interact and hence benefit from the productivity increases.

To understand the implications of the transformational scenario for transport demand, TfN has developed a Northern Transport Demand Model using a baseline of demand for road and rail. Using this model to create a dynamic simulation of how activities at locations produce a demand for travel, including how businesses produce jobs which need to be filled by workers who have access to the available jobs. Travel demand is segmented into three types of trip purpose: Commuting, Business and Other. There are two additional sub-models that represent freight demand and trips to/from Manchester International Airport.

Two future influencers have also been modelled to understand future transport demand across the North in a transformational economic growth scenario:

- Technological and socio-cultural change: meaning the relative impact of technology, costs of travel and socio-cultural attitudes to travel demand.
- Enabling policy and plans: meaning the relative impact and focus of local transport and land-use policy and planning on the drivers of travel demand.

These were specifically chosen as having significant impacts on future travel demand that need to be understood and allowed for within any forecasting work, but which sit outside the current remit of TfN's work.

Variations of these two influencers give four potential alternative but plausible, futures for 2050. The four alternatives all reflect futures in which interventions (including the implementation of TfN-sponsored interventions in road, rail and smart travel as well as other policy initiatives/investment) have achieved a transformation in the economy of the North by 2050 whereby levels of employment, productivity and output are more similar to the South East of England than they are today. This means in all four scenarios the future levels and distributions of population and employment are consistent with transformational scenario set out in the NPIER. However, the future scenarios deliberately reflect other uncertainties that will influence travel demand.

Dimension	Enabling Policy and Plans	Technological and Socio-Cultural Change
Description	Represents the uncertainty in how local planning processes and policies (local government priorities, land-use and development planning, and local transport planning)	Represents uncertainty in how technologies such as autonomous vehicles, alternative fuels and digital connectivity will evolve
Impact on Transport Demand Drivers	The level of future housing development and employment growth that occurs in urban centres as opposed to the suburbs (or urban expansion)	The cost of energy (and the consequent effect on travel costs)
	The level of improvement achieved in travel conditions (journey times, reliability and travel experience) within local authority districts	The capacity and usage of the road network The decision to undertake activities face-to-face or digitally
Summary	Captures the spectrum of outcomes between 'Compact' urban areas and 'Dispersed' urban areas	Captures the spectrum of outcomes between a preference for 'Digital' connection and a more 'Travel Friendly' future

Each scenario has been tested in the Northern Transport Demand Model to show how the volume and pattern of transport demand would respond to the various assumptions in each alternative future. The business as usual scenario has also been modelled to act as a comparator for these four future transformational scenarios.

The outputs of this work will inform the overall strategic case for the STP, but also provide an important part of the supporting evidence base for the development of future interventions in this report. This is documented in a separate 'Transport Demand and Analysis Report' produced by TfN.

3. Roads and the North's Economy

3.1 What Roads Do

The recognition of the positive role that roads and other transport modes make to our economy is long understood and referenced in our national and local partner led studies (referenced in **Appendix A**). The North's transport networks as they stand have helped shape its economic geography. Highways England's research⁵ demonstrates that sectors heavily dependent on the Strategic Road Network (SRN) employ 7.4 million people and contribute £314 billion in GVA to England's economy. These sectors are logistics and freight, manufacturing, wholesale, retail, and leisure and tourism. Combined they generate £77 billion GVA and employ 2.13 million people in the North⁶, with advanced manufacturing, logistics and freight recognised as key growth areas in the NPIER. These sectors are likely to grow by 35% by 2030 generating an additional £110 billion for England's economy. Yet the SRN cannot cater for all of this growth on its own. The SRN only accounts for 2% of the network, and for many of the North's economic clusters it is the rest of the transport network that does the 'door-to-door' job, including those first and last miles from the SRN.

Research from TfN, Highways England and Local Partners all concur that the following economic assets are crucially dependent on our road network to add value to the North's economy:

- The North's ports and airports, supporting imports, exports and the visitor economy.
- Geographic clusters of the NPIER prime and enabling capabilities.
- Important Economic Centres (IECs).
- Major centres of tourism.

Where roads work well, they:

- Enable international connectivity, investment and trade by providing an attractive business environment and improved access routes to global markets.
- Support agglomeration economies by bringing firms closer to other organisations and people to help make them more productive and competitive.
- They release growth in key employment and housing sites without hindering existing network functions.
- Increase the resilience of the economy to external opportunities and threats.
- Enable people and firms to make the most efficient journeys across multiple modes.
- Support the North's tourism economy, with Britain's tourism industry contributing around 10% to the nation's GDP. National Parks and other key destinations in the North also make a major contribution to local and regional economies.

We now briefly describe why each of these is important to the delivery of a transformational Northern economy.

3.2 Enabling International Connectivity, Investment and Trade

Key road and rail links to airports and ports are vital to get business and leisure passengers and freight to time sensitive locations as efficiently as possible. This reduces costs and time constraints to businesses whether they are importing or exporting; improves access for the local population and visitors (tourist or business), delivering benefits for freight and logistics, and enhancing the viability of current and future trade routes. Indeed 24% of businesses surveyed by the British Chambers of Commerce in 2012⁷ cited the quality of connections to international gateways as a barrier to exporting.

The NPIER demonstrated that the North's key prime capabilities such as advanced manufacturing depend on time-sensitive freight connections to international gateways to be able to compete internationally, both in terms of the import of goods for 'just in time' manufacture as well as the export of finished goods to the global market place. Indeed firms such as Nissan UK's Manufacturing plant in Sunderland rely heavily on just in time supply chains aided by reliable imports through international gateways as well as local firms, of which the surface road

⁵ Highways England, 2016, *The Road To Growth Discussion Paper*, https://highwaysengland.citizenspace.com/he/strategic-economic-growth-plan/supporting_documents/The_Road_to_Growth_discussion_paper_FINAL_high_res.pdf, Accessed 01 February 2017

⁶ Highways England, 2017, *analysis associated with The Road to Growth Discussion Paper provided to TfN* 08 March 2017

⁷ Highways England, 2016, *Economic growth and the strategic road network* https://highwaysengland.citizenspace.com/he/strategic-economic-growth-plan/supporting_documents/Economic%20Growth%20and%20the%20SRN%20%20final.pdf, Accessed 01 February 2017

links are a key component. Firms such as Nissan also provide the anchor for investment by local supply chains – in this case aiding the demand for investment in the International Advanced Manufacturing Park (IAMP), with the Government's Industrial Strategy contribution of £42 million set to unlock 5,200 new jobs.⁸

Others such as the enabling capabilities of financial, professional services or higher education require high quality and efficient passenger transport not only within and between urban centres but likewise to international gateways. Exporting £52 billion in 2015, many businesses in the North rely on good international connectivity in form of airports and ports to export knowledge-based goods and services, attract foreign direct investments and qualified staff.⁹ Most businesses competing on the international market need reliable connections to international gateways for their clients, staff and supply chain, and these are vital to the make the most of significant opportunity to expand into fast growing emerging markets.

Many of the North's airports have proved successful over the past decade in attracting international business destinations and airlines (such as Newcastle to Dubai via Emirates) to their portfolio of routes, including routes this year from San Francisco and Boston to Manchester amongst others. The Independent International Connectivity Commission's Report states that the North has potential capacity for an additional 60 million air passengers per annum based on current airport master plans and a DfT assessment. Capacity available at the North's major airports and ports could help deliver improved global connectivity over a short timeframe, if it is properly supported with improved surface access

The major road network also provides an incredibly important first impression to the North of England for customers and investors. With the right performance and function they will support the local and international investment in our prime and enabling sectors critical to transformational growth.

Moving to the North's ports, these prove successful where they are able to easily transport goods onwards across the country, either by rail or our road network. Where they work well they drive demand for large warehousing in locations with good accessibility to both ports and typically the SRN where goods can be split and re-distributed nationally. The recent opening of the £400M Liverpool2 deep water container port is a case in point. The warehousing that has either been provided speculatively or is now in development along the M62 within the wider Atlantic Gateway (such as at Speke, Ashton-in-Makerfield and Warrington - Omega) is a direct result of investment in the Port of Liverpool alongside the growth in activities to satisfy the ever increasing consumer demand for same and next day delivery.^{10 11}

3.3 Supporting Agglomeration Economies

A reliable and resilient road network helps make organisations and people more productive and competitive by:

- Increasing the number and availability of inputs to the production process by improving access to labour, suppliers, **complementary 'prime' or enabling capabilities** or by stimulating the creation of new firms;
- Increasing the number of employment and collaboration opportunities for people and firms, thereby helping to reduce unemployment and stimulate greater trade and better products;
- Improving the efficiency with which inputs are used and so reducing the cost of the manufacture and distribution processes of goods and services by facilitating safe, reliable and efficient journeys;
- Increasing the speed and certainty with which producers can get their goods to market, in a highly competitive environment
- Support a virtuous circle where better transport connectivity improve supply-chain linkages and helps promote a higher employment rate thereby making the region more attractive to global businesses selecting locations for investment.

Previous work appraising the wider economic benefits of road schemes by Atkins has found that agglomeration benefits represented the majority of wider economic benefits and were equivalent to 16-18% of benefits attributed to the conventional assessment of direct impacts¹²

⁸ <https://www.gov.uk/government/news/pm-unveils-plans-for-a-modern-industrial-strategy-fit-for-global-britain>, Accessed 27 January 2017

⁹ HMRC, 2016, *Regional Trade Statistics* <https://www.uktradeinfo.com/Statistics/RTS/Pages/default.aspx> Accessed 01 February 2017

¹⁰ TfN, 2017 *International Connectivity Commission Report*

¹¹ Highways England, 2016, *Commercial development and the strategic road network*, https://highwaysengland.citizenspace.com/he/strategic-economic-growth-plan/supporting_documents/Commercial%20Development%20and%20the%20SRN%20%20final.pdf, Accessed 01 February 2017

¹² Atkins. 2008b. A11 Wider Economic Impacts Study; Atkins. 2010. A5-M1 Link Road Wider Economic Benefits referenced in Highways England (2016) *Economic Growth and the Strategic Road Network*

In relation to the four pan-Northern '**prime**' **capabilities** many production facilities, in **advanced manufacturing** and **energy** require large-scale premises in locations which offer high-quality connectivity to their supply chains, to energy networks, to global markets, and to research institutions. Typically locations that meet these characteristics are not universally distributed, leading to firms clustering in those specific locations.

The same applies to other NPIER sectors, which have their own requirements for high productivity. **Health innovation** and **digital technology** often cluster in the largest towns and city centres close to higher education and research institutions, such as the North's six university teaching hospitals. They require highly specialist skills most likely found in these locations. Their successful development in the North depends on the ability to offer the depth of specialisation and the range of jobs that gives workers the prospect of career development without having to repeatedly move location, one of the key agglomeration benefits that better connectivity supports.

The capabilities, whose activities require a central location in the largest towns and cities in the North, benefit from agglomeration effects that increase with employment density such as access to specialist skills and greater exchange of knowledge. Transport connectivity is essential to this achievement. Yet *The Northern Powerhouse Strategy* notes that employers in Northern cities draw workers from smaller areas than in the South: in 2011, almost half a million commuters travelled over 30km to work in London, double the number that travel the same distance to work across all six major Northern city regions. This limited reach of Northern cities' labour markets means that workers choose from fewer employers, and vice versa, holding back wages and productivity.

Reliability of journey time and delays are of particular concern to business road users in this context, and make a difference in terms of the investment in an area and the performance of firms based there:

- Additional time spent on the road reduces business productivity.
- Stop-start driving and longer journey times increase fuel costs.
- Unforeseen delays can result in the loss of business through missed opportunities.
- Late delivery of goods and services can cause reputational damage and jeopardise relationships with clients/customers.

This is particularly valid in the context of our freight and logistics **enabling capabilities** responding positively to the investment in Liverpool2. The *Northern Freight and Logistics Report*¹³ highlights the potential for the North's freight and logistics sector to make a significant contribution to the overall economy, with forecast potential economic benefits of around £50 billion by 2060 including £35 billion of user and non-user benefits to the UK.

The location of these activities is highly sensitive to transport costs. Ernst & Young's *European Attractiveness Survey 2015*¹⁴ indicated that investors see transport and logistics infrastructure as the third most important factor in choosing a location, behind only political transparency and stability and the country or region's domestic market. These costs can be minimised through the co-location of warehousing, port and rail terminals and the efficiency, reliability, resilience and quality of the access links. It is such opportunities, developed near the North's IECs and MRN, which provide the basis for sustainable economic growth in this sector.

Highways England's commercial research¹⁵ into the role of the SRN notes that three of the top 20 developments adjacent to the SRN in England between 2014 and 2016 were in a very focussed area of the North West: Omega on the M62 in Warrington, Airport City (World Logistics Hub) and at Logistics North on the M61 in Bolton which benefit from connectivity to Manchester Airport (the predominant source of airfreight in the North¹⁶) and the Port of Liverpool.

Looking elsewhere across the North, Partners such as the Sheffield City Region are supporting enhanced connectivity to the Humber Ports to build on the established links via the M1 to the specialist freight hub of East Midlands Airport for the very same reason¹⁷. Easily accessible locations to major roads and container ports are

¹³ TfN, 2016, *Northern Freight and Logistics Report*, <http://www.transportforthenorth.com/wp-content/uploads/TfN-Freight-and-Logistics-Report.pdf> Accessed 01 February 2017

¹⁴ Ernst & Young's *European Attractiveness Survey 2015* in Highways England, 2016, *Economic growth and the strategic road network*

¹⁵ Highways England, 2016, *Commercial development and the strategic road network*

¹⁶ TfN, 2017, *International Connectivity Commission Report*

¹⁷ National Infrastructure Commission, 2016, *High Speed North*, <https://www.gov.uk/government/publications/high-speed-north-a-national-infrastructure-commission-report>, Accessed 1 February 2017

seen as key to supporting the Sheffield City Region's ambition for logistics, building on existing investment by the likes of Aldi and ASOS in the Dearne Valley and Markham Vale to the south.

3.4 Releasing Growth in New Homes and Employment Sites

While transport plays an important role in facilitating productivity growth, investment in its infrastructure alone is unlikely to create economic potential. Partners' feedback notes that the connectivity priorities determined as essential to the transformational growth for the Northern Economy need to work alongside both theirs and businesses' plans for spatial planning, inward investment and skills development.

Highways England responds to 3,500 planning applications and local plans every year across England. They have provided TfN with the spatial distribution of major local plan development allocations in excess of 100 homes, 100 jobs and major mixed use developments in the North to which they responded as statutory consultees over the last five years. This is a mark of the interest in investors in locations with good road links. It needs to be remembered that these are allocations and not actual developments, and as a consequence of the phasing in Local Plans, not all areas are shown, but is useful to understand the scale of interest in economic activity around the North's major roads.

Partners are looking to bring forward major transformational residential growth close to the MRN through garden city / village developments in places such as Bailrigg, Lancaster (3500 homes near the M6 and Lancaster University), Handforth Garden Village near the A34 and A555 (2000 homes) and St Cuthbert's near the M6 at Carlisle (10,000 homes) amongst others. These will need access to the MRN to unlock their potential alongside an appropriate sequencing of other transport infrastructure to integrate active and sustainable mode choices and the adoption of smart technology into the community from day one, and thereby contribute to the NPIER growth trajectories described in **Chapter 2**.

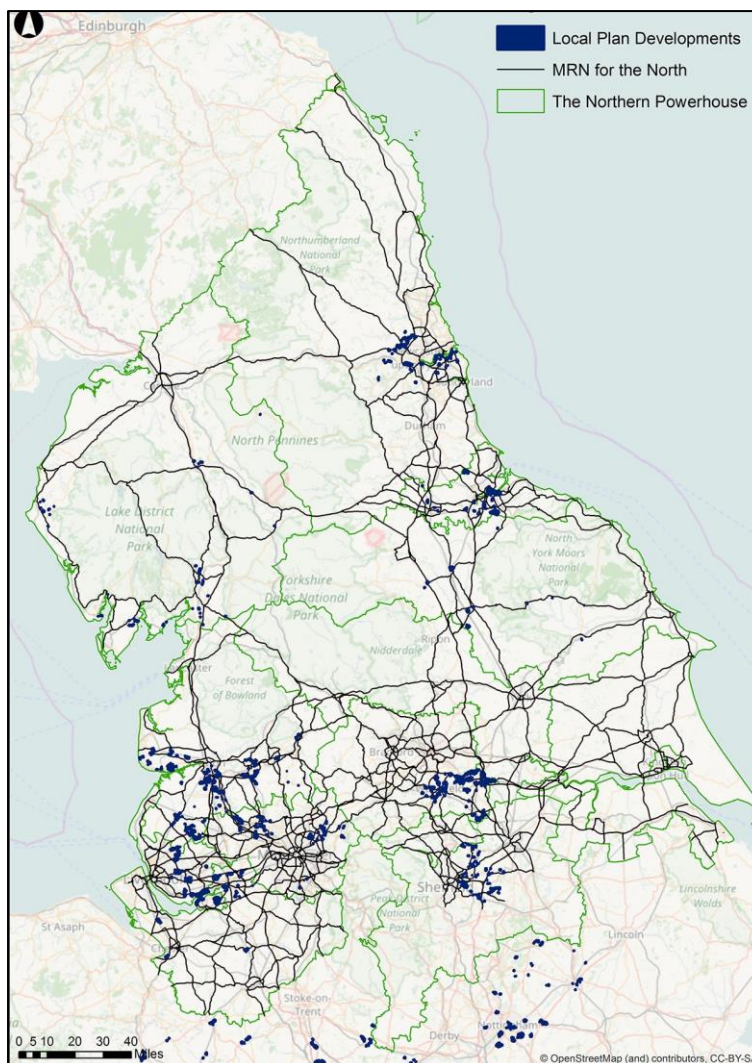


Figure 3.1: Heat Maps showing scale of major local plan development allocations commented on by Highways England in the last 5 years. (This map is not an exhaustive representation of all areas of the North)

3.5 Increasing the Resilience of the Economy

The road network must provide the capacity needed to allow individuals and firms to exploit opportunities in high growth sectors and embrace new ways of working proactively rather than find transport a hindrance. It needs to allow companies based on the North's Nuclear and Wind Energy Coasts for instance to realise their high growth potential in an area of traditionally challenging terrain, as well as draw upon the skills of similar energy firms in Cheshire & Warrington, Lancashire, Cumbria, the North East, Tees Valley, Humber, Sheffield City Region and vice versa. New energy generation is also vital for the future power requirements of the whole of the UK and the decarbonisation of the economy.

Taking the first example, the infrastructure to provide sustainable and resilient connections between employers and their supply chain, markets and workforces is fundamental to maximising and spreading the economic

potential of energy development. Energy schemes often require movement of significant amounts of goods or material, or in the case of offshore wind facilities, the ability to access port facilities for installation and maintenance. One of the reasons why this is crucial is the scale of the investment unlocked. Just taking Cumbria as an example, helps realise £20 billion plus¹⁸ of investment for the Northern economy and UK plc.

The road network also needs to enable firms located close to international gateways and research institutions make the most of changing technology and global trade dynamics. The implications of Brexit and US elections in 2016 provide the potential for a whole new series of trade relationships and dynamics. As mentioned in 3.2, providing the surface access by which the North's international connectivity assets can respond quickly to these external factors will prove crucial in delivering transformational growth.

3.6 Road and Rail Complement the Delivery of Transformational Growth

The road network is crucial to everyday life and the functioning of the North's economy, accounting for 74% of all modal travel to work journeys, more than for the country as a whole and further emphasising the multi-modal nature of the network. But it is also important to note that whilst the majority of pan-Northern transport is by road, regional economies have shown a complementary blend of rail, road, maritime and aviation solutions are vital to economic success. The decoupling of car ownership from GDP growth in recent decades and the experience in other European countries demonstrates that road solutions on their own are not sufficient.

Both the evidence base from National and Local Partners recognises the complementary nature of road and rail schemes. Providing users with different modal options provides the requisite agglomeration, choice, capacity, resilience, environmental, quality of life and equity benefits. Examples include:

- **Strategic Rail Freight Interchanges and inland ports** (such as Port Warrington, Port Salford Tri-Modal Facility or Goole Intermodal Terminal) to maximise the role of rail freight and water transport through consolidating goods for bulk transfer throughout the spine of the North and to surrounding regions.
- **Parkway stations** and improved road access / car parking / public transport for key rail nodes to maximise use of high speed, strategic and light rail services; to provide efficient alternatives to congested parts of the MRN as well as delivering greater agglomeration potential.

3.7 Next Steps

Moving forward NPIER growth requires a more connected network in all senses that can link the transformational clusters of activity across the North. There is a need to make it easier for those in the nuclear industry at Birchwood Science Park to access opportunities in Cheshire and Warrington alongside those in Lancashire and Cumbria's Energy coast and vice versa for those at Whitelakes Science Park.

There is also a need for enabling capabilities such as financial and professional services to benefit from being in well-connected locations such as towns in Calderdale, Craven, Kirklees, Burnley and Pendle through their connections to Leeds, Bradford, Manchester, Preston and each other; with similar patterns repeated elsewhere.

This needs to be a network for all seasons. Do investors have the confidence in the network to get their people and goods to the places they need to be as efficiently as possible? The SRN is not sufficient for all of this. It is also necessary to focus on:

- The Primary Road Network between IECs.
- Other SRN access routes.
- Tactical and agreed diversion routes for the SRN.
- Roads performing ring road or bypass functions or IECs.
- Roads that connect ports, airports, Enterprise Zones and growth locations, universities and key freight hubs with other IECs.

This is the functionality of the Major Road Network for the North. Chapter 4 describes how this has been derived in detail.

¹⁸ Cumbria County Council, 2016, *Cumbria's Strategic Investment Plan, Delivering the four-pronged attack*

4. The Major Road Network for the North

4.1 Introduction

To meet the aspirations of the **NPIER** detailed in **Chapter 2**, a specific network has been developed, termed the draft **Major Road Network (MRN) for the North**. It should be noted that in defining the MRN, TfN does not have, nor seeks to acquire, an operational network role.

4.2 Important Economic Centres

The MRN will **connect approximately 200 Important Economic Centres (IECs)**¹⁹ across the North, including **towns, cities, ports, airports, enterprise zones, universities and other key employment sites**. These have been principle driven, making maximum use of TfN's Strategic Local Connectivity workstream, the NPIER and partner feedback. General principles include:

- **Current economic centres** - generally have a population of >50,000 people (or perform a strong sub-regional function, e.g. Northallerton), represent a regionally important international gateway for people or goods (e.g. Newcastle International Airport or Port of Workington) or employment cluster (e.g. Wilton International, Redcar) or university located external to a major settlement (e.g. University of Lancaster).
- **Future economic growth locations** - key growth centres in local Strategic Economic Plans and Local City Region Strategies, especially linked to the NPIER sectors that deliver a sufficient number of jobs/dwellings to have a significant impact on the economy when considered at the level of the North.

4.3 The MRN for the North

4.3.1 The Purpose of the MRN for the North

The MRN for the North and IECs will be a live network that evolves to meet the emerging needs of the Northern economy and its connectivity priorities, both now and in the future. The MRN for the North includes the SRN and is further developed from associated evidence from:

- Extensive engagement with Local and National Partners.
- Understanding of key connections to centres of economic activity adjacent to the North.
- Rees Jeffreys Road Fund's '*A Major Road Network for England*'.
- Local Partners' current and draft Key Route Networks (KRN).

Linked to this are two core aspects to a MRN for the North:

- **Economic** between IECs and/or key NPIER sector clusters and their labour/ export catchments; whether now, or in the future.
- **Functional** between core economic centres on the network.

This is the network that is most economically functional to securing the North's productivity and growth; both now, and in the future.

Both economic and functional views of the MRN are important. All transport systems need this seamless link for the passenger or freight user to begin, conduct and complete their 'economically critical' journey easily and conveniently to maximise the economic output of the MRN for the North.

Through the use of the MRN, TfN will work with Partners, including Highways England, to identify the connectivity priorities that support transformational growth in the northern economy. TfN will work in partnership, to develop business cases and secure funding for investment where funding might come from National RIS programmes, Combined Authority and LEP funding programmes and from the private sector.

¹⁹ A list of IECs can be found in Appendix D.

4.3.2 Working Definition of the MRN for the North

Throughout the process, there has been a need to develop the MRN both now and in the future with regard to the following factors. These have been discussed and agreed with Partners through the Highways Working Groups attended by representatives from all Partners.

- Connect IECs inclusive of both the first and last miles as directly as possible to drive the agglomeration of the Northern economy.
- Use the 'most appropriate' roads, i.e. the highest part of the road hierarchy available. This naturally means the inclusion of the SRN alongside sections of local networks that also:
 - Connect to the highest part of the road hierarchy available as efficiently as possible – for time critical business traffic this supports their contribution to a productive economy through highly reliable just in time delivery.
 - Provide network resilience that business can depend on to move goods and people efficiently – through both a combination of routes that can withstand traffic incidents and natural hazards effectively as well as provide strength in depth through their ability to provide tactical diversion route functions (recognising that in some cases these are under review).
 - Connect to other modes and provide opportunities for multi-modal integration to enable users to make the most efficient and sustainable journey as part of the overall STP.
 - Perform Ring Road or bypass functions to core population centres – providing relief to valuable places and environments from the impact of traffic while still supporting a productive economy.

This working definition of the MRN for the North has proved useful in facilitating engagement within TfN and stakeholders. This has enabled a collaborative review and refinement of a network to reflect the local knowledge and economic priorities of Highways England and the local highway authorities across the North, for both now and in the future. This is a process that can be revisited with a similarly consistent analysis during future refreshes. **Appendix E** gives an overview of the iterative development of the MRN.

4.3.3 The MRN in January 2017

The January 2017 version of the MRN as illustrated in **Figure 4.1** (overleaf) has been developed based on the working definition of the MRN described above. This also includes the connections between the MRN and the SRN and principal 'A' roads in Scotland, Wales and the Midlands. The MRN within the part of Derbyshire and Nottinghamshire covered by the Sheffield City Region has also been illustrated with dashed lines given its pending status within either TfN or Midlands Connect.

It is important that this network does represent the major roads across the North. As a result it is constructive to compare the length of the Network against the current SRN, and the MRN as developed at a National level by Rees-Jeffreys. A summary of the draft network mileage is presented in the table below.

Summary Statistics	Length (miles)
SRN	1,519
MRN for the North (excludes SRN)	3,389
MRN for the North (includes SRN)	4,908
MRN (Rees Jeffreys Road Fund Report) – North (includes the SRN) *	2,622

***Note** – there is some discrepancy between numbers quoted in this and the Rees Jeffrey Road Fund Report due to the level of detail inherent in the road network shape files used. A factor of 15% has been applied to the Rees Jeffrey Road Fund Report figures based on a sample of selected links.

It is the connectivity to the North's IECs that drives much of the difference in road mileages between the networks here; as it is the full extent of economic centre to economic centre connectivity that it is important to delivering productivity benefits.

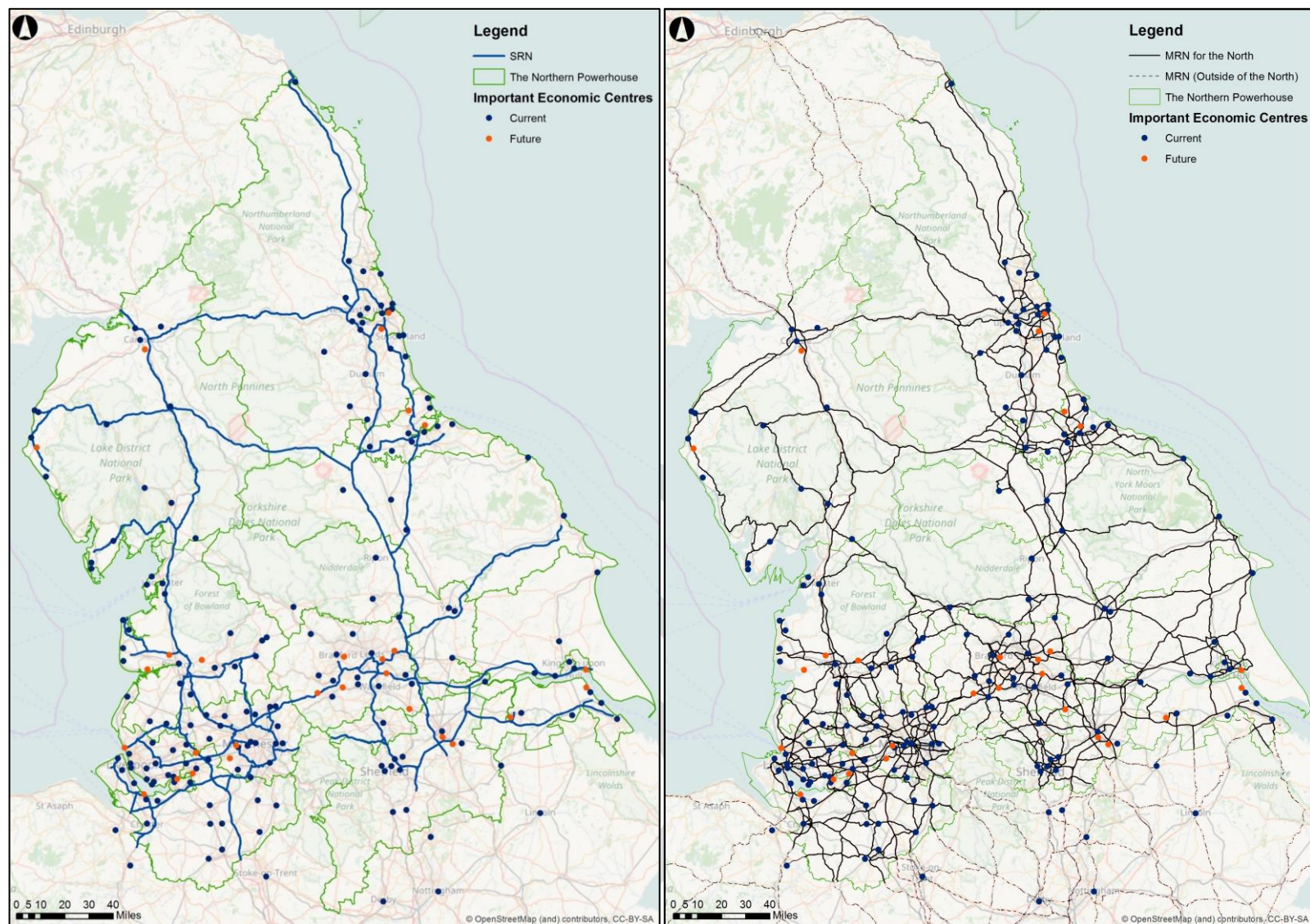


Figure 4.1: Comparison of the SRN in the North (excluding Derbyshire and Nottinghamshire parts of Sheffield City Region) – left – with the Draft MRN for the North (21st April 2017) – right – and its interface with current and future IECs

This is critical to the North, to transform:

- **Agglomeration** - If this is about linking clusters of economic activity then so must the North's road network and investment in it.
- **The North's productivity gap** – IEC to IEC movements must be more productive, more reliable and less congested to close this gap for the North.
- **The ability to better connect current and future IECs to the SRN, MRN and rail networks** - is crucial to promote and provide the headroom for employment and housing growth, while encouraging a network that seamlessly links local networks to key locations.
- **Reducing the cost of exporting goods to national and international markets** - Goods and their transport costs start and end at IECs, not just at the SRN boundary.
- **Time, reliability and resilience Benefits** - It is the above benefits that investing in a MRN for the North will deliver.

Chapter 5 develops this further, to ensure an economically led derivation of core outputs and a vision for this network; supporting by broader objectives to ensure an economically-led but not economically-deterministic outcome for the future.

5. The Vision for the MRN for the North

5.1 The Evidence Base

Central to TfN's vision is a resilient MRN increasingly offering improved, and more reliable journey times linked seamlessly to local networks and the IECs critical to achieving transformational economic growth.

Our review of an extensive strategic and local transport, land use planning and regeneration led evidence base (**Appendix A** provides a list of the evidence reviewed), identified complementary aspirations on the role and performance of our MRN, and how it can contribute to transformational economic growth, whilst also contributing to quality of 'Place'. These include the role of roads in terms of the following outcomes:

- **Journey Reliability.**
- **Network Efficiency.**
- **Network Resilience.**
- **Journey Quality including information provision and asset condition.**
- **Safety.**
- **'Place' in terms of the urban and natural environment.**

We analysed these road based activities in the context of pan-Northern connectivity, the emerging objectives in the TfN Strategic Transport Plan²⁰ and where TfN has a role to play and value to add. Adopting terminology used in the rail industry we then developed a number of Conditional Outputs, essentially outcomes we want to achieve for the MRN.

The primary purpose of any road network in terms of safety and asset condition remain the operational responsibility of the local highway authority and the Conditional Outputs, which have been developed by TfN and agreed with Partners, must be considered in this context. Equally, TfN wish to promote an enhanced built and natural environment across the North but it will remain Local Partners' role to manage quality of place within their local context.

Safety and the environment are important to the pursuit of transformational economic growth but are overarching objectives best considered at the STP level, and as such they have not been identified as specific Conditional Outputs within this report.

5.2 Conditional Outputs

This naturally leads to four key areas of Conditional Outputs (CO) that TfN has an influence over, and in the specific context of pan-Northern journeys in particular. These are:

- **CO1. Journey Reliability.**
- **CO2. Network Efficiency, including a measure of average delay, enhanced use of technology and vehicle occupancy as a proxy for people's behavioural change.**
- **CO3. Network Resilience.**
- **CO4. Journey Quality including information provision and asset condition.**

It is important that the Conditional Outputs are considered in an economic; rather than transport context. The 'Stepping Stone' model, illustrated in **Figure 5.1** demonstrates why each of these four Conditional Output areas are important to the transformational growth scenario detailed in previous chapters, and to the specific NPIER and productivity challenges that are holding back the North's economy.

²⁰ TfN Strategic Transport Plan, proposed objectives will be published at the same time as this report in May 2017.

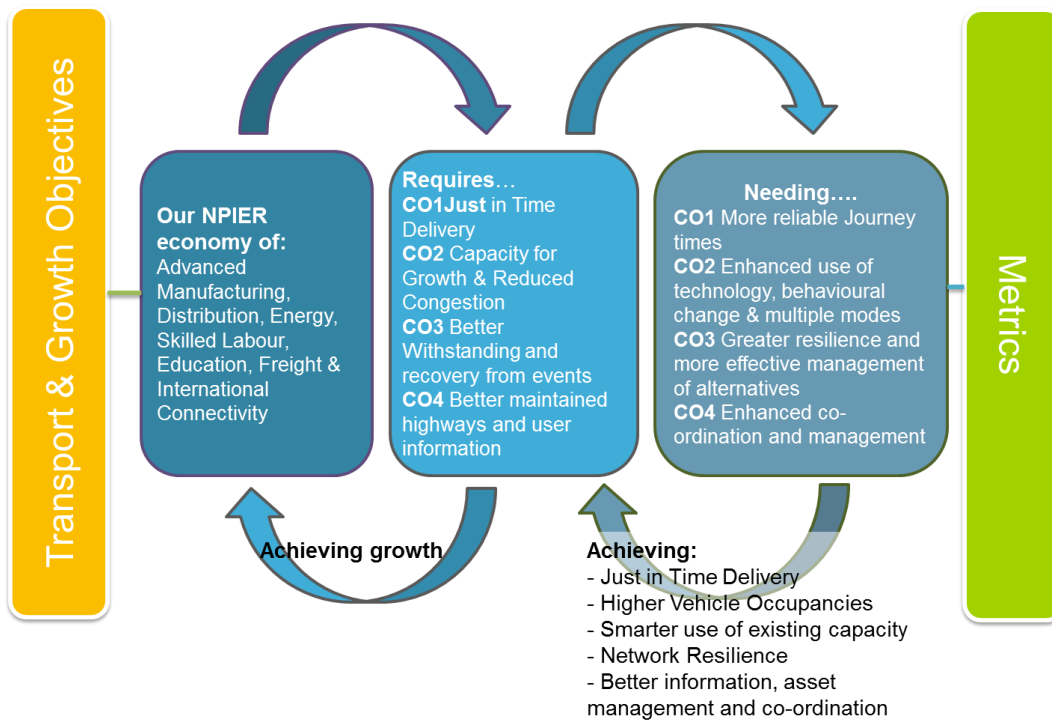


Figure 5.1: Why the Conditional Outputs provide the NPIER economy requirements with what it needs from the MRN

5.3 Linking Metrics and Data Needs to Conditional Outputs

It is important that these Conditional Outputs are defined such that they can be established at a MRN level; connecting the North's IECs. This means that specific measures and metrics for these Conditional Outputs need to be flexible enough to be meaningful for rural and urban areas, and where relevant separate different users of the network; especially between passengers and freight. As with any metric they should also be SMART²¹ to enable TfN and Partners to make informed decisions about how the MRN can deliver the vision articulated in both the STP and Major Roads Report.

In order for the Conditional Outputs to work effectively, there are a number of key principles that need to be adopted, and considered in terms of delivering preferable metrics. These need to:

- Link to the economic purpose/ function of the journey;
- Be scalable to rural and urban areas, as well as both shorter and longer pan-Northern journeys;
- Ensure freight is clearly included within these;
- Be clear, easy to interpret, and have clear measurement;
- Nest within and not impinge on Highways England & Local Key Route Network definitions and metrics; and
- Must be feasible and cost-effective to collect and maintain.

A series of potential options; developed from Highways England and Local Partners' evidence were developed to shortlist, and linked to each agreed Conditional Output area. Based on a series of scoring and feedback sessions with Partners, preferred metrics for each Conditional Output area have been agreed as follows in **Figure 5.2**. Alongside this we indicate the potential datasets to provide objective measurement of performance are indicated.

²¹ SMART – Specific, Measurable, Assignable, Robust, Time Specific

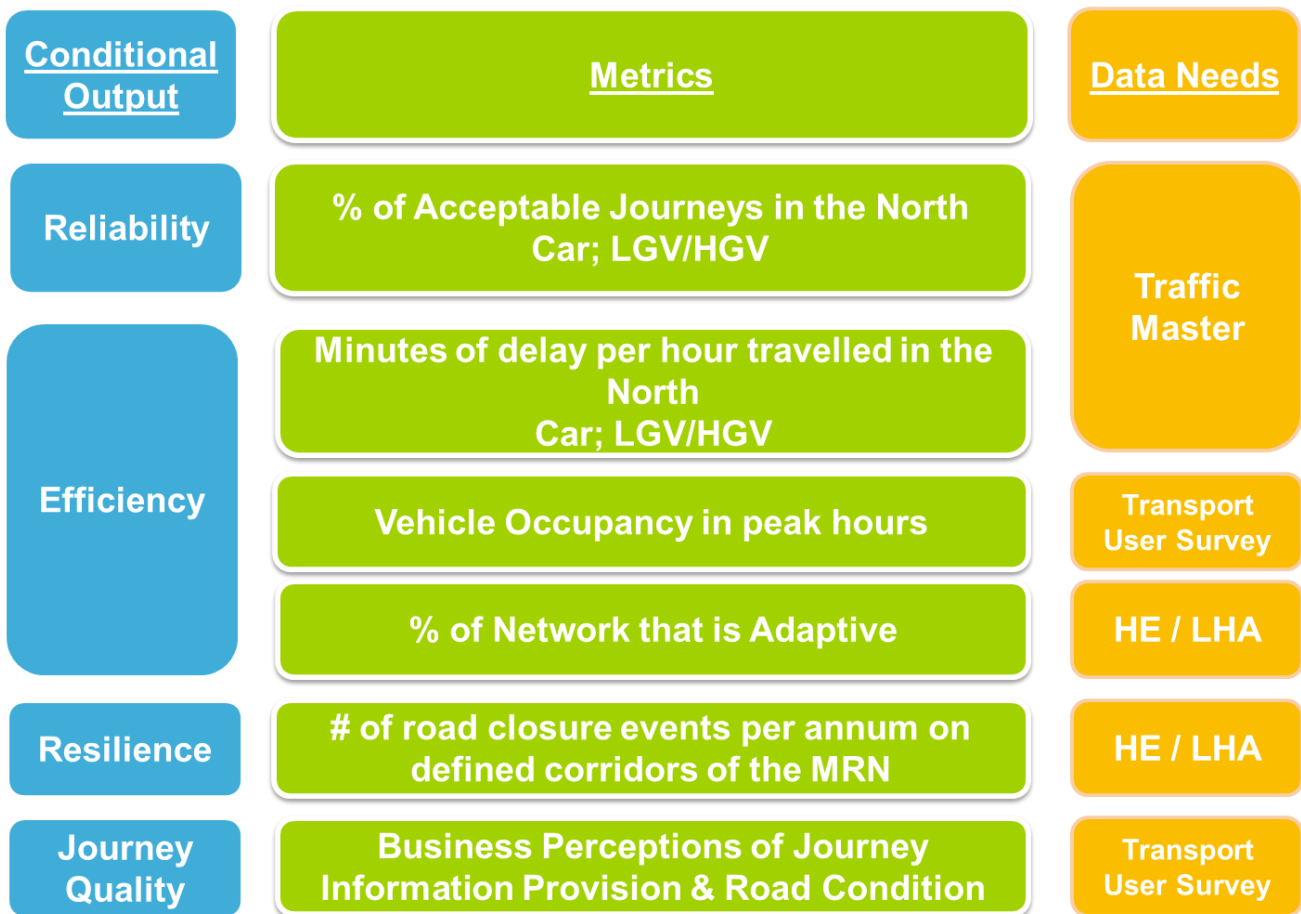


Figure 5.2: The link between Conditional Outputs, Metrics and Data Needs

It is also important that there is a consistent thought process across both the Major Roads Report and Integrated Rail report so that these directly link to the STP objectives and the development of the investment programme. To this end the Conditional Outputs across both road and rail have been shared with each consultant team during their respective iterations and tested in the draft prioritisation process developed for the STP to provide this alignment.

5.4 Data Needs and TfN Requirements

We have worked with Partners to understand the practicalities of data collation and collection options associated with the Conditional Outputs. There is an existing pilot analysis of a pan-Northern Traffic Master dataset to prove the concept for two of the three most highly rated Conditional Outputs. Further details of the suggested approach and initial results are provided in **Appendix F**.

In time the Conditional Outputs will provide a robust baseline of the performance of the MRN. To date **the analysis of the baseline performance of the MRN has been based on a qualitative review of the Partner evidence base, which is summarised in Chapter 6.**

6. Baseline Assessment of the MRN

During the development of the Major Roads Report, Partners provided feedback on the ranking of Conditional Output areas, reflecting their view on the importance of these to the economic function of roads, both now and in the future:

1. Journey Reliability.
2. Resilience.
3. Efficiency including delay, vehicle occupancy and smart adaptive network.
4. Journey Quality & Multi-Modal Opportunity.

In terms of the first three conditional outputs, a series of consistent themes has emerged from the evidence reviews and partner feedback that provides a useful framework to assess the baseline performance of the MRN and its resultant future needs (see **Chapter 8 – Strategic Gaps**). The following aspects cut across multiple conditional output areas (namely journey reliability, resilience and delay) in their specific ways:

- North-South Connectivity.
- East-West Connectivity.
- International Connectivity (see Chapter 7).
- Future access to the MRN.

Additional specific trends for the MRN in relation to resilience, vehicle occupancy, smart adaptive network, journey quality and multi-modal opportunity and the environment are drawn out separately.

6.1 Thematic Trends

6.1.1 North-South Connectivity

It is helpful to conceptualise the MRN as a ladder that only provides the requisite strength for transformational growth with a series of strong north-south routes and multiple rungs for east-west connectivity.

Throughout the evidence base, north-south movement is generally seen as better than east-west connectivity at present with the core components of the SRN, such as the M6, M1, M18, A1 and A168/A19 providing vital links between the North, Scotland and the Midlands. These have helped to define the economic geography in terms of journey to work, industry clusters and supply chain patterns of the North. Specific examples include:

- The links via the A19 between Nissan with a car produced every 4 minutes²² and the Port of Tyne which is the second largest exporter of cars in the UK.²³
- The continued strength of the logistics and food industry in the A1(M) corridor through North Yorkshire.²⁴
- The contribution and ongoing importance of the M1 (including its links to the M62) in terms of supporting the diversity of the polycentric and multiple NPIER sector West Yorkshire, Leeds City Region and Sheffield City Region economies alongside a wider pan-Northern and national connectivity role between London, the East Midlands, North East and Scotland.
- Major distribution centres for growing retailers as part of a major transformation of the Dearne Valley area including ASOS and Aldi benefitting from links to the M1 and A1(M).²⁵

This over-reliance on the SRN for these north-south movements results in congestion and sections of the network prone to incident related resilience issues however, with particular problems including:

- The M1 around Sheffield and the A1(M) around Doncaster. Along the latter there is a local aspiration to provide growth and enhance the role of Doncaster Sheffield Airport and the surrounding area and provide a resilient alternative to the constrained M1 past Sheffield, yet key junction capacity challenges

²² Personal communication from the North East Combined Authority Highways Working Group representative, January 2017

²³ TfN, 2017, *International Connectivity Commission Report*

²⁴ North Yorkshire County Council, 2015, *A Strategic Transport Prospectus for North Yorkshire*

²⁵ Sheffield City Region LEP, 2016, *Sheffield City Region Integrated Infrastructure Plan*

already exist in a number of areas, particularly A1(M) Doncaster to Darrington, where the road is a two-lane motorway and the section north to Redhouse is an all-purpose A road.²⁶

- The A1(M) including the A1 Newcastle - Gateshead Western Bypass, which links the whole area to Newcastle Airport, is one of the most congested roads in England;²⁷
- The A19 in the Tees Valley and North East, with the approaches to and the interchange with the A66 link to the A1 and Teesport a key constraint for the area's network. A new Tees Crossing is the subject of a Large Local Major Scheme study announced in 2016's *Autumn Statement*.²⁸
- The M6 in Cheshire and Warrington,²⁹ albeit now benefiting from RIS1 smart motorway enhancements.

The issue for the MRN is that it is not only the SRN that fails, but also the sections of the MRN to and through the IECs.

*"This spine of connectivity is congested and fragile in terms of its resilience. When it fails, not only does connectivity become impaired, but the sub-regional centres are paralysed with congestion"*³⁰

Estuary / river crossings and urban areas also provide north-south connectivity issues at a LEP level, with the following constraints to growth noted amongst others:

- River Tyne crossing points and their approaches are often subject to congestion³¹. Further issues in the short to medium term are expected with planned major maintenance schemes on some of the Tyne Crossings providing fewer options and resilience for these journeys.
- A19 Tees Crossing - a pinch point at the Tees flyover, where delays regularly occur because there are too few high quality roads crossing the Tees.³²
- The Ribble Crossing proposal to unlock new development in Preston, South Ribble and Fylde.³³
- Radial links to and through IECs, such as the A34 Corridor through Congleton approaching capacity and the subject of a scheme through the Growth Fund.³⁴
- The Manchester Ship Canal, through Greater Manchester, Warrington and Cheshire West, where limited and often low capacity bridging points create resilience and capacity issues.

6.1.2 East-West Connectivity

Consistently across the evidence base the number, capacity, reliability and resilience of east-west road connections are seen as a constraint on the Northern economy. This is pertinent to links across the Pennines as well as the connections to and from key north-south axes described above. This is summed up well in *A Strategic Transport Prospectus for North Yorkshire*:

*"In common with the rest of the North of England north – south transport links in North Yorkshire are generally good but the east – west transport links are relatively poor."*³⁵

The M62 and the A63 to the port of Hull are the only continuous east-west dual-carriageway roads linking the M6/M74 and A1/M1 north of the A50 corridor in the Midlands and south of the M8-A8 in Central Scotland. It carries half of all trans-Pennine road traffic, and two thirds of all freight, while performing a vital function in respect of the diversity and growth of the Liverpool City Region, Greater Manchester, West Yorkshire / Leeds City Region and Humber economies. Yet this role also leads to certain stretches experiencing a 70%-80% likelihood of serious congestion during peak periods. It is also a key issue for network resilience, being the North's highest altitude motorway and more susceptible to snow and adverse weather³⁶. Various Partner

²⁶ Sheffield City Region LEP, 2016 *Integrated Infrastructure Plan*

²⁷ North East LEP, 2013, *Independent Economic Review*

²⁸ <https://www.gov.uk/government/publications/autumn-statement-2016-transport-announcements/autumn-statement-2016-transport-projects>, Accessed 01 February 2017

²⁹ Cheshire and Warrington LEP, 2016 – *Cheshire and Warrington Subregional Transport Strategy Draft Final*

³⁰ Cheshire and Warrington LEP, 2016, *Cheshire and Warrington Subregional Transport Strategy Draft Final*

³¹ North East LEP, 2014, *North East Strategic Economic Plan*

³² Tees Valley Combined Authority, 2016, *Tees Valley Strategic Transport Plan Framework*

³³ Lancashire LEP, 2016, *Strategic Transport Prospectus*

³⁴ Cheshire & Warrington LEP, 2014, *Cheshire & Warrington Matters: Strategic and Economic Plan for Cheshire and Warrington*

³⁵ North Yorkshire County Council, 2015, *A Strategic Transport Prospectus for North Yorkshire*

³⁶ Steer Davies Gleave on behalf of HS2 Ltd, 2014 - *Transport Constraints and Opportunities in the North of England*

documents³⁷ reference the need for a long term strategy for improving resilience and reliability on this section of the M62 and A63, the neighbouring M60 and other trans-Pennine highway links.³⁸

In essence the ability of the Northern Powerhouse to work together as one and generate the benefits for the whole of the UK is currently heavily dependent on the successful operation of just one road.

MRN alternatives are a combination of single and dual carriageway with only limited stretches of motorway. East-west travel across the Pennines and Cumbrian mountains on these other routes can be unreliable with severe delays and closures not uncommon in bad weather. Strategic studies are in progress concerning some of these alternatives:

- Between Greater Manchester and the Sheffield City Region, the SRN consists of largely single carriageway roads (A57/A628/A616/A6102) through the middle of the Peak District National Park, taking almost 90 minutes through one of the country's most valued habitats and landscapes. The drive time between Rotterdam and Utrecht in the Netherlands, a comparable distance, is closer to 45 minutes. The current strategic study is evaluating the potential for tunnelled options and strategic links to a tunnel.
- The A66 between Scotch Corner and Penrith (with links to Teesport and Workington) is a mix of dual carriageway and single carriageway road at risk of closure during adverse weather (snow and wind) given its high elevation, with additional susceptibility to journey time reliability.
- The all-weather route (A69) between Newcastle and Carlisle has a higher percentage of single carriageway roads, and like the A66 also suffers from journey time reliability.³⁹
- Connectivity to the North's major ports is hindered by poor 'first and last mile' connections from the motorway network, for example freight traffic on the A63 to the Port of Hull experiences substantial delays.

North of the M62 the Central Trans-Pennine corridor between Lancashire and Yorkshire includes two broad alternative routes from the M6/M61 and the urban areas of the Leeds City Region, Skipton, Harrogate and the A1(M) using roads largely under the operation and management of local authorities:

- M65 is an inconsistent standard of motorway between the M6 at Preston and the edge of Colne with important links to the A56/M66 to Greater Manchester. The predominantly two lane section between the M61 (Junction 2) and Whitebirk (Junction 6) is increasingly a bottleneck, reducing the ability of the M65 to function as a key gateway for East Lancashire.⁴⁰ Single carriageway connections at its eastern terminus to the A59 at Skipton (via the A56) and A650 for the Airedale Valley (via the A6068) provide the trans-Pennine connections.
- A59 provides a largely single carriageway link from Preston to Harrogate and the A1(M) with resilience issues (Kex Gill geotechnical issues) and sections through congested urban areas such as Harrogate.⁴¹

East-west connectivity is also raised by Partners as an issue for other sections of the MRN. The M56 is crucial in providing access to Manchester Airport, the Airport City Enterprise Zone, a future airport HS2 station and further highly important NPIER growth on the Cheshire Science Corridor. However congestion hotspots are noted on various sections between Manchester and Chester.⁴² Other examples amongst others include congestion issues are noted on corridors such as the A64 between Scarborough and York and the A1(M) and the A1079/A1237/A59 between Hull, York and the A1(M), with sections around York Ring Road encouraging traffic to divert through the city, causing further congestion in York's city centre.⁴³

6.1.3 Future Access to the MRN

The MRN also needs to cater for access to future Nationally Significant Infrastructure Projects (NSIP) and major housing allocations. Specific examples from the evidence include but are not limited to:

³⁷ Such as the *Greater Manchester Spatial Framework Consultation Draft*, 2016

³⁸ *Greater Manchester Transport Strategy 2040, Consultation Draft* 2016

³⁹ Cumbria LEP Infrastructure Plan, 2016

⁴⁰ Lancashire LEP - East- West Connectivity Study, 2016

⁴¹ York, N. Yorkshire and East Riding - Strategic Economic Plan - Update 2016

⁴² Cheshire & Warrington LEP, 2015, *Subregional Transport Strategy Draft Final*

⁴³ York, N. Yorkshire and East Riding - Strategic Economic Plan + Annex, 2014

Moorside nuclear power station on Cumbria's Energy Coast. This will be capable of supplying up approximately 7% of the UK's current electricity requirement.⁴⁴ To have this open for 2024 requires the transportation of construction materials and 6,000 workers who do not already live in West Cumbria, and to do so during ongoing operation of Sellafield and on sections of road such as the A66 and A595 that are currently in the top third of the SRN for delay⁴⁵. This is not just important for the North, it is also crucial for UK plc.

South Humber Bank NSIPs. A strong logistics and transportation sector and a coastline which includes the UK's largest port has a requirement for new and improved infrastructure to facilitate development at the likes of ABLE Marine Port. Some of this infrastructure is already in place, such as the A160 Immingham Improvement, but further connectivity to the North and Midlands will help realise the potential.⁴⁶

High Speed Two. Crewe is the most unique of the HS2 stations, and is a game changer for Cheshire and Warrington and its neighbouring areas. The major catalyst is the Northern Gateway Development Zone (NGDZ) supported by the Staffordshire and Cheshire and Warrington LEP; its objective is to capitalise on this investment and provide a zone for economic development, delivering 100,000 homes and 120,000 new jobs by 2040.⁴⁷ However access to the MRN via the A500, M6 and other roads is crucial to achieving this vision.

6.2 Further Commentary

6.2.1 Resilience

Resilience issues for the MRN vary according to the role of the particular part of the MRN. Resilience issues are greatest where the specific role the section of the MRN plays cannot be replicated elsewhere. Where this involves the SRN, it is its ability to carry large volumes of traffic rapidly and safely most of the time. Where it cannot perform this function, most often because of accident and delay, the alternative sections of the MRN do not have the ability to cope.

There is no common database or methodology for monitoring the resilience of the MRN. Highways England have Operational Management Plans refined through years of response to incidents and adverse weather, and have implemented and are developing further plans for Smart Motorways (such as those on the M56 and M6) and other technology schemes such as on the A1 and A19 to provide active management of traffic including incidents to minimise its impacts on the function of the network.

Some partners have data on road closures recorded or mapped, with the best available data from the North East of the region, where of the 221 closures on local authority roads in 2016, 51 were on the MRN. Elsewhere data is sparse or not spatially referenced although some partners are moving to systems such as ELGIN that allows this performance to be recorded.

In mountainous and coastal areas the impact is often adverse weather. The topography means that a less dense network of roads exists and hence the impact on users is major in terms of journey time and cost to business productivity through the diversions that result. Closure of the A591 section of the MRN between Keswick and Grasmere for 5 months⁴⁸ was just one consequence of Storm Desmond in 2015/2016. Maps of the MRN and their adjacencies to areas of snowfall, rain and flood risk are presented in **Appendix G**.

The variability of available data raises a number of questions for TfN and the Highways Working Group to consider before determining how resilience of the MRN should be monitored, these are:

- Should the Major Roads Report set a resilience target for the MRN as a whole or focus on setting a target and monitoring performance for key corridors on the MRN?
- Is there a role for TfN and the Highway's Working Group in supporting the standardisation of data collection on incidents impacting on the MRN?

⁴⁴ Cumbria LEP Infrastructure Plan, 2016

⁴⁵ West of M6 Strategic Connectivity Study Option Appraisal Report August 2016

⁴⁶ Greater Lincolnshire LEP Strategic Economic Plan 2014-2030 Refresh – 2016

⁴⁷ Cheshire East 'High Growth Region': The Evidence Base for Crewe Superhub – 2016

⁴⁸ The Guardian, 11 May 2016. "Lake District road reopens after five months of misery".

6.2.2 Efficiency

Smart, Adaptive Assets

Through dialogue with both Highways England and local Partners, it has become clear that there is considerable variability across the North in the type of smart, adaptive assets deployed on the road network and in the maintenance of asset registers detailing their existence. **Appendix H** provides a summary of smart or adaptive assets readily available on the MRN, as of 30 January 2017.

The speed of technological change is accelerating. The widespread adoption of internet based technology and complex data processing is changing the way we think about data and its possibilities. Advances we are seeing in everyday life in smartphones, entertainment and communication are also happening in transport. We are moving away from a world where transport authorities are solely responsible for transport technology to one where they play a part in a wider technological ecosystem.

As we move further into the digital age it will become ever more important to embrace new approaches to travel demand management, travel information and behaviour change, building on the good work that Partners are already doing in this area.

Recommendations are that TfN and Partners:

- Work together to develop and implement a transport technology strategy for the North, sharing resources and best practise, working together with digital industry partners to maximise the benefits of investment.
- Agree on the assets which constitute a smart, adaptive network today, and on how existing assets be best utilised to improve the performance of the MRN.
- What should a smart and adaptive network look like in 2020, 2025, and 2030 and beyond? For example this could mean
 - By 2020, users of the MRN have access to live traffic and travel information, and tailored to their journey, information on travel disruptions pushed out to them via smartphone and in vehicle technology; Information could include performance of road and public transport networks, parking availability, expected arrival time and cost of their journey. Also for 20% of the MRN to have active traffic management
 - By 2025, further communication, 40% of MRN to have active traffic management, with integration between Highways England and Local Transport Authority traffic management systems. Emerging autonomous vehicle technologies piloted on a number of routes.
 - 2030 and beyond, 80% of MRN with fully integrated active traffic management. Further rollout of autonomous vehicle technologies.

Vehicle Occupancy

Data from the National Travel Survey for the North shows that vehicle occupancy has generally been declining slightly over the past 14 years from 1.60 to 1.54⁴⁹. This is despite the investment that Partners have made in rapid transit alternatives to the private car in towns and cities alongside travel demand management initiatives. Likewise many of the North's economic assets, such as airports with their Surface Access Strategies and businesses with their workplace travel plans and travel policies are actively seeking to encourage alternative travel modes to the private car or car sharing. Taking Newcastle Airport as an example it has set targets to further increase sustainable transport usage to 30% (from 20%) and to grow staff sustainable travel to 25%.⁵⁰

⁴⁹ Department for Transport, 2017, Bespoke data analysis for the North associated with Table NTS0905, Car/van occupancy across England from 2002 to 2015

⁵⁰ Newcastle Airport Surface Access Strategy, 2013

It is recommended that TfN and Partners work together to encourage the more efficient use of the MRN, through higher levels of car sharing, particularly for commuter journeys during peak periods on the road network.

6.2.3 Journey Quality

There is no comprehensive pan-Northern dataset regarding the views of road users and businesses on the performance and quality of the road network. Survey data does however exist in the following formats:

- National Highways and Transport (NHT) Satisfaction Survey. 39 Local Highway Authorities in the North took part in 2016, with variable numbers in previous years. This covers all roads and all road based journey modes, not just the MRN.
- Pan England Transport Focus surveys for Highways England as part of the evidence base for their emerging 2020-2025 Route Strategies, providing a useful insight into the perception of different road users and businesses that use the SRN, such as fleet managers.⁵¹

It is recommended that with the input of the Highways Working Group, TfN commission a study, potentially in partnership with Highways England, to measure user perception of the MRN.

Congestion and slow moving traffic drives dissatisfaction for a third of all road users. This outweighs the quality of the road itself, mentioned by 16% for 'A' roads, but just 5% for motorways. Transport Focus asked road users for their views on their priorities for 2020 and beyond to understand whether this was any different. Interestingly road surface quality does not feature strongly, as it is seen by road users as a maintenance problem to be solved now. When asked to look beyond 2020, road users are more concerned by increasing demand and the capacity issues that arise from this challenge.

Transport Focus carried out sampling across the Northern SRN where users were asked for their live feedback at the moment of the survey. **Figure 6.1** presents a summary of findings below:

Route	% experiencing problems	Most frequent problem
London to Scotland East (M1 & A1 north of Leeds)	40	Roadworks
South Pennines (M18, M53, M56, M57, M60, M61, M62, M180)	40	Congestion and queuing
London to Scotland West (M40 & M6)	37	Congestion and queuing and roadworks all equal
London to Leeds (East) (A1)	28	Accidents, road closures, congestion, queuing all equal
North Pennines (A66, A69, A590, A595)	17	Roadworks

Figure 6.1: Key problems by route in the North ⁵²

The importance of journey information is evident from road users' responses. Users say that they consciously pre-plan their journey to avoid roadworks (10%) or road closures (5%) or congestion hotspots (4%).

6.2.4 Multi-Modal Opportunity

Park and ride opportunities exist for road users for pan-Northern journeys through:

- **Railheads** – typically on stations on the East and West Coast Mainlines, such as Northallerton drawing passengers for longer distance journeys from a large catchment area where the rail service is sparse
- **Park and Ride on the periphery of major cities associated with rapid transit systems** such as Ashton Moss for the Manchester Metrolink, Meadowhall for Sheffield Supertram and Callerton Parkway for the Tyne and Wear Metro, amongst others.
- **Bus based Park and Ride** serving historic town and city centres or tourist destinations, such as York, Chester and Scarborough, amongst others.

⁵¹ Transport Focus, 2016, *Road to the future – What road users want from Highways England's 2020-2025 Route Strategies*

⁵² Transport Focus, 2016, *Road to the future – What road users want from Highways England's 2020-2025 Route Strategies*, p. 7

A gap exists in terms of the provision of multi-modal interchange for some of the other pan-Northern railway lines. Taking Burnley Manchester Road as an example, Lancashire's aspiration for additional car parking will provide the opportunity for more pan-Northern journeys to transfer from road to rail for the majority of their journey to other IECs such as Halifax, Bradford, Leeds and Manchester providing an efficient alternative to the M62 as well as delivering greater agglomeration potential. Such initiatives would benefit from integrated ticketing and through fare structures.

6.3 Environmental performance

Although the consensus from the work on the development of the STP is that the environment is an overarching objective best analysed at this scale, feedback from Highways Working Group Partners and the evidence review has highlighted the importance of the environment to the role of roads.

Air quality issues are an important consideration. Already the North's town and city centres face air quality problems and in many instances transport emissions are the most significant a significant contributor to this poor air quality, including within the designated local air quality management areas (AQMA) in the North. Local areas surrounding sections of the motorway network experience concentrations of pollutants close to, or in excess of, European prescribed limits. Examples include but are not limited to:

- M1 between J32 and J35a east of Sheffield, where a 60mph speed limit is under consideration by Highways England ⁵³
- M60 in Greater Manchester.
- North Valley area of Colne has a particular issue with standing traffic affecting local air quality and the route effectively severing the North Valley housing estate from all amenities in the town. ⁵⁴

Even with improved emission characteristics of the national vehicle fleet, any further traffic growth has the potential to worsen these conditions.

Local Authorities have responsibility for the management and reporting on AQMA. TfN will need to ensure that through working with Local Authorities decisions on where to invest in the MRN take account of impacts on air quality. This will enable TfN's long term strategy to deliver transformational economic growth, whilst supporting the quality of life of today's citizens and generations to come.

6.4 Safety

Appendix G shows the statistical risk of being killed or seriously injured (KSIs) occurring on the MRN for the North for 2010-2012. The risk is calculated by comparing the frequency of road crashes resulting in death and serious injury on every stretch of road with how much traffic each road is carrying. The risk rating is in comparison to the whole of Great Britain as calculated by The European Road Assessment Programme (EuroRAP). This map is used indicatively to identify locations across the North with resilience and safety issues occurring as a result of road collisions. TfN is not seeking responsibility to address road safety issues, which are managed by Highways England and Local Highway Authorities Route Management Strategies and Operational Plans.

Having considered the baseline performance of the MRN across multiple themes there is also a need to consider the future challenges and opportunities for the MRN. **Chapter 7** presents that summary of what the MRN needs to provide in terms of its future economic function, technological change and climate change.

⁵³ "60 mph speed limit for M1 under consideration to combat air pollution", *The Guardian*, 22 January 2017

⁵⁴ Lancashire LEP - East- West Connectivity Study - 2016

7. Future Network Requirements

7.1 Northern Powerhouse Independent Economic Review (NPIER) Demand Assumptions

Chapter 2 provided an overview of how the transformation in the economy of the North by 2050 could materialise in terms of four scenarios. In all cases the levels of employment, productivity and output are more similar to the South East of England than they are today. TfN has produced a separate Transport Demand and Analysis Report, covering each of the four scenarios across both road and rail. The headline growth in road based travel demand across the North from 2015 to 2050 for each of the four scenarios is as follows:

Functional Geography	Scenario 1 – Compact and Digital		Scenario 2 – Compact and Travel Friendly		Scenario 3 – Dispersed and Digital		Scenario 4 – Dispersed and Travel Friendly	
	Commute	Other	Commute	Other	Commute	Other	Commute	Other
Within City Regions	13%	43%	30%	51%	15%	35%	32%	44%
Within Rest of North	14%	30%	27%	34%	12%	28%	26%	32%
Between City Regions	-16%	42%	56%	74%	-17%	54%	60%	86%
Between City Regions and Rest of North	-6%	28%	53%	58%	-2%	35%	58%	65%
Total	11%	39%	32%	49%	12%	35%	34%	45%

Table 7.1: Growth in Travel Demand from 2015 to 2050 for each of the four foresighting scenarios based on NPIER

7.2 Freight Network Requirements

7.2.1 Context

Freight transport and logistics services are delivered almost exclusively by private sector companies which invest heavily in infrastructure such as ports, inland terminals and warehouses and equipment. To deliver these services they interact with the road networks that are able to carry the appropriate sized vehicles. This includes the MRN.

The North of England already punches above its weight in handling 35% of the total port throughput of some 500 million tonnes p.a. in Great Britain and hosts 30% of the 40 million square metres of large distribution warehouses in the country. In addition, 35% of all road freight and 56% of all rail freight has an origin or destination in the North, all of which demonstrates its existing competitiveness.

TfN's Freight and Logistics Report identifies the opportunity to increase the proportion of goods to and from the North of England arriving directly by rail (whether to and from the South East ports or Scotland, for example), or by sea to northern ports; in either case by-passing the road network in the South and the Midlands. This cuts user costs, saving money for existing users and attracting employment by making logistics locations in the North more competitive.

7.2.2 Existing Demand

The MRN plays a key role in the transport of freight given road's dominance in overall mode share. **Table 7.2** summarises the freight mode share in the North expressed in both tonnes lifted and tonne kilometres.

Table 7.2 Freight Mode Share - 2016 Base

Mode	Tonnes Lifted		Tonne Km	
	Tonnes Lifted	Mode share	Volume	Mode share
Road	574,040,614	91.0%	71,841,903,276	87.2%
Rail	44,078,262	7.0%	9,994,744,474	12.1%
Waterway	12,820,832	2.0%	526,873,283	0.6%
Total	630,939,709	100.0%	82,363,521,033	100.0%

The North's key freight infrastructure is shown on **Figure 7.1**. This includes the MRN and the rail network, ports and airports, and warehousing density across the North.

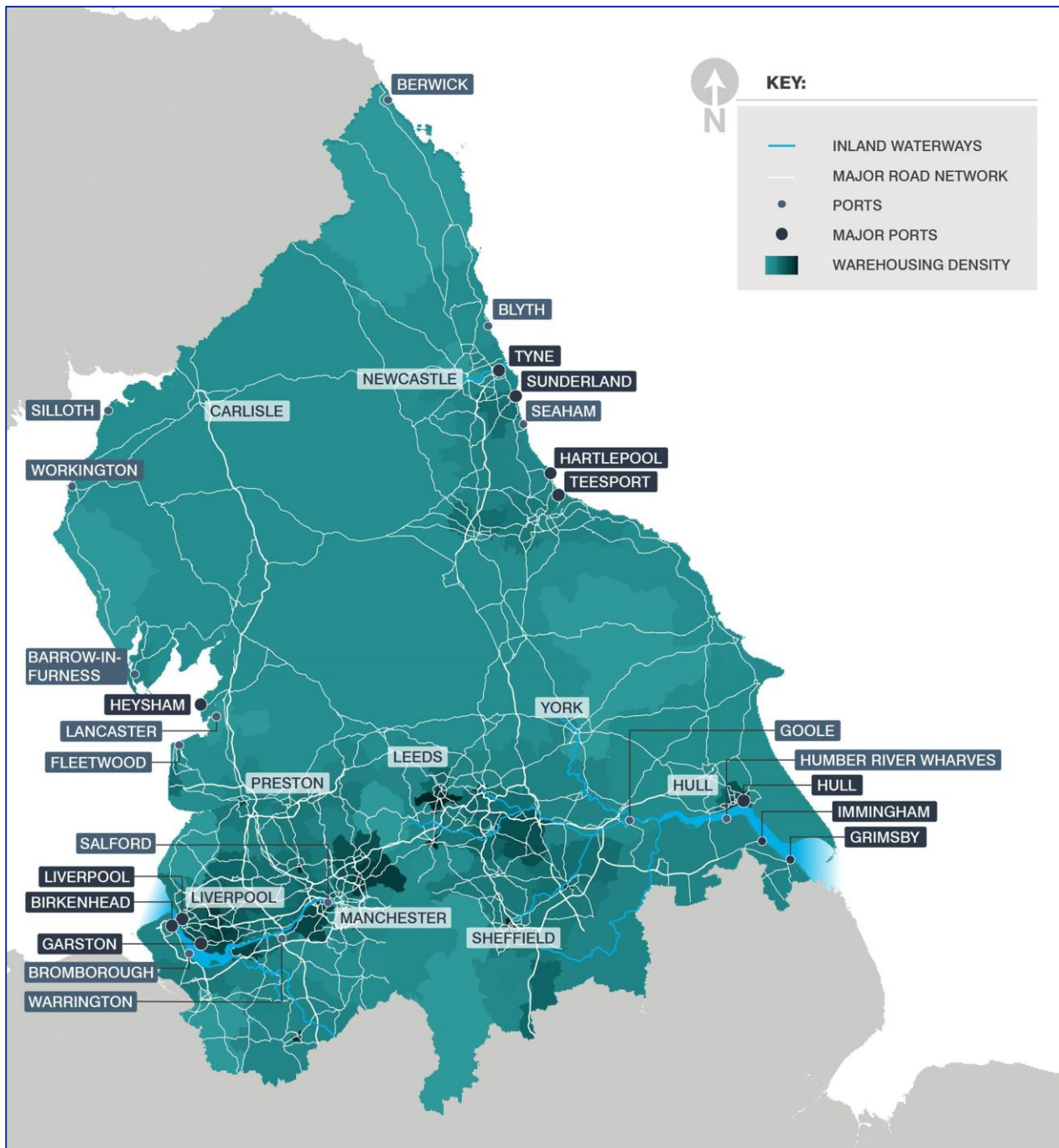


Figure 7.1 Freight Infrastructure

Existing road freight demand has been modelled using the independent Great Britain Freight Model (GBFM) developed by MDS Transmodal (MDST). The model is an integrated software/database system linking domestic and international GB freight data within simple economic models for explaining freight demand and allowing trend and scenario based forecasting. **Figure 7.2** shows the 2016 base freight flows in cargo tonnes that travel via the MRN.

The largest flows of HGVs can be found on the following sections of the MRN:

- M6 south of Liverpool and Manchester.
- M62 between Manchester and Leeds.
- M56 west of the M6.
- M1 to the south of Sheffield.
- A1(M) in Yorkshire.

- Routes towards the Humber ports on the North and South Banks.

A large volume of cargo is also imported and exported from the North. These flows are transported through the North's ports, namely;

- Port of Liverpool.
- Teesport.
- Humber Ports (Ports of Hull, Immingham and Grimsby).
- Port of Tyne.
- Port of Heysham.

A significant proportion of the freight heading to and from the North also travels through ports out with the North such as Felixstowe, Southampton, London Gateway and London Thamesport. In addition, Manchester Airport handles a small percentage (4%) of the UK's air freight, with significant volumes travelling between the North and other airports such as Heathrow, East Midlands and Stansted.

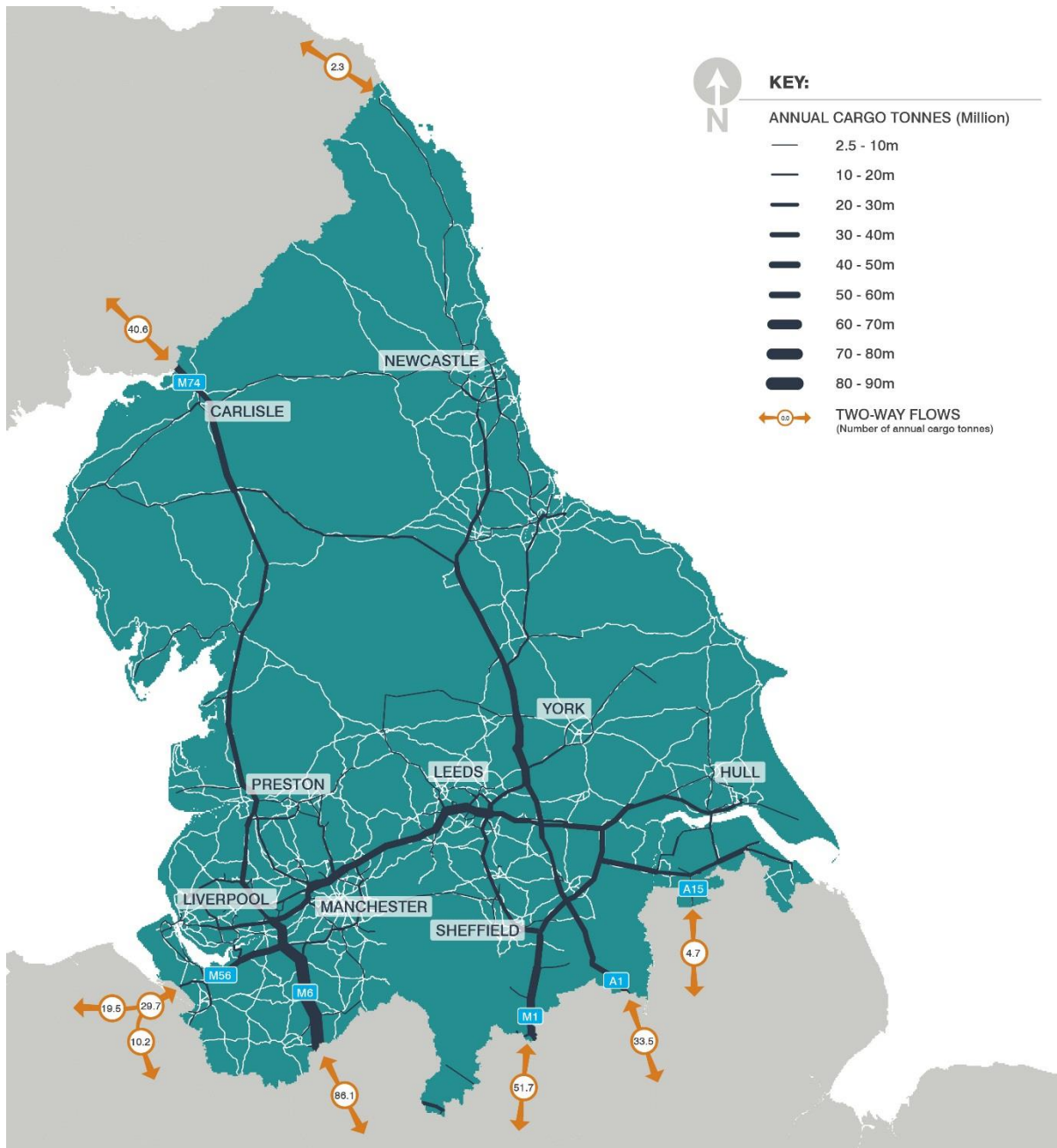


Figure 7.2 –2016 Base Road Freight (Cargo tonnes)

7.3.3. Future Demands

Utilising the growth predictions based upon Business as Usual (BAU) and NPIER scenarios, future freight demands on the road network have been modelled for 2050. At this stage the model is based on unconstrained growth on the transport network and assumes that only existing committed transport interventions are delivered. The BAU growth forecasts show that by 2050 freight movement by road (cargo tonnes) increases by 49%, with the NPIER growth scenario resulting in a 62% growth in road freight.

Figure 7.3 shows annual cargo tonnes on the road network with NPIER levels of economic growth and **Figure 7.4** shows the increase in cargo tonnes in 2050 compared to the 2016 baseline.

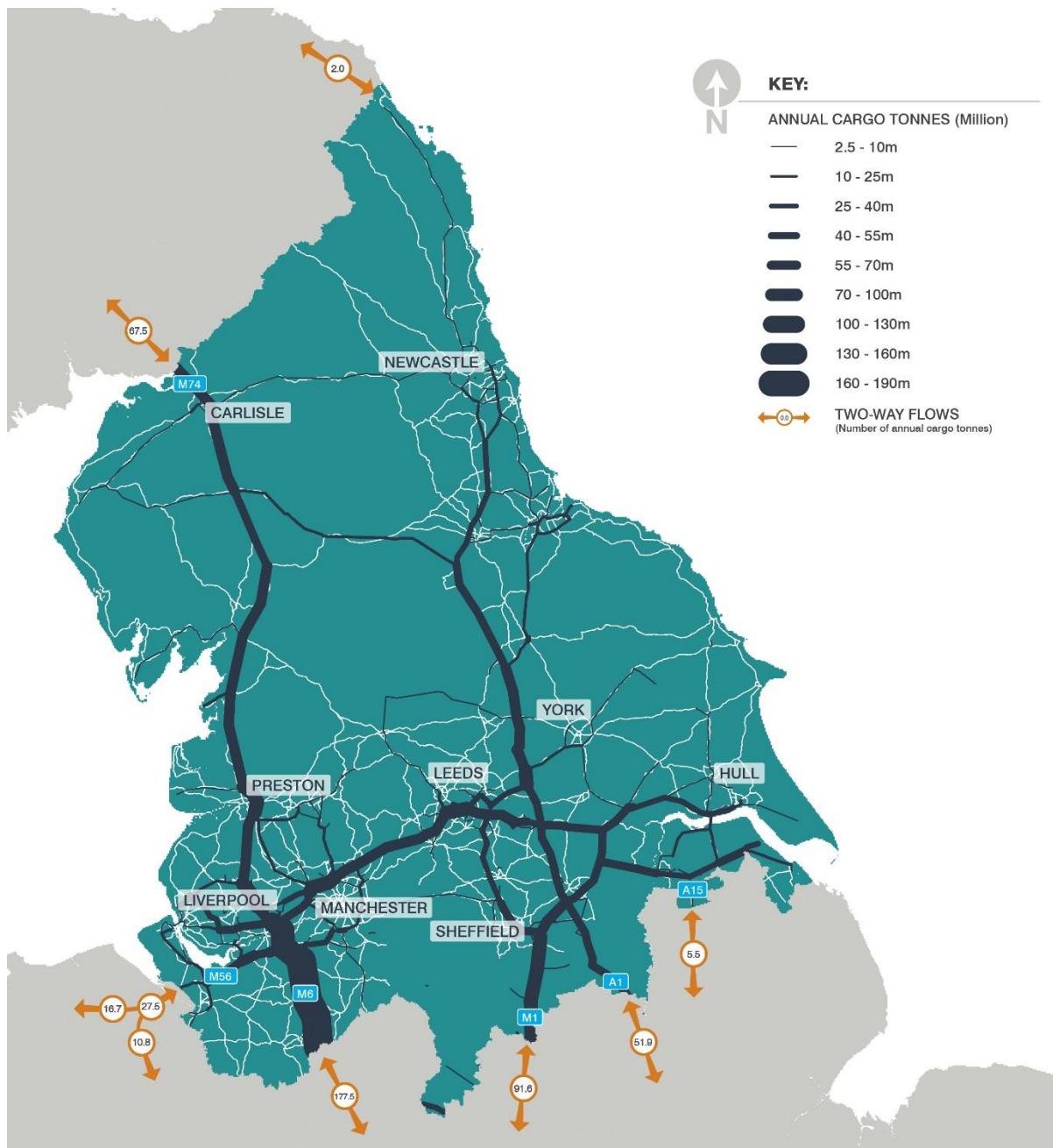


Figure 7.3 Annual cargo tonnes per year (millions) 2050 – NPIER Growth

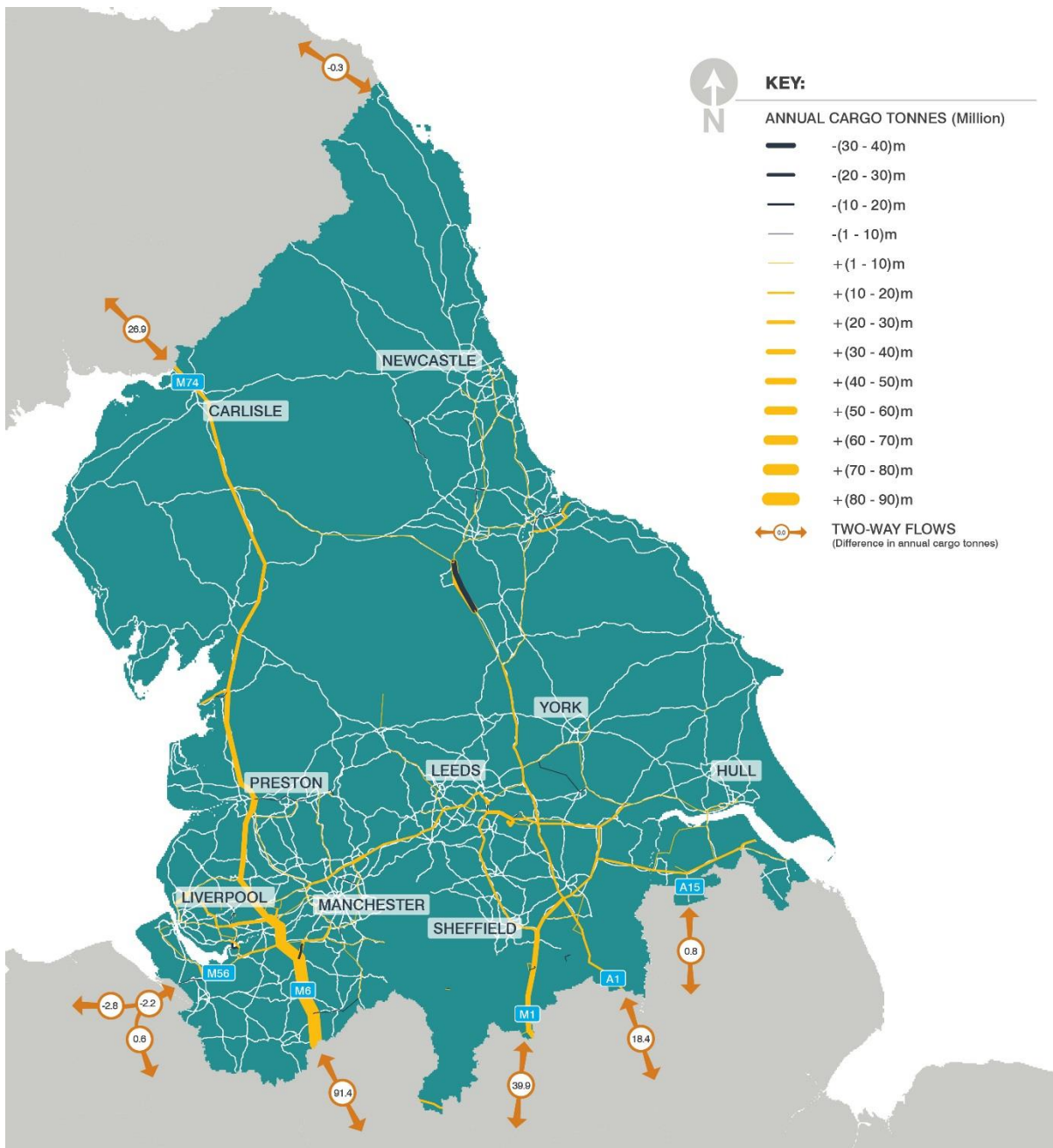


Figure 7.4 Additional annual cargo tonnes in 2050 - NPIER Growth compared to 2016 baseline

Figures 7.3 and 7.4 show that on the existing road network the heaviest road freight flows occur on the M6, particularly south of Warrington and on the east–west axis between Liverpool / North Wales, Manchester, Leeds and the Humber, with the A1(M) in North Yorkshire and M1 South of Sheffield also experiencing significant growth in volumes of freight traffic. Planned interventions on the road network will need to consider how future freight demands can be accommodated through more efficient use of existing routes. Additionally, where investment in new road infrastructure is needed, for example, planned investment in the M62 will support the better management of traffic. This investment, combined with improving alternative east-west routes throughout the North would help relieve pressure on that single corridor and build a more resilient road network.

7.4 International Connectivity Network Requirements

7.4.1 Context

In a global economy, high levels of international connectivity are crucial for the North's economic success. The Independent International Connectivity Commission's report to TfN⁵⁵ and its stakeholder evidence base has helped inform this context.

Increasing the range of destinations and frequency of direct international services to and from the North will boost business efficiency, encourage entrepreneurship, enhance employment opportunities and increase Foreign Direct Investment, inward investment and exportation opportunities. It will also create conditions which attract and retain top talent and skills.

International passenger connectivity provided by the North's airports alone contributed over £5.5 billion towards the North's GVA (1.7% of the total) in 2015. But for the North to punch above its weight economically, the size of the air market should be closer to 50% (rather than the current 30%) of the size of the market in the South East. To achieve this, the latent capacity across the North's airports, capable of delivering an additional 60 million passengers per annum, must be exploited.

Under the transformational agenda, international connectivity can drive economic growth rather than simply to follow it. Under the required Northern Powerhouse growth scenario, international connectivity's GVA contribution should rise to £13 billion (2.1% of transformational GVA). This makes international connectivity even more important to the economy in future than it is today. Around £4bn of the additional transformational growth in annual GVA required would be at risk if we do not deliver improved international connectivity.

33% of all UK freight uses Northern Ports and the ports themselves contribute £1.5 billion directly to the North's economy. A key aim of Northern ports is to see the development of an east-west 'super corridor', making the North a linchpin for the movement of freight from North America to/ from Europe. This would allow direct goods links to the North, transform the way goods are transported around the North and help reduce congested North-South routes. There is also capacity for increased air freight to/from Northern airports.

The Independent Commission's report stated that international connectivity starts on the ground. This ambitious but critical aspiration can only be achieved by making it easier, faster and more reliable for passengers and freight to travel to/from the North. This will increase the demand for services meaning that if supported by the right infrastructure, the North's airports and ports could make an increased material contribution to international connectivity, i.e. an increased number of direct routes to global destinations.

NPIER has demonstrated the need for the North's key prime capabilities to be able to compete internationally, including enhanced connectivity to international hubs and markets. Many Strategic Economic Plans of Northern city regions stress the necessity of improving regional, national, but also international connectivity. International connectivity stands or falls with the access to the gateways, thus ensuring efficient and reliable access to the gateway in the catchment area is essential.

7.4.2 Requirements

Northern Ports benefit from good connectivity to the rest of the world utilising short sea shipping routes, maximising the reach of the North. For example the opening of the major development at Liverpool 2 grows the port's ability to handle 97% of the world's shipping. This opens markets to the North of England and is vital to unlocking growth for both the City Region and the national logistics network.⁵⁶ The challenge now is to match the road and rail infrastructure to realise the opportunity.

To do this connectivity to and from the North's ports and the MRN must be strong. The first and last miles of infrastructure into and out of ports are vital for the efficiency of global supply chains and export in advanced manufacturing sectors. For instance the Port of Tyne serves the car industry as the second largest car port in the UK, which supports a strong automotive industry. Nissan UK's Manufacturing plant in Sunderland rely heavily on just in time supply chains aided by reliable imports through this and other nearby international gateways as well as local firms, of which the surface road links are a key component. However we know that for many of the first and last miles, users often suffer from congestion. RIS1 interventions such as the Liverpool2

⁵⁵ TfN, 2017, *Independent International Connectivity Commission Report* <http://www.transportforthenorth.com/publications/>

⁵⁶ Liverpool City Region LEP, 2014, *Investment Pipeline for the LGF and Growth Deal*

related A5036 Princess Way scheme and the Port of Hull, related A63 Castle Street scheme are testament to the priority already attached to this part of the network.

For Teesport and Cairnryan (for access to Northern Ireland and the Republic of Ireland) the A66 is a key access route, whose increasing traffic volumes will inhibit regional and international connectivity without interventions on the road network. East-west route connectivity is particularly critical for access to Teesport and Durham Tees Valley Airport, providing international connectivity and opening up logistics, freight, container market and aviation-related opportunities for businesses in the Tees Valley and to attract global investment.

The continued growth of Manchester Airport as the UK's principal international gateway outside London offers the type of global connections that will become increasingly important for the wider Northern economy.⁵⁷ By 2050, Manchester will need to provide a route network to a much wider range of global destinations and carry a similar number of local passengers (excluding connecting passengers) to long haul destinations as Heathrow does today to provide the underpinning support to economic transformation. By doing this it will improve the quality and efficiency of access to the North, reducing the costs and time constraints to business, as well as access for the local population, visitors and freight.⁵⁸

What does good look like in this respect? The Independent International Connectivity Report links growth in international destinations and thereby the global competitiveness of airports such as Manchester to the size of the population within 2 hours' travel time. Better and more reliable connections between airports and IECs in the North that increase the size of their catchment areas, and where those catchment areas overlap increase the choice and resilience available to businesses and customers support that goal. The potential exists for TfN to model the catchment areas of particular IECs such as airports and use what good looks like in terms of acceptable journey times to highlight the prize.

It is accepted that strategic gaps and performance issues affect the MRN that provides much of the wider access to the North's major airports. The M56 by which Manchester Airport and the related 'Airport City' Enterprise Zone connects to much of the wider MRN experiences flows of over 120,000 vehicles per day, and frequent congestion leading to delays.⁵⁹ Future improvements are also likely necessary on the M60/Manchester North-Western Quadrant, which is not only part of the trans-Pennine corridor but also provides international connectivity to Manchester Airport and between ports in Liverpool, Humber, Salford and the North East, serving both passenger and freight traffic. Currently, no trans-Pennine route offers direct access to the main international airport of the North.

Newcastle Airport performs a vital role for the North East and Tees Valley both in terms of passengers and to a lesser extent freight given its distance from Manchester. The Independent Commission's report notes that to achieve its anticipated growth (and what the North needs for transformational growth) Newcastle will need improvements to the A696, associated junctions that connect it to the A1, as well as the A69 to expand its catchment area and provide reliable access. As mentioned in **Chapter 6**, the A1 Newcastle and Gateshead Western Bypass is one of the more congested parts of the North's major road network and RIS1 improvements are vital to this airport's role.

The airports at Leeds Bradford, Liverpool and Doncaster-Sheffield also have potential to develop some long haul business connections principally to hubs in the USA and Middle East, alongside predominantly leisure routes over the period to 2050. These airports also need improvements to their surface access to minimise journey times, ensuring that they remain competitive and that the North's connectivity offer supports customer demand.

In all cases reliably growing the catchments or the airports of the North within two hours' travel time by multiple modes will help to support NPIER transformational growth.

⁵⁷ Greater Manchester Spatial Framework Consultation Draft, 2016

⁵⁸ TfN, 2017, *Independent International Connectivity Commission Report* <http://www.transportforthenorth.com/publications/>

⁵⁹ High Speed North

7.5 Multi-Modal Opportunity

Major investment in the rail network associated with HS2 involves the following plans:

- Phase 1 to the West Midlands with onward use of the West Coast Mainline (scheduled to open in 2026).
- Phase 2a from the West Midlands to Crewe with onward use of the West Coast Mainline (scheduled to open in 2027).
- Phase 2b from Crewe to Manchester and West Midlands to Leeds with onward extensions East along the East Coast Mainline (scheduled to open in 2033).

This includes services to some of the North's major city centre stations either direct via HS2 or via sections of classic compatible railway, as well as transformative opportunities associated with a new Crewe and Manchester Airport station, alongside a potential option for a HS2 station on the Sheffield to Doncaster M18 Corridor, subject to a study, notwithstanding the serving of Sheffield Midland station by HS2.⁶⁰

Transformative east-west rail connectivity associated with Northern Powerhouse Rail is the subject of current TfN studies. Alongside HS2 these plans provide transformative journey time savings between major cities by rail, and will alongside connectivity priorities identified in the Integrated Rail Report enhance its attractiveness compared to the private car.

As part of the parallel Integrated Rail Report, the accessibility of 44 key rail stations by public transport is being investigated including the potential to resolve strategic gaps to provide seamless journeys for larger catchment areas of the Northern economy. Where this is not feasible, such as in areas serving dispersed population areas, improved access to a selection of existing railway stations or even new parkway style stations would help to widen the catchment area of rail services and help release some of the demand on the MRN.

There has also been a good deal of partner feedback on the link between demand for intra-urban travel and inter-urban travel in the North. Spatial planning and intra-urban transport solutions remains the domain of Local Planning Authorities and City Regions, Providing connectivity between the MRN and multi-modal options for first and last mile(s) journeys into IECs by bus, light rail, heavy rail and active mode solutions will be considered as part of future strategic studies. This could include multi-modal integration through the provision of new transit hubs, line extensions or new transit systems for interchange with the MRN.

7.6 Technology and Smarter Travel

The current pace of technological innovation is unprecedented with the potential to transform travel behaviour, safety, capacity, as well as network maintenance and management. The widespread adoption of social media, the rise of same day delivery, and the unexpected success of ride sharing apps are a few examples where new technologies have disrupted traditional patterns of socio-economic activity and transport.

Over the next thirty years it is likely that technological innovation will continue to impact how and why people travel as vehicles become more intelligent, cleaner, and safer; traffic management systems radically improve; up to date information is shared with ease; people increasingly work and shop from home; and we pay for transport in ever simplified ways. The high cost and long life expectancy of transport infrastructure means it is important that we identify future trends with the potential to impact the transport system. With the Government beginning its Connected Vehicles and Infrastructure trial on the A2/M2 and planning to trial driverless cars on the SRN under way it is imperative that this process starts now. Key headlines and summary detail is provided in **Appendix I**.

⁶⁰ HS2 Ltd (2017): Serving South Yorkshire

7.7 Climate Change

The Government has previously studied the impact of climate change scenarios on the UK's road infrastructure.⁶¹ Possible climate impacts include:

- Increased/more intense rainfall events.
- Wetter winters and drier summers.
- Higher temperatures.

These all present an issue for MRN resilience going forward, with the following specific implications assuming no substantial adaptation is made to the infrastructure.

- Flood risk to roads.
- Increased scour of bridges.
- Increased instability of cuttings and embankments.
- Increased damage to road surfaces.
- Impacts on interdependent infrastructure including telecommunications, energy supplies, rail network, ports and airports, and network management centres.

In addition to an ongoing focus on the importance of up to date strategic diversionary routes to maintain network resilience, further adaptations may include the need for:

- Bridges built to higher than currently required to accommodate larger tidal ranges due to sea level rise over their lifespan.
- Bridge and other structural foundations reinforced to cope with higher magnitude flood events and their resultant increased river flow speeds.
- Embankments and cuttings stabilised to cope with higher magnitude rainfall events.
- More 'blue' and 'green' infrastructure alongside roads to provide more sustainable drainage solutions.
- Road surface materials with the ability to cope with hotter temperatures and intense rainfall.
- Technology solutions designed to withstand higher temperatures.

All of this will require ongoing monitoring and analysis by network providers for the existing MRN and appraisal in the design process for new interventions. This will require effective, efficient and equitable solutions with the evidence base including a full understanding of the economic impacts of asset and wider system failure.

⁶¹ HM Government, 2011, *Climate Resilient Infrastructure: Preparing for a Changing Climate*

8. Schemes Committed and in Development

8.1 Existing Investment

Recognising the demands on the MRN, there are some good plans already underway. Recent investment in the SRN has been considerable and the committed schemes under construction in the North will support economic growth and help alleviate some of the worst congestion currently faced on the network. RIS1 includes £2.9bn of commitments in the first Roads Investment Period to 2020, illustrated in **Figure 8.1 (overleaf)**.

Within RIS1 there are 33 schemes in the North, such as the upgrade of the A1 to continuous motorway standard from the M1 to Newcastle, and conversion of sections of the M1 and M62 to smart motorways to provide a four lane standard for a majority of the route.

RIS1 will also provide major improvements to port and airport access, with five major Northern ports benefitting from committed schemes such as the A5036 Princess Way in Liverpool and A63 Castle Street in Hull. Manchester, Robin Hood Doncaster Sheffield and Newcastle airports will also benefit from improvements to the strategic or local network. .

In 2016, the DfT commissioned Highways England to manage three strategic studies to plan the next generation of major enhancements for Northern roads. DfT, TfN and Highways England are progressing these studies together with stakeholders to identify priorities for the M60 Manchester North West Quadrant, key east-west routes across the north Pennines – the A66 / A685 and A69, and a high performance transport link between Greater Manchester and Sheffield City Region with a Trans-Pennine Tunnel. There is strong interrelationship between each study in terms of improving trans-Pennine connectivity in the North and the outcome of the studies is informing RIS2.

Local Enterprise Partnerships across the North have also brokered City Deals, Growth Deals and Devolution Deals with Government securing over £2 billion in Local Growth Fund allocations for local transport projects. This has been supplemented by locally funded investment programmes in a number of areas. This is alongside support for targeted investment in high risk roads in the North such as the A18 in Yorkshire and Humber, A1290 in the North East and A536 in the North West amongst many others.

Most recently, DfT announced £90 million of funding for the North to help cut congestion and journey times for motorists and improve safety. They will be completed by spring 2020. This includes improvements to the A595 and A66 junctions in Cumbria, junctions on the A69 at Hexham and Corbridge, and A63 Garrison Road in Hull amongst others.⁶²

8.2 Schemes in Development

RIS1 also includes commitments to bring forward schemes for RIS2 between 2020 and 2025. This includes the reconstruction of some of the most congested motorway junctions in the North, such as the Lofthouse Interchange between the M1 and M62 and Simister Island on the M60 / M62 / M66. A full list of known schemes is included in **Appendix J**.

The DfT's highways announcement of 29 November 2016 alongside the *Autumn Statement* also provides support for developing a number of Large Local major schemes across the North including the following:

- Warrington Waterfront Western Link
- A500 dualling (west of the M6)
- A1079 and A164 Jocks Lodge Junction
- Sheffield Innovation Corridor (Links between Sheffield and Rotherham around the M1)
- New Tees Crossing
- Tees Valley East-West Connections (A1(M) and the A66 to the North West of Darlington).

Despite their development funding it is important to note the distinction between these schemes and those already in RIS1 and within Northern LEP's Local Growth Deals and City Deals. Schemes in development will

⁶² <https://www.gov.uk/government/news/220-million-to-help-motorists-beat-congestion> accessed 29 March 2017

require funding for implementation and will need to compete with ideas that emerge from further strategic studies to get into investment programmes for 2020-2025, 2025-30 and so on.



Figure 8.1: RIS1 Commitments in the North including those completed and under construction

9. Strategic Gaps

9.1 Introduction

Having taken into account the vision, the baseline performance, future demands and current investment, a series of strategic gaps have emerged in terms of the MRN for the North. These have been shared and agreed with Partners via the Highways Working Group as pertinent to supporting transformational growth, and have then acted as a guide to define the initial portfolio of pan-Northern interventions (described in **Chapter 10**) that will be taken through the STP prioritisation process.

- **Technological and environmental improvements for the MRN.**
- **Resilience of the MRN.**
- **Multi-modal connectivity.**
- **International connectivity from the North's ports and airports to the MRN.**
- **Freight.**
- **Connectivity of the North's economic hinterland's to the MRN.**
- **Links between similar and complementary NPIER capability clusters.**
- **Connectivity between Important Economic Centres.**
- **Delivery of Nationally Significant Infrastructure Projects and major employment.**
- **Major local development approvals.**

Within these strategic gaps there is a particularly strong emphasis on the weakness of east-west links, with only the M62 acting as a continuous east-west dual carriageway road across the North. Even where north-south links have helped establish a recognisable economic spine for a sub-region such as the A1/A19, current and emerging pressures are also evident that merit consideration. However, it is considered that to simply focus on the existing SRN will not provide the impetus to enact a transformational change across the North; at best it will just maintain the existing economic geography with business as usual.

9.2 Technological and Environmental Improvements for the MRN

An ongoing focus for all network providers is making better use of existing capacity, and where new capacity is provided to incorporate smart adaptive technology into its effective management to lock in the benefits. As **Chapters 6 and 7** demonstrate what is considered to be a smart and adaptive network is constantly evolving, as both infrastructure and vehicular technology moves forward at pace. What constitutes a smart network on sections of the local authority run section of the MRN will not replicate that on the SRN and may not necessarily be integrated with each other, although the potential to do this is increasing. As **Appendix I** demonstrates, technology such as Highways England CHARM⁶³ system provides strong potential to integrate both strategic and local advanced systems for the collaborative management of traffic performance and incidents.

Likewise the environmental performance of the North's road networks is an ongoing strategic focus for all providers. For sections of the SRN and MRN in predominantly urban areas, statutory considerations in relation to AQMAs are of importance to how these networks are managed and improved. Options include:

- Enhanced provision and active support for both the rail investment priorities within the STP, and locally led schemes for rapid transit and freight consolidation / intermodal connectivity.
- Working with new developments (such as Garden Villages and through the Healthy New Towns initiative where the ethos and willingness to be early adopters exists), investors, businesses and manufacturers to act as exemplar projects for the trial and active usage of sustainable modes, electric vehicles, cleaner engine technology (as implemented elsewhere at Bicester Northwest Ecotown for example). Linking this potential to NPIER growth sectors such as digital or advanced manufacturing provides the opportunity for the North to take a lead and benefit both the economy and environment.
- Freight consolidation centres outside of major cities, to allow movement of goods by quieter / cleaner vehicles in city centres.
- Pollution linked speed limits (potentially with real-time technology monitoring to minimise impacts on efficiency during quieter periods) whereby speeds lower than 70mph result in reduced emissions, currently being considered for a stretch of the M1 in Sheffield City Region.

⁶³ CHARM = Common Highways Agency and Rijkswaterstaat Model – next generation Anglo-Dutch collaboration on an advanced traffic management system to be introduced on the SRN in the North East of England in 2017.

- Low Emission Zones for polluted urban areas, as currently exists in London for goods and public service vehicles, with its plans for an Ultra-Low Emission Zone to cover all vehicles by 2020.
- Use of technology and digital communication channels, widening customer understanding and 'real world' choice of transport options, encouraging travel behaviour change leading to more efficient use of transport networks.

The environment is a key focus for the STP, and working with Partners TfN will seek to achieve improved environmental outcomes, whilst recognising that it is for network providers and local planning authorities to develop approaches that comply with statutory provisions and best suit the needs of their local areas.

9.3 Resilience of the MRN

From a resilience perspective, the identified strategic gaps are both prevalent in terms of the following:

9.3.1 East-West Connectivity

- Only one dual carriageway link crosses the Pennines in the North (the M62).
- 'A' road links are at risk of closure or reduced capacity through winter and extreme weather, flooding or geotechnical issues (such as the A59 Kex Gill, A57 Snake Pass amongst others).
- In some instances alternatives are not able to cater for the peaks in traffic and freight usage with numerous constraints through urban areas and villages.
- In other instances ready alternatives do not exist at all, posing significant impacts to movement and the economy where closures occur.

9.3.2 Coastal and Mountainous Roads

- Through storms, flooding and geotechnical issues, exacerbated by seasonal peaks in demand associated with tourism.

9.3.3 SRN Related Incidents

- The duration of impact is normally shorter than those that impact on east-west links; the very nature of the SRN as often a bypass of major towns and cities, means that incidents and closures result in periodic adverse impact on the function of local networks. Highways England and Local Partners are working currently to refresh the tactical diversion routes to provide ongoing resilience, and future technological integration through CHARM offers potential.

Inadequate resilience poses a threat to business as usual, and does not support transformational growth.

9.4 Multi-Modal Connectivity

The MRN can complement the rail network, by maximising the opportunities presented by the following and in so doing providing a virtuous circle of increased rail demand and further investment:

- High Speed Two.
- Northern Powerhouse Rail.
- Intensification of rail services on connectivity corridors proposed in the Integrated Rail Report.
- Locally led rapid transit and bus priority schemes, as well as park and ride.
- Ongoing investment in intermodal facilities at inland ports, ports and airports and their access arrangements from the MRN to expedite efficient carriage of cargo throughout the North.

At this stage it is not for TfN to prescribe where some of these locations should be, but as further study work into the rail and road interventions occurs through the STP work with Partners to understand emerging priorities.

9.5 International Connectivity

The Independent International Connectivity Commission's Report⁶⁴ endorses proposed surface access interventions to improve connectivity to the North's ports and airports across multiple modes from both the urban area it serves and the neighbouring hinterland, including:

⁶⁴ TfN, 2017, *Independent International Connectivity Commission Report*

- Manchester Airport
- Newcastle Airport
- Liverpool John Lennon Airport
- Pan-northern interventions to reduce journey times for onward road and rail links beyond the immediate area of ports and airports.
- Leeds Bradford Airport
- Port of Liverpool
- Port of Hull

Interventions vary for each economic asset with some schemes already committed (such as improvements to A63 Castle Street, Hull and A5036 Princess Way, Liverpool), some schemes local in nature and best delivered by the owners and Local Partners, alongside longer term strategic interventions for TfN to support.

Related investment in Nationally Significant Infrastructure Projects (NSIP) also provides the potential to unlock wider legacies from port-related development such as those serving the North's Nuclear and Wind Energy Coasts.

9.6 Freight

Freight traffic in the form of HGVs are primary users of the MRN and are highly susceptible to the resilience and reliability of the road network. Strategic gaps for freight cover the strategic freight routes with the greatest congestion across the North, particularly east to west movements across the Pennines and north to south on the M6 and M1 / A1(M). In addition to these strategic routes, it is imperative that access to ports and rail freight interchanges ensures the efficient carriage of cargo throughout the North.

The provision of secure HGV parking facilities should be considered in a similar way to the use of strategic park and ride sites.

While every effort should be made for freight to use alternate modes of transport in the form of rail and / or water where it is reasonable and practicable to do so, road will remain the dominant method of transporting cargo and as such improving the corridors set out in **Chapter 10** is a necessity.

9.7 Connectivity to the North's Economic Hinterland

The North's functional economic geography and the economic role of its roads do not just stop at the boundaries of the Northern Powerhouse. IECs such as Carlisle, Berwick, Grimsby and the South Humber Bank, Doncaster, Sheffield, Crewe, Chester, Manchester and Liverpool have established travel to work, supply chain connections, international connectivity and railhead links with economic assets in Scotland, the Midlands and Wales respectively. The sections of the MRN that cross boundaries often provide national economic functionality through long distance links on the trans-European road network, including the M6 north of Carlisle through to the ports of Glasgow, Stranraer and Cairnryan, and the A55 / A494 west of Chester through to the Port of Holyhead.

TfN is in active dialogue with Transport Scotland, the Welsh Assembly and Midlands Connect in the development of these cross-border connectivity priorities.

9.8 Links between Similar and Complementary NPIER Capability Clusters

The NPIER alongside Partners' evidence has provided a useful picture of some of the existing economic linkages and those that have the potential to contribute to the agglomeration story of the North.

For the nuclear energy generation industry well represented in coastal geographies such as Cumbria (Sellafield, Moorside NSIP), Tees Valley (Hartlepool), Lancashire (Heysham), effective links with nuclear processing (Cheshire & Warrington and Cumbria) and clusters of nuclear research and development organisations in Cumbria, Cheshire and Warrington, Greater Manchester and the Sheffield City region are of great value. Providing more efficient and resilient connections between these coastal clusters of activity on east-west axes and via the M6 / A1(M) will aid agglomeration.

For advanced manufacturing, higher productivity depends on effective collaboration between materials and manufacturing process research and development and advanced manufacturers with associated relationships with energy, health and digital capabilities. These include:

- The aerospace and defence industry in Central Lancashire and Barrow, with connections to Greater Manchester and Sheffield for materials and process research and development.
- The Atlantic Gateway and Cheshire Science Corridor with its combination of advanced manufacturing, energy and health innovation based capabilities, connected to universities, consultancies and international airports.
- New advanced manufacturing capabilities associated with the International Advanced Manufacturing Park in the North East and Advanced Manufacturing Innovation District in the Sheffield City Region, with their potential links to both firms in their hinterland and the wider North of England and beyond.
- The agri-tech and food industry in York, North Yorkshire and East Riding of Yorkshire, Hull and Humber and Leeds City Regions.

9.9 Connectivity between Important Economic Centres

Strategic gaps will be further refined by the Traffic Master analysis (**Appendix F**) of acceptable journeys and delay. A common strand from both the pilot and Partners' evidence is the difficulty of east-west connectivity. This is prevalent across the Pennines, Peak District and Cumbrian mountains, as well as across LEP areas such as Cheshire and Warrington into North Wales and Greater Manchester; across Yorkshire and along the Tees Valley. Such analysis has already informed the need for the DfT sponsored strategic studies across the North covering the A69, A66, Manchester M60 NW Quadrant and Trans-Pennine Tunnel, but it is evident from our analysis that we need to look wider to realise the productivity potential of the North along these axes.

While north-south links are generally stronger, they are more at risk from incident and accident related resilience episodes. Furthermore, some of the North's key corridors such as the A1 and A19 provide an inconsistent level of service either in terms of link and junction capacity constraining the reliability and efficiency of pan-Northern and local movement.

9.10 Delivery of NSIP and Major Employment Sites

These strategic gaps include the need to facilitate the effective construction, operation and ongoing legacy of known and potential NSIP and major employment opportunities, such as the following examples:

- Moorside Nuclear Power station, Cumbria
- International Advanced Manufacturing Park, Sunderland and South Tyneside, with Government support through the *Industrial Strategy*
- York Potash, Whitby and related harbour facilities at Teesport
- Dogger Bank Offshore Wind
- South Humber Bank (various)
- Liverpool2 – a new £400M deep-water container terminal at the Port of Liverpool that opened in 2016
- Walney Offshore Wind, Cumbria
- HS2 and its related stations including Crewe and Manchester Airport
- Trans-Pennine Tunnel and its potential linkages.

These provide both a potential source of infrastructure funding through the development consent process as well as new demands and agglomeration potential for existing networks and economic geographies.

9.11 Major Local Housing Development Plans

These include garden villages and cities, urban extensions and regeneration across the North. These cater for population growth from demographic trends and in-migration to areas experiencing employment growth, as well as to help retain residents in areas with a higher quality of housing commensurate with the development of the local economy. As with the NSIP, these provide both a potential source of funding for infrastructure as well as a demand on the existing network.

10. Portfolio of Connectivity Priorities

10.1 Defining Pan-Northern Priorities

The purpose of developing a pan-Northern definition was to build consensus with Partners as to why and how investment in the MRN should take place. Agreement on this has allowed a portfolio of strategic corridors to be viewed through that strategic economic lens. This focussed on both the ‘why’ and ‘how’, as follows:

Why? “Enable transformational growth within the NPIER framework either directly by road, rail or by improved multimodal interchange for passengers and freight”

How will this be delivered?

- Technological and environmental improvements for the MRN
- Increased resilience for the MRN
- Multimodal opportunities
- Also through interventions that either / and
 - Link international connectivity gateways to the MRN
 - Link similar / complementary NPIER capability clusters
 - Improve connectivity between Important Economic Centres
 - Unlock delivery of Nationally Significant Infrastructure and employment projects
 - Take account of major local development approvals

Both the definition and the ‘**what**’ – the resulting portfolio of strategic priorities were shared with Partners for comment through the Highways Working Group and individual 1-2-1s in January 2017. These connectivity priorities arose out of workshops featuring road, rail and freight disciplines. Representatives used a suite of information from each of the stages of the Major Roads Report in a logical form as shown in the flow below.

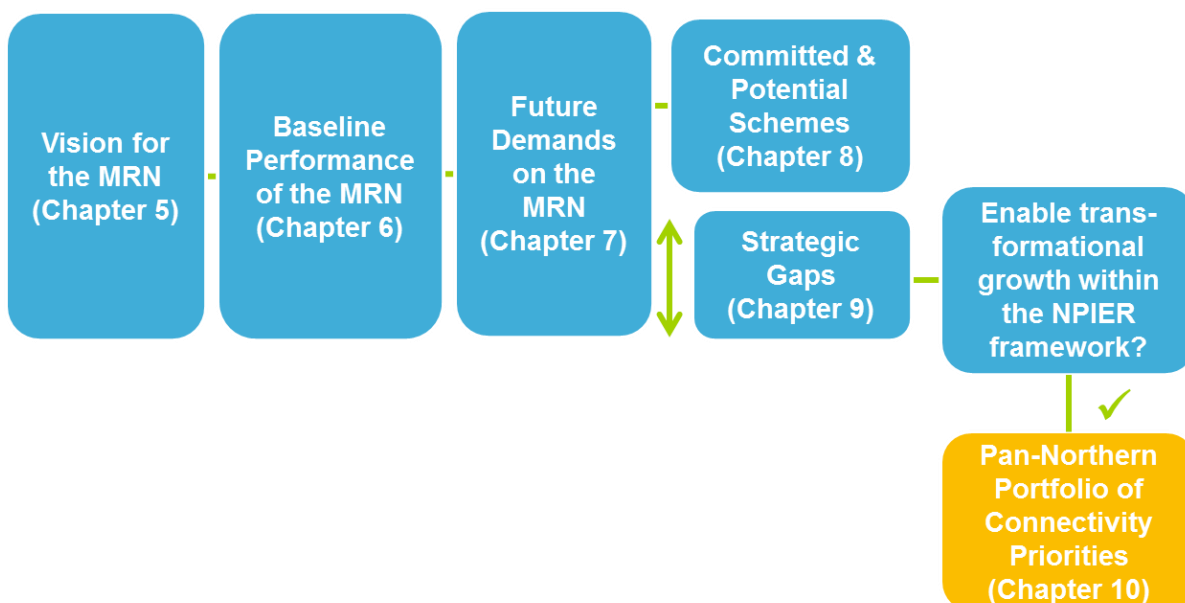


Figure 10.1: The flow of information through the Major Roads Report to arrive at the Portfolio of Strategic Corridors

This has resulted in a focussed set of 13 connectivity priorities for subsequent sequencing and study alongside similar rail based connectivity priorities within the ongoing STP process. Figure 10.2 illustrates an overall summary of 12 of the 13 Connectivity Priorities and how these interface with major international and multi-modal economic assets such as ports and airports and potential HS2 stations.

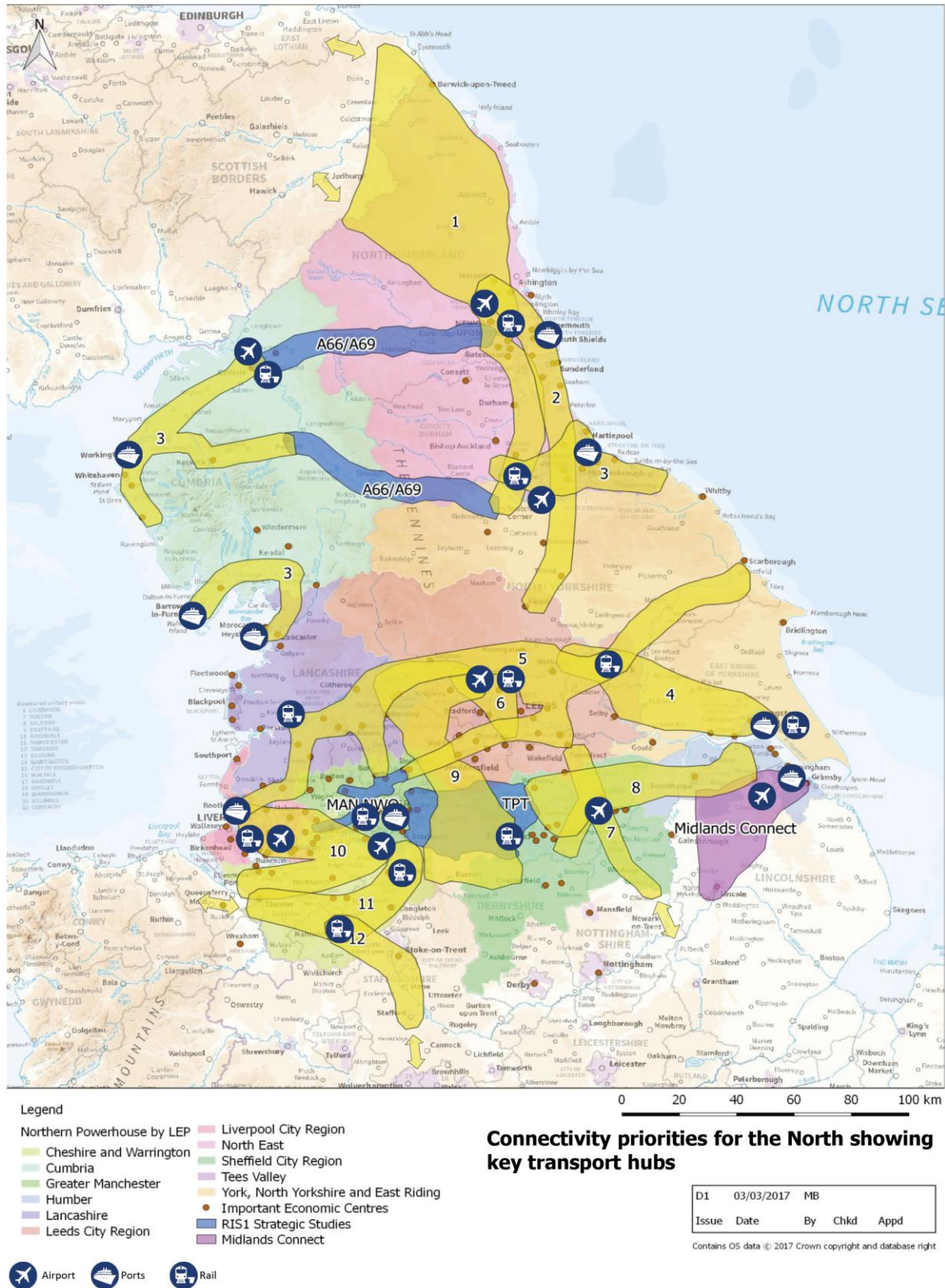


Figure 10.2: Summary map of the Portfolio of Strategic Priorities showing key transport hubs

10.2 Connectivity Priorities

On the basis of the above sections of this report, 13 broad transport corridors – referred to as connectivity priorities – have been identified for further appraisal. These connectivity priorities are outlined with a brief summary in the table below. Supporting details are included in **Appendix K** covering the following:

- Geographical coverage and impact.
- Justification at a pan-Northern level using the criteria presented in **Section 10.1**.
- Anticipated benefits including NPIER sectors, drawing upon information from Partners.
- Schemes that are currently in progress (either in terms of construction or development), or other schemes that are not currently funded that could make a contribution to solving the strategic gaps and realising the economic potential of the corridor(s). It is important to note that these unfunded schemes will have to compete with other ideas that arise out of further studies to get into investment programmes for 2020-2025, 2025-30 and so on.

Ref	Name	Summary
1	A1 Scotch Corner to Scotland	Phased interventions to enhance the A1 corridor and crosslinks to the parallel A19, ensuring the major north-south route provides a level of service and resilience that is both consistent and appropriate to the needs of Important Economic Centres it links and strategic journeys that it facilitates. This includes interfaces with Connectivity Priority 2.
2	A19 Expressway	A programme of targeted improvements to the A19 corridor and crosslinks to the parallel A1 through North East and Tees Valley Combined Authority areas and North Yorkshire. This includes a new River Tees Crossing and interfaces with Connectivity Priorities 1 and 3.
3	(Nuclear and Wind) Energy Coasts Access Improvements	Package of schemes to improve accessibility and resilience of the MRN to open up access to nuclear and wind energy opportunities and complementary port, employment and housing opportunities to help develop a legacy for this mega investment on both the Cumbrian coast and Teesside. This provides links between energy sectors on East and West Coasts of Northern England and the MRN, and extends and enhances the A66 / A69 commitments in RIS2.
4	Port of Hull (A63) to A1 (M) / M1 and westwards	A package of improvements to enhance the road links between the Port of Hull (A63), York and the A1 (M) / M1 and westwards. Complements Connectivity Priorities 5 and 6 in providing additional resilience and connectivity as an alternative to the M62.
5	Central Trans-Pennine Corridor Connectivity	Considering phased improvements to MRN connections between Liverpool City Region, Central and East Lancashire, Greater Manchester and Yorkshire. Ultimately provides enhanced and more resilient M6-M1/A1(M) links encompassing M65/A59 and M62 corridors, with potential for strengthened onward links to international connectivity assets such as Port of Liverpool, Leeds Bradford Airport and the Port of Hull via RIS1 schemes and Connectivity Priorities 4 and 6.
6	Leeds City Region NW Quadrant	A new or enhanced connection between the A1 (M), Leeds Bradford Airport, the Central Trans-Pennine Corridor and the M62 / M606 to the east of Bradford. Facilitates improved connectivity and network resilience across the MRN in multiple LEP regions and employment growth aspirations in West Yorkshire in particular around Leeds Bradford Airport. Complements Connectivity Priority 5.
7	A1 Improvements (Doncaster to Sheffield, West Yorkshire and Nottinghamshire)	Improvements to the A1 between Darrington and M1 / M18 junction - upgrading to motorway standard as part of providing a consistent level of service between the M18 at Doncaster and Newcastle. Improvements in level of service on the A1 corridor south of Doncaster into Nottinghamshire to complement Midlands Connect aspirations for additional north-south connectivity and resilience.
8	South Humber Trans-Pennine	Broad corridor between the M1 and its potential interface with a trans-Pennine tunnel corridor and the M18 and M180 in the east, with onward connections to the Ports of Hull, Immingham and Grimsby. Provides long term connectivity and

Ref	Name	Summary
	Connectivity	<p>a 'missing link' between M180 and a potential enhanced trans-Pennine connection. It also provides a complete second east-west coast trans-Pennine connection and M62 alternative with particular benefits for freight traffic.</p> <p>Link to Midlands Connect study associated with the A15 / A46 from Lincolnshire and Nottinghamshire, and its connections to the South Humber Bank</p> <p>Both Connectivity Priorities 7 and 8 would need to take into account the impacts and interfaces of the ongoing Sheffield CR Local Major / RIS2 studies into the Sheffield Innovation Corridor and AMID (M1 Junctions 33 to 35).</p>
9	Short to medium term Trans-Pennine improvements	<p>Various corridor enhancements to cater for initial growth to 2020s and resilience prior to the opening of a Trans-Pennine Tunnel. These could include but are not limited to:</p> <ul style="list-style-type: none"> • Central Trans-Pennine corridor including the M62 (connectivity priority 5) • A628 Woodhead Pass • A619 / A623 / A6 Corridor in Derbyshire (outside of the North) • Northern Powerhouse Rail.
10	Cheshire Science Corridor and Atlantic Gateway	<p>A broad fan of connectivity, resilience and journey quality improvements between Manchester in the east and the Liverpool City Region, Cheshire and Warrington and North Wales in the west, along corridors such as the M6, M62, M56, M58, M53, A55, A494 and A580. This recognises the importance of international connectivity assets such as the area's ports and airports and the transformational potential of the area's strong NPIER economic clusters, and the strong cross-border economic links.</p>
11	Manchester Airport HS2 to North Wales Arc	<p>An enhanced east-west corridor of movement that capitalises on the major opportunities provided by HS2 at Manchester Airport and Crewe to benefit Greater Manchester, Cheshire and Warrington, the north Midlands and North Wales. Provides enhanced resilience for key components of the SRN by providing alternative routes to the M6 and M56 for sub-regional, yet economically important movement in an area of existing high economic performance and further transformational potential for the North's economy. Complements Connectivity Priorities 10 and 12.</p>
12	Crewe HS2 Northern Gateway	<p>Infrastructure improvements to facilitate access to the proposed HS2 Hub at Crewe from across the region and the neighbouring Midlands. Complements Connectivity Priority 11.</p>
13	Strategic Multi-Modal Opportunities	<ul style="list-style-type: none"> • A prioritised programme for multi-modal interchange to maximise use of public transport for strategic (such as railheads) and last mile(s) (such as park and ride) IEC end journeys. • Strategic Freight distribution parks and Inland Ports including secure HGV parking. • Locations to be determined in collaboration with Partners and the Integrated Rail Report.

Appendix K also provides a summary of their complementary fit with each other and the three current Strategic Studies.

10.3 Sequencing

The intention of the next version of the Major Roads Report is to provide a recommendation on the sequencing of the above connectivity priorities for study and delivery. Some of the above connectivity priorities have already been the subject of recent extensive study and in some cases are linked to imminent triggers that would warrant an earlier sequencing. Others are dependent or heavily linked to other schemes under study and naturally follow on at the same time or subsequently as a complementary measure. Working with Partners the intention is to develop a programme of work on bringing forward more detailed work on a series of strategic development corridors, most of which will take a multi-modal approach, developing and appraising options for investment in both road and rail.

10.4 Conclusion and Next Steps

The Initial Major Roads Report sets out the case for action and investment in the North's road network, crucially based on the economic opportunities for both the North and the UK's economy. There is a direct link between transforming connectivity and allowing the North's economy to thrive, and the importance of the transport system to the transformation of the North's economic performance is well understood and underlines the primary function of TfN. With the right investment in transport, skills and innovation by 2050 the North's economy would generate an additional £97 billion in economic benefits and provide 850,000 extra jobs.

To achieve the shared vision of the Northern Powerhouse and the Government's Industrial Strategy, sustained and targeted investment is needed in the North's transport network. The long term investment programme that will be set out in the STP will play a critical role in creating the conditions in which people and businesses can thrive.

This Initial Major Roads Report is positioned within a suite of documents that will feed into the STP, presenting a genuine opportunity to expand work that has been undertaken purely to meet road derived outputs, and address the complex demands of travel across the north of England on a multi-modal basis.

Working collaboratively with TfN Partners on its production, the Initial Major Roads Report has:

- Set out road's importance in delivering the transformative economic growth envisaged in NPIER.
- Outlined the conclusions of economic and demand forecasting work under a transformational economic growth scenario, and how this is forecast to affect passenger and freight demand in the North.
- Brought together options currently under development for infrastructure improvements, presented for the first time on a pan-Northern scale.
- Developed a specific network of economically important roads, termed the Major Road Network for the North.
- Agreed associated outcomes (Conditional Outputs) and performance measures and reviewed the existing evidence base, with recommendations for further work on developing a baseline and the future monitoring of the MRN.
- Taken evidence on future growth from the NPIER, from TfN Partners' Growth Deals and Strategic Economic Plans, and from Highway's England 'Roads to Growth' work, to identify the connectivity requirements to enable transformational economic growth.
- Set out a portfolio of interventions for subsequent sequencing and further development within the STP.

Both the Integrated Rail and Major Roads Reports, taken together, provide a portfolio of connectivity priorities that will inform development of a single strategic investment programme for the STP up to 2050. The interventions in the STP are those which are fundamental to the joint ambition of TfN and Government for the Northern Powerhouse to deliver a step change in economic growth. These have been developed as a 'single voice' acting on behalf of City Regions and Local Enterprise Partnerships across the North, for the first time.

Bibliography

This will be completed for the final version of the report later in 2017. This shall include key reference documents with online links where these exist.

Appendix A. Evidence Log of Documents Reviewed

National Documents⁶⁵

Author	Title	Published
DfT	Road Investment Strategy - Strategic Vision	2014
DfT	Road Investment Strategy: Investment Plan	2014
DfT	Road Investment Strategy: Performance Specification	2014
DfT	Road Traffic Forecasts 2015 & NPIER Forecasts	2015
Highway England	Delivery Plan 2015-2020	2016
Highway England	Operational Metrics Manual	2016
Highway England	Roads Investment Programme	2013
Highway England	Roads Investment Programme- Progress Update	N/A
Highway England	RIS 1	2013
Highway England	RIS 2- Emerging Objectives, and Priorities	N/A
Highway England	Smart Motorway Programme	2016
Highway England	Trans-Pennine Tunnel Study	2016
Highway England	Northern Trans-Pennine Routes Strategic Study	2016
Highway England	London to Scotland West - Route Strategy	2016
Highway England	Strategic Business Plan. 2015-2020	2014
Highway England	Highways England - Road Investment Strategy	2016
HS2 Ltd	Transport Constraints and Opportunities in the North of England	2014
Highway England	Northern Trans-Pennine strategic study: stage 3 report	2016
Highway England	Trans-Pennine tunnel strategic study: stage 3 report	2016
Highway England	Manchester North-West Quadrant strategic study stage 3 report	2016

⁶⁵ Documents listed are publicly available.

Highways England	The Road to Growth - Discussion Paper for Consultation	2016
Highways England	Economic Growth and the Strategic Road Network	2016
Highways England	Commercial Development and the Strategic Road Network	2016
Highways England	International Gateways and the Strategic Road Network	2016
Rees Jeffrey Road Fund	A Major Road Network for England	2016
National Infrastructure Commission	High Speed North	2016
HMRC	Regional Trade Statistics	2016
House of Commons Transport Committee	Summary of the 2006 Eddington Study	2011

Regional Documents

Author	Title	Published
1North	One North: A Proposition for an Interconnected North	2014
HM Government	he Northern Powerhouse: One Agenda, One Economy, One North,	2015
CE and SQW on behalf of TfN	The Northern Powerhouse Independent Economic Review	2016
TfN	NPIER Local Centre Definitions	2016
TfN	Strategic Local Connectivity- Economic Nodes, and Priorities	2015
TfN	International Connectivity Commission Report	2017
TfN	Northern Freight and Logistics Report	2016
TfN	Freight Forecasts & Strategy	Not published
TfN	Strategic Economic Growth and Transport Demand Analysis	2017

Local Documents

LEP / City Region	Local Authority	Name	Published
Cheshire and Warrington / Staffordshire	Cheshire and Warrington / Stoke on Trent and Staffordshire	Northern Gateway Development Zone – A Collaboration for Growth and Prosperity	2016
Cheshire and Warrington	Cheshire and Warrington	Cheshire and Warrington Matters: Strategic and Economic Plan for Cheshire and Warrington	2014
Cheshire and Warrington	Cheshire and Warrington	Growth Deal	2014
Cheshire and Warrington	Cheshire and Warrington	Growth Deal Expansion	2015
Cheshire and Warrington	Cheshire and Warrington	Cheshire and Warrington Sub-Regional Transport Strategy	2015
Cheshire and Warrington	Cheshire East	Cheshire East 'High Growth Region': The Evidence Base for Crewe Superhub	2016
Cheshire and Warrington	Cheshire East	Local plan Strategy proposed changes 'clean version'	2016
Cheshire and Warrington	Cheshire East	Infrastructure Delivery Plan	2014
Cheshire and Warrington	Cheshire East	LTP3 Final Strategy (2011-2026)	2011
Cheshire and Warrington	Cheshire West and Chester	Infrastructure Delivery Plan	2013
Cheshire and Warrington	Cheshire West and Chester	LTP Integrated Transport Strategy 2011-2026	2011
Cheshire and Warrington	Warrington	LTP3 Strategy	2011
Cheshire and Warrington	Warrington	LTP - Implementation Plan	2011
Cheshire and Warrington	Warrington	Warrington's Economic Growth & Regeneration Programme	Draft
Cumbria	Cumbria	West of M6 Strategic Connectivity Study	2016
Cumbria	Cumbria	Cumbria's Strategic Investment Plan, Delivering the four-pronged attack	2016
Cumbria	Cumbria	LTP	2011
Cumbria	Cumbria	Cumbria LEP Infrastructure Plan	2016
Cumbria	Cumbria	Growth Deal Expansion	2015

LEP / City Region	Local Authority	Name	Published
Cumbria	Cumbria	Growth Deal	2014
Cumbria	Cumbria	Cumbria Strategic Economic Plan 2014-2024	2014
Cumbria	Cumbria	Moving Cumbria Forward Cumbria Transport Plan Strategy 2011-2026	2011
Greater Manchester	Greater Manchester	2040 Vision	2015
Greater Manchester	Greater Manchester	2040 Transport Strategy (Draft)	2016
Greater Manchester	Greater Manchester	Greater Manchester Transport Strategy 2040 and Delivery Plan 1	2016
Greater Manchester	Greater Manchester	Greater Manchester LTP3 2011/12 - 2015/16	2011
Greater Manchester	Manchester City Council	Transport Strategy for Manchester City Centre	2010
Greater Manchester	Greater Manchester	Stronger Together: Greater Manchester Strategy	2013
Greater Manchester	Greater Manchester	Manchester Airport- Manchester Airport Master Plan to 2030	2007
Greater Manchester	Greater Manchester	Manchester Airport - Sustainable Development Plan 2016 Land Use & Surface Access	2016
Greater Manchester	Greater Manchester	Key Route Network Baseline Studies: Northern Segment	2015
Greater Manchester	Greater Manchester	Greater Manchester Spatial Framework Consultation Draft	2016
Greater Manchester	Greater Manchester	Greater Manchester Spatial Framework Integrated Assessment	2016
Greater Manchester	Greater Manchester	Highways Delivery Plan (information from TfGM workshop)	2016
Greater Manchester	Greater Manchester	Growth Deal	2014
Greater Manchester	Greater Manchester	Growth Deal Expansion	2015
Greater Lincolnshire	North East Lincolnshire / North Lincolnshire	Greater Lincolnshire LEP – Strategic Economic Plan 2014-2030 Refresh 2016	2016

LEP / City Region	Local Authority	Name	Published
Hull and Humber	Hull and Humber City Region	Humber LEP - Strategic Economic Plan	2014
Hull and Humber	Hull and Humber City Region	Humber - Investment and Delivery Plan	2014
Hull and Humber	Hull and Humber City Region	Growth Deal	2014
Hull and Humber	Hull and Humber City Region	Growth Deal Expansion	2015
Hull and Humber	Hull	LTP	2011
Hull and Humber	North East Lincolnshire	LTP	2011
Hull and Humber	North Lincolnshire	LTP	2011
Lancashire	Blackburn with Darwen	LTP	2011
Lancashire	Blackpool	LTP	2011
Lancashire	Lancashire	LTP	2011
Lancashire	Lancashire	Central Lancashire Highways and Transport Masterplan	2013
Lancashire	Lancashire	West Lancashire Highways and Transport Masterplan	2014
Lancashire	Lancashire	East Lancashire Highways and Transport Masterplan	2014
Lancashire	Lancashire	Fylde Coast Highways and Transport Masterplan	2015
Lancashire	Lancashire	Lancaster District Highways and Transport Masterplan	2016
Lancashire	Lancashire	Lancashire Strategic Transport Prospectus	2016
Lancashire	Lancashire	East-West Connectivity Study	2017
Lancashire	Lancashire	City Deal Implementation plan 2015-2018	2015
Lancashire	Lancashire	Lancashire - LEP Strategic Economic Plan and Growth Deal	2014

LEP / City Region	Local Authority	Name	Published
Lancashire	Lancashire	Growth Deal	2014
Lancashire	Lancashire	Growth Deal Expansion	2015
Liverpool City Region	Liverpool City Region	Merseyside Transport Partnership LTP3	2011
Liverpool City Region	Liverpool City Region	Liverpool City Region - A Transport Plan for Growth	2015
Liverpool City Region	Liverpool City Region	Liverpool City Region LEP Growth Prospectus	2014
Liverpool City Region	Liverpool City Region	Liverpool City Region Growth Strategy	2014
Liverpool City Region	Liverpool City Region	Liverpool City Region LEP - Growth Deal 2014 Investment Pipeline	2014
Liverpool City Region	Liverpool City Region	Growth Deal	2014
Liverpool City Region	Liverpool City Region	Growth Deal Expansion	2015
North East	Durham	LTP	2011
North East	North East	Our Journey – A 20 Year Transport Manifesto for the North East	2016
North East	North East	North East - SEP Evidence 2016	2016
North East	North East	North East - SEP refresh of transport section 2016	2016
North East	North East	North East Independent Economic Review	2013
North East	Tyne and Wear	Tyne and Wear LTP3 Strategy 2011	2011
North East	Tyne and Wear	Tyne and Wear LTP3 - Delivery Plan 2011	2011
North East	North East	Newcastle Airport- Surface Access Strategy	2013
North East	North East	North East - SEP 2014	2014

LEP / City Region	Local Authority	Name	Published
North East	North East	Growth Deal	2014
North East	North East	Growth Deal Expansion	2015
North East	Northumberland	LTP	2011
Sheffield City Region	Sheffield City Region	Integrated Infrastructure Plan	2016
Sheffield City Region	Sheffield City Region	Sheffield City Region - Strategic Economic Plan and Growth Deal	2014
Sheffield City Region	Sheffield City Region	South Yorkshire Local Transport Implementation Plan	2011
Sheffield City Region	Sheffield City Region	Sheffield City Region Transport Strategy 2011-2026	2011
Sheffield City Region	Sheffield City Region	Sheffield City Region - Assurance and Accountability Framework	2015
Sheffield City Region	Sheffield City Region	Sheffield City Region - Initial prioritised list of schemes	2013
Sheffield City Region	Sheffield City Region	Growth Deal	2014
Sheffield City Region	Sheffield City Region	Growth Deal Expansion	2015
Tees Valley	Tees Valley	Tees Valley Strategic Transport Plan Framework	2016
Tees Valley	Tees Valley	Strategic Economic Plan	2013
Tees Valley	Tees Valley	Statement of Transport Ambition	2011
Tees Valley	Tees Valley	Tees Valley - Devolution Agreement	2015
Tees Valley	Tees Valley	Tees Valley LEP - Strategic Infrastructure Plan 2014	2014
Tees Valley	Tees Valley	Growth Deal	2014
Tees Valley	Tees Valley	Growth Deal Expansion	2015
Leeds City Region	Leeds City Region	Leeds City Region - Growth Deal Submission	2016

LEP / City Region	Local Authority	Name	Published
Leeds City Region	Leeds City Region	Leeds City Region - Strategic Economic Plan	2016
West Yorkshire	West Yorkshire Combined Authority	Draft Transport Strategy	2016
West Yorkshire	West Yorkshire Combined Authority	Draft Transport Strategy Evidence Base	2016
West Yorkshire	Leeds City Council	Leeds City Region - Local Implementation plan and transport strategy	2011
Leeds City Region	Leeds City Region	Growth Deal	2014
Leeds City Region	Leeds City Region	Growth Deal Expansion	2015
Leeds City Region	Leeds City Region	Transport Strategy	2009
Leeds City Region	Leeds City Council	Transport Strategy (and Public Transport Investment programme)	Draft
Leeds City Region	Leeds City Region	Infrastructure Investment Framework 2017	Draft
York, North Yorkshire and East Riding of Yorkshire	East Riding	East Riding of Yorkshire Council LTP Strategy	2015
York, North Yorkshire and East Riding of Yorkshire	East Riding	East Riding of Yorkshire Infrastructure Delivery plan	2015
York, North Yorkshire and East Riding of Yorkshire	East Riding	East Riding of Yorkshire council LTP Implementation Plan	2015
York, North Yorkshire and East Riding of Yorkshire	North Yorkshire	North Yorkshire - Local Transport Plan 3	2011
York, North Yorkshire and East Riding of Yorkshire	North Yorkshire	North Yorkshire - A Strategic Transport Prospectus for North Yorkshire	2015
York, North Yorkshire and East Riding of Yorkshire	North Yorkshire	North Yorkshire - Local transport Plan 4 (2016-2045)	2016
York, North Yorkshire and East Riding of Yorkshire	York	Infrastructure Delivery Plan	2013
York, North Yorkshire and East Riding of Yorkshire	York	LTP	2011

LEP / City Region	Local Authority	Name	Published
York, North Yorkshire and East Riding of Yorkshire	York, North Yorkshire and East Riding of Yorkshire	York, North Yorkshire and East Riding Enterprise Partnership - Strategic Economic Plan 2014	2014
York, North Yorkshire and East Riding of Yorkshire	York, North Yorkshire and East Riding of Yorkshire	York, North Yorkshire and East Riding Enterprise Partnership - Strategic Economic Plan Update 2016	2016
York, North Yorkshire and East Riding of Yorkshire	York, North Yorkshire and East Riding of Yorkshire	Growth Deal	2014
York, North Yorkshire and East Riding of Yorkshire	York, North Yorkshire and East Riding of Yorkshire	Growth Deal Expansion	2015
York, North Yorkshire and East Riding of Yorkshire	York, North Yorkshire and East Riding of Yorkshire	An Overview of York's Economy	2016
York, North Yorkshire and East Riding of Yorkshire	York, North Yorkshire and East Riding of Yorkshire	York Economic Strategy 2016-2020	2016

Appendix B. Highways Working Group Members

Peter Molyneux	TfN - Strategic Road Network Director
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Gillian Heyworth	Sheffield City Region
Simeon Butterworth	Jacobs
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Alec Curley	Jacobs

Appendix C. Important Economic Centres

These have been principle driven, making maximum use of TfN's Strategic Local Connectivity workstream, the NPIER and partner feedback. General principles include:

- **Current economic centres** - generally have a population of >50,000 people (or perform a strong sub-regional function, e.g. Northallerton), represent a regionally important international gateway for people or goods (e.g. Newcastle International Airport or Port of Workington) or employment cluster (e.g. Wilton International, Redcar) or university located external to a major settlement (e.g. University of Lancaster).
- **Future economic growth locations** - key growth centres in local Strategic Economic Plans and Local City Region Strategies, especially linked to the NPIER sectors that deliver a sufficient number of jobs/dwellings to have a significant impact on the economy when considered at the level of the North.

This is a live network, and the current list as of March 2017 is as follows.

District	Key Economic Centre	Timeframe
Copeland	Whitehaven	Current
Copeland	Sellafield including Moorside	Current
Copeland	Westlakes Science Park	Future
Carlisle	Carlisle	Current
Carlisle	Carlisle Kingmoor Park	Current
Carlisle	Carlisle South	Future
Carlisle	Carlisle Airport	Current
South Lakeland	Kendal	Current
South Lakeland	Kirkby Lonsdale	Current
South Lakeland	Windermere	Current
South Lakeland	Ulverston	Current
Allerdale	Keswick	Current
Allerdale	Workington	Current
Eden	Penrith	Current
Barrow-in-Furness	Barrow-in-Furness	Current
Chesterfield	Chesterfield	Current
Chesterfield	Markham Vale EZ	Current
West Lancashire	Skelmersdale	Current
West Lancashire	Edge Hill University	Current
Lancaster	Heysham Port	Current
Lancaster	Lancaster	Current
Lancaster	Lancaster University and Bailrigg Garden Village	Current
Lancaster	Morecambe	Current
Chorley	Chorley	Current
South Ribble / Chorley	Cuerden / Buckshaw	Current
South Ribble	Samlesbury EZ	Future
Fylde	Blackpool Airport	Current
Fylde	Warton EZ	Future
Preston	Preston	Current
Preston	North West Preston	Future
Wyre	Fleetwood	Current

District	Key Economic Centre	Timeframe
Wyre	Hillhouse International EZ	Current
Pendle	Colne	Current
Pendle	Nelson	Current
Ribble Valley	Clitheroe	Current
Hyndburn / Rossendale	Accrington / Rossendale Valley	Current
Burnley	Burnley	Current
West Lindsey	Gainsborough	Current
Lincoln	Lincoln (Outside of the North)	Current
Scarborough	Scarborough	Current
Scarborough	Whitby	Current
Selby	Selby	Current
Craven	Skipton	Current
Richmondshire	Catterick Garrison	Current
Harrogate	Harrogate	Current
Harrogate	Ripon	Current
Hambleton	Thirsk	Current
Hambleton	Northallerton	Current
Mansfield	Mansfield	Current
Barnsley	Barnsley	Current
Bolton	Bolton	Current
Bolton	Middlebrook & Parklands	Current
Bolton	Logistics North, Bolton	Current
Bradford	Bradford	Current
Bradford	Keighley	Current
Bradford	Bradford EZs	Future
Bury	Bury	Current
Calderdale	Halifax (including Sowerby Bridge)	Current
Calderdale	Brighouse	Current
Calderdale	Lindley Moor East and West EZ	Future
Doncaster	Doncaster	Current
Doncaster	Robin Hood Airport Doncaster Sheffield	Current
Doncaster	iPort Doncaster	Future
Doncaster	Rossington	Future
Gateshead	Gateshead	Current
Gateshead	intu Metrocentre	Current
Gateshead	Team Valley Trading Estate	Current
Kirklees	Dewsbury	Current
Kirklees	Huddersfield	Current
Kirklees	Batley	Current
Kirklees	Moor Park EZ and Cooper Bridge	Future
Knowsley	Huyton	Current
Knowsley	Knowsley	Current
Leeds	Leeds	Current

District	Key Economic Centre	Timeframe
Leeds	Leeds Bradford Airport	Current
Leeds	Wetherby	Current
Leeds	Aire Valley EZ	Future
Leeds	Newmarket	Future
Leeds	East of Leeds Extension	Future
Liverpool	Port of Garston	Current
Liverpool	Liverpool	Current
Liverpool	Speke	Current
Liverpool	Liverpool Hope University	Current
Liverpool	Liverpool John Lennon Airport	Current
Liverpool	Port of Liverpool	Current
Manchester	Manchester	Current
Manchester	Manchester Airport including Airport City and Enterprise Zone	Current
Newcastle upon Tyne	Newcastle	Current
Newcastle upon Tyne	Northumbria University	Current
Newcastle upon Tyne	Newcastle International Airport	Current
North Tyneside	Tynemouth	Current
North Tyneside	Tyne Port	Current
North Tyneside	Tyne Employment and Retail Area	Current
Oldham	Oldham	Current
Rochdale	Rochdale	Current
Rochdale	Heywood Distribution Park	Current
Rochdale	Kingsway Business Park	Current
Rotherham	Rotherham	Current
Rotherham	Meadowhall	Current
Rotherham	AMP and Waverley EZ	Current
Salford	Central Salford	Current
Salford	Salford Quays: Media City	Current
Salford	Port Salford	Future
Sefton	Bootle	Current
Sefton	Southport	Current
Sefton	Seaforth	Future
Sheffield	Sheffield	Current
Sheffield	Upper Don Valley	Current
Sheffield	Lower Don Valley	Current
South Tyneside	South Shields	Current
South Tyneside	Tyne Tunnel	Current
South Tyneside	Holborn Riverside	Future
Stockport	Stockport	Current
St. Helens	St Helens	Current
St. Helens	Haydock Industrial Area	Current
St. Helens	Parkside	Future

District	Key Economic Centre	Timeframe
Sunderland	Sunderland	Current
Sunderland	Port of Sunderland	Current
Sunderland	Doxford International Business Park	Current
Sunderland	IAMP	Future
Tameside	Ashton-under-Lyne	Current
Tameside	Ashton Moss Business Park	Current
Trafford	Altrincham	Current
Trafford	Trafford Park	Current
Trafford	Carrington, Trafford	Future
Wakefield	Castleford	Current
Wakefield	Pontefract	Current
Wakefield	Wakefield	Current
Wakefield	South Kirkby Business Park EZ & Langthwaite Grange EZ	Future
Wigan	Leigh	Current
Wigan	Wigan	Current
Wirral	Birkenhead	Current
Wirral	Wallasey	Current
Wirral	Wirral International Business Park	Current
Blackburn with Darwen	Blackburn	Current
Blackpool	Blackpool	Current
Cheshire East	Congleton	Current
Cheshire East	Crewe	Current
Cheshire East	Macclesfield	Current
Cheshire East	Nantwich	Current
Cheshire East	Greater Manchester Life Science	Current
Cheshire East	Middlewich	Current
Cheshire West and Chester	Chester	Current
Cheshire West and Chester	Ellesmere Port	Current
Cheshire West and Chester	Northwich	Current
Cheshire West and Chester	Thornton Science Park	Current
Cheshire West and Chester	Winsford	Current
Cheshire West and Chester	Port Cheshire	Future
City of Derby	Derby	Current
City of Kingston upon Hull	Hull	Current
City of Kingston upon Hull	University of Hull	Current
City of Kingston upon Hull	Green Port Hull EZ	Future
City of Nottingham	Nottingham	Current
City of Stoke-on-Trent	Stoke-on-Trent (Outside of the North)	Current
County Durham	Bishop Auckland	Current
County Durham	Consett	Current
County Durham	Durham	Current
County Durham	Peterlee	Current
County Durham	Chester-le-Street	Current

District	Key Economic Centre	Timeframe
County Durham	Port of Seaham	Current
County Durham	Newton Aycliffe	Current
Darlington	Darlington	Current
Darlington	Durham Tees Valley Airport	Current
East Riding of Yorkshire	Bridlington	Current
East Riding of Yorkshire	Brough	Current
East Riding of Yorkshire	Goole	Current
East Riding of Yorkshire	Humber Bridge	Current
East Riding of Yorkshire	Beverley	Current
Halton	Runcorn	Current
Halton	Widnes	Current
Halton	Sci-Tech Daresbury	Current
Halton	Mersey Gateway Bridge	Future
Halton	Ditton	Current
Hartlepool	Hartlepool	Current
Hartlepool	Seaton Carew	Current
Hartlepool	Wynyard	Future
Middlesbrough	Middlesbrough	Current
North East Lincolnshire	Grimsby	Current
North East Lincolnshire	Port of Immingham	Current
North Lincolnshire	Humberside Airport	Current
North Lincolnshire	Scunthorpe	Current
North Lincolnshire	Able Marine Energy Park	Future
North Lincolnshire	Port of Killingholme	Current
North Lincolnshire	Lincolnshire Lakes Housing Development	Future
Redcar and Cleveland	Teesport	Current
Redcar and Cleveland	Redcar	Current
Flintshire	Deeside (Outside of the North)	Current
Stockton-on-Tees	Stockton-on-Tees	Current
Stockton-on-Tees	Tees Valley EZ	Future
Stockton-on-Tees	Thornaby	Current
Warrington	Warrington	Current
Warrington	Birchwood	Current
Warrington	Omega South, Warrington	Current
Warrington	Warrington Waters	Future
Wrexham	Wrexham (Outside of the North)	Current
York	York	Current
York	University of York	Current
Northumberland	Ashington	Current
Northumberland	Berwick-upon-Tweed	Current
Northumberland	Port of Blyth	Current
Northumberland	Morpeth	Current

Appendix D. Iterative development of the MRN

Iterative Development of the MRN for the North

This review has followed a logical top down and bottom up analysis to arrive at an agreed consensus fit for January 2017:

- **Stage 1: Comparison of the SRN with the geography of Important Economic Centres (too small a network).**
- **Stage 2: Comparison of partners Key Route Networks (KRN) with the geography of Important Economic Centres and the above criteria (too large a network).**
- **Stage 3: Iterative development of a network that better fits the MRN narrative at both a LEP and local highway authority level alongside the cross-boundary links.**

The following maps and narrative explain why the MRN as it currently stands best meets the aspirations for the North's major road network.

Stage 1 – Comparison with the SRN

The initial comparison of the current SRN in the North with Important Economic Centres illustrates a significant number of strategic connectivity gaps in the North. This is contributing to the Productivity Gap of the North. Whilst the solution to these connectivity issues is not necessarily an extension of the SRN networks, it is clear that strategic connectivity must extend beyond current confines to support economic growth. These gaps, consistency played out in each part of the North, include:

- **East-West Connectivity Gaps** (Trans-Pennine South, M62, Trans-Pennine Central, A66, A69)
- **Gaps linking Important Economic Centres to SRN and junction access / constraints**
- **Gaps linking future growth locations within Important Economic Centres to the MRN and key rail interchanges**
- **International connectivity through the links to both major ports and airports in the North**
- **Resilience:** A sparse network serving key corridors and crossing major geographical barriers.

Stage 2 – Comparison with Partners' Key Route Networks (KRN)

Overlaying local Partner's KRN (primarily developed in city regions and with varied criteria applicable to the local geography and primarily traditional traffic management requirements), and then applying similar principles for other areas that do not have a defined KRN results in something too dense for the North (Figure E.1). This is a network that includes key bus routes; many 'B' and 'C' class roads with some imbalance between the network in areas such as Greater Manchester and Merseyside compared to similar urban areas in the east of the region. Its total length was 7,874 miles – in comparison to the 4,908 mile length of the MRN now derived.

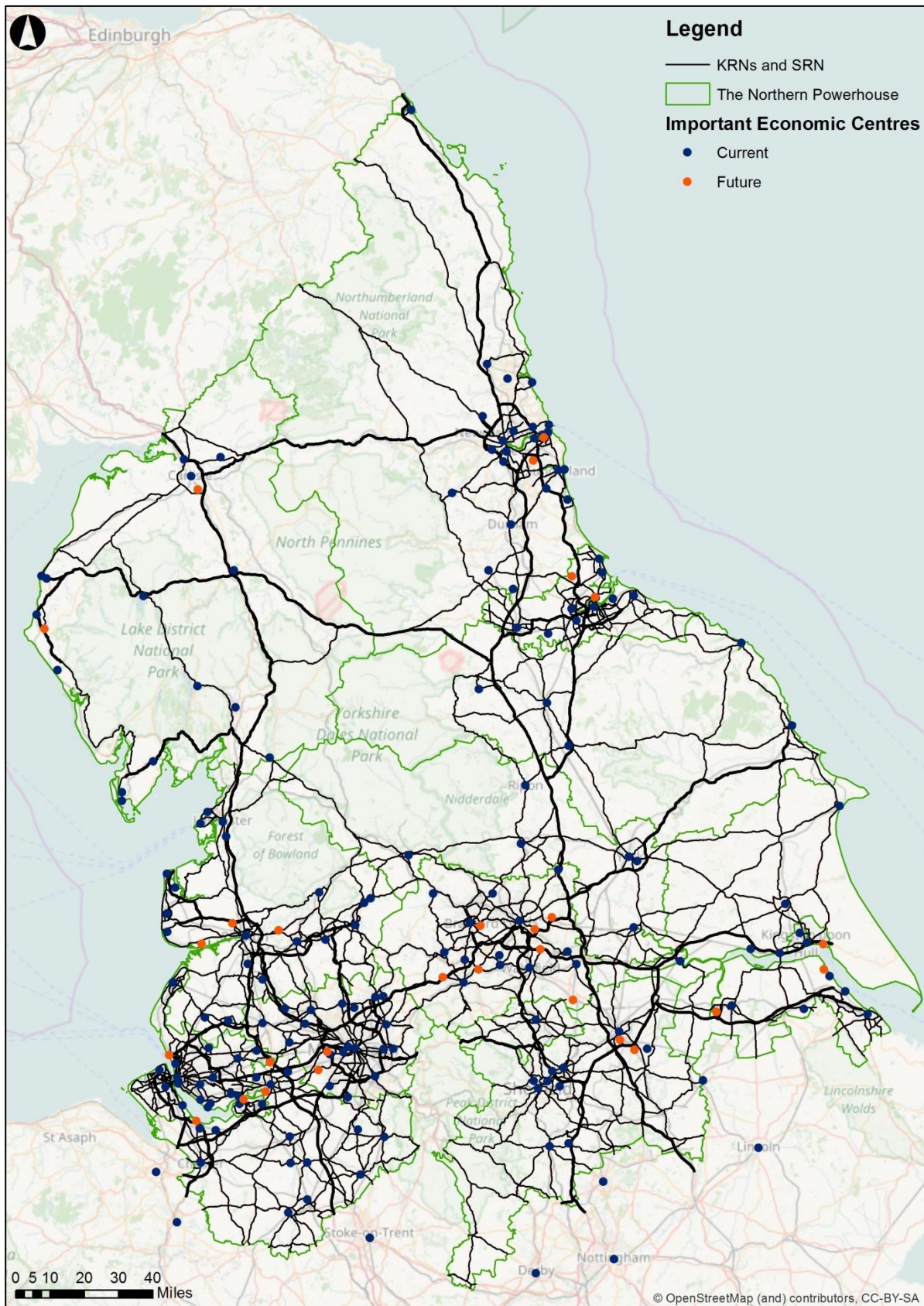


Figure E.1 : Iterative development of a draft MRN in November 2016 – Initially a very dense network based on the SRN and City Region KRN

Appendix E. Conditional Output Data Collection Needs

Reliability and Efficiency (Delay)

Acceptable journeys and delay should both be assessed through the same, single, consistent, pan-Northern data-set. Through engagement with Highways England and the Department for Transport we sourced the pan-Northern 2015 raw 'Traffic Master' dataset that was used in the development of Highways England's regional models to help prove the concept. We have applied a largely automated GIS programming approach to analyse 45 pan-Northern journeys that reflect the variation in urban and rural, long and short journeys that characterise movement between the North's IECs. These are shown below:

Ref	Origin / Destination 1	Origin / Destination 2	Ref	Origin / Destination 1	Origin / Destination 2
1	Blackpool	Bridlington	24	Newcastle	Berwick
2	Blackpool	Hull	25	Northallerton	Selby
3	Carlisle	Newcastle	26	Penrith	Darlington
4	Colne	York	27	Port of Barrow	Sellafield inc. Moorside
5	Crewe	Carlisle	28	Port of Barrow	Skipton
6	Crewe	Manchester	29	Port of Immingham	York
7	Crewe	Newcastle	30	Port of Liverpool	Teesport
8	Crewe	Sheffield	31	Preston	Catterick Garrison
9	Darlington	Carlisle	32	Preston	Leeds
10	Ellesmere Port	Manchester	33	Preston	Manchester Airport
11	Ellesmere Port	Port of Immingham	34	Preston	Salisbury EZ
12	Ellesmere Port	Teesport	35	Salisbury EZ	Skipton
13	Fleetwood	Darlington	36	Sheffield	Berwick
14	Fleetwood	Lancaster	37	Sheffield	Carlisle
15	Keswick	Newcastle International Airport	38	Barnsley	Skipton
16	Lancaster	Newcastle	39	Wetherby	York
17	Leeds	Sheffield	40	Whitehaven	Newcastle International Airport
18	Leeds	York	41	Crewe	Stoke-on-Trent
19	Manchester	Hull	42	Crewe	Birkenhead
20	Manchester	Leeds	43	Doncaster	Scarborough
21	Manchester	Liverpool	44	Doncaster	Sunderland
22	Manchester	Port Salford	45	Port of Immingham	Barnsley
23	Manchester	York			

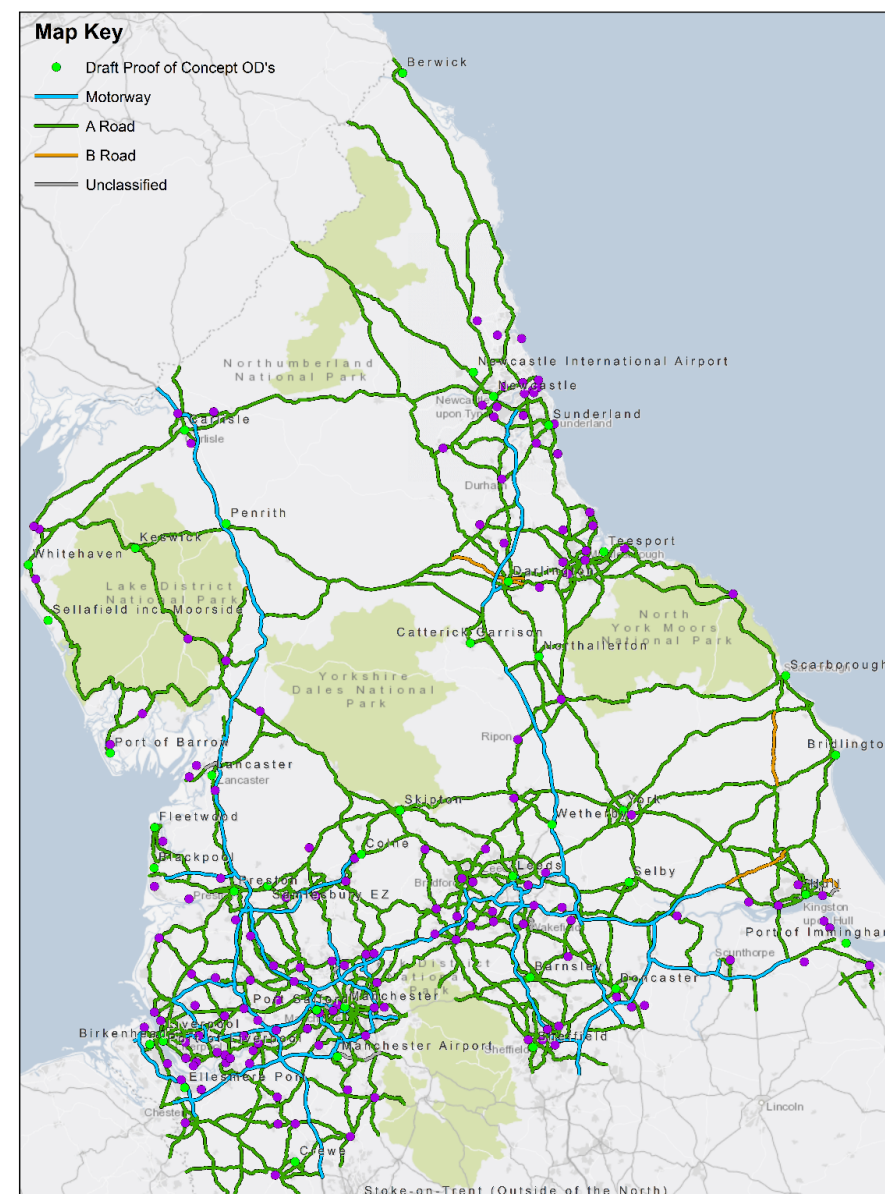


Figure F.1: List and location of the 45 IEC-IEC pairs used in the Reliability and Efficiency Trafficmaster proof of concept

The dataset

The data is GPS sourced and centrally purchased by the Department for Transport and contains millions of GPS links broken down into 15 minute segments throughout the day. TrafficMaster data is made up of a mixture of vehicles with over 135,000 polled every 1 to 10 seconds giving an extremely accurate dataset.

The Department for Transport runs queries to remove local & national events and accidents before splitting the data into various local authority boundaries. The datasets contain bi-directional link travel time and speeds data.

This data is updated every month, with changes to the ITN network being taken into consideration, along with additional probes that are added to the TrafficMaster fleet making this an extremely accurate and valuable dataset.

Pilot study data facts:

- Over 1 billion observations in 2 months
- Data is from neutral months March and April 2015
- Local & national events and accidents removed
- 7am - 7pm average hour data.

Methodology

For consistency a single route is selected for each OD pair using a routing engine based upon the quickest TrafficMaster times. The automated routing engine supply's the routes road centre line with the corresponding ITN link reference. An SQL database script then joins over 1 billion TrafficMaster observations to the routes ITN reference, calculates the total route time then identifies the quickest and slowest average travel times for over 20,000 time period and OD pair combinations before categorising then into RAG. Route selection is based on the quickest average TrafficMaster time between 7am and 7pm. For consistency in the analysis the same routes are used throughout the day.

Results

This Traffic Master dataset allows us to create a useful dashboard of IEC to IEC journeys, highlighting performance issues and gaps. Extracts from this analysis are now presented below in terms of

- Delay – Figure F.2
- Average Speed – Figure F.3 to Figure F.4
- Reliability – Figure F.5.

Delay

Figure F.2: Delay Analysis for each IEC-IEC pair – ordered by time period

- Less than 8 seconds per mile – **Green**
- Between 8 seconds and 15 seconds – **Amber**
- Greater than 15 seconds – **Red**
- Minimum Time – **Grey**

Please note that figures are rounded.

Traffic Master OD Pair	Distance (Miles)	18:00	17:00	16:00	15:00	14:00	13:00	12:00	11:00	10:00	09:00	08:00	07:00
Barnsley - Skipton	45	12	34	8		2	5	6	10	20	33	36	0
Blackpool - Hull	139	16	15	3	2	1	0		0	2	5	5	0
Blackpool - Bridlington	148	17	16	6	4	2	2	2	2	3	4	5	
Carlisle - Newcastle	59	5	10	3	3	4	3	3	3	4	3	6	
Colne - York	57	18	53	10	1		7	5	9	21	25	38	6
Crewe - Manchester	36	23	43	14		2	5	2	1	8	24	49	19
Crewe - Sheffield	59	3	21	11	3		6	11	4	16	17	26	1
Crewe - Carlisle	144	3	5	1		1	2	1	3	5	8	15	4
Crewe - Newcastle	174	16	22	5	1		0	0	0	2	10	16	4
Darlington - Carlisle	77		3	3	2	8	5	4	5	4	3	3	1
Ellesmere Port - Manchester	39	23	38	13	1	2	3	2		3	14	26	12
Ellesmere Port - Port of Immingham	145	15	14	4		0	1	1	1	3	13	15	3
Ellesmere Port - Teesport	147	16	17	5		1	1	1	1	3	13	18	3
Fleetwood - Lancaster	25		23	11	13	13	22	14	16	33	20	10	8
Fleetwood - Darlington	110	5	9	5	6	8	9	6	7	9	7	4	
Keswick - Newcastle International Airport	82		12	6	11	12	9	9	10	8	7	7	7
Lancaster - Newcastle	116	10	10	5	3	4	3	3	4	4	4	5	
Leeds - York	25	0	30	11	4		6	4	9	12	10	28	5
Leeds - Sheffield	36	12	33	10	0		3	6	7	7	24	38	8
Manchester - Port Salford	6	35	81	35		8	3	4	10	30	98	128	62
Manchester - Liverpool	34	24	44	18	1		3	3	1	7	30	47	24
Manchester - Leeds	43	29	35	7		1	0	2	0	8	24	25	7
Manchester - York	66	18	32	7	1		1	2	2	7	16	24	4
Manchester - Hull	97	10	14	1		0	0	0	0	3	10	11	1
Newcastle - Berwick	62		8	5	5	6	6	5	2	5	4	4	2
Northallerton - Selby	55	1	3	1	5	2	1	2	1	2	3	0	
Penrith - Darlington	58		4	2	5	6	5	3	5	5	2	2	1
Port of Barrow - Sellafield inc. Moorside	43		5	12	13	9	13	13	13	10	13	8	5
Port of Barrow - Skipton	71		5	12	11	13	13	12	11	10	8	5	0
Port of Immingham - York	57	8	22	6	2	2	4	5	5	6	5	10	
Port of Liverpool - Teesport	142	19	21	5	1	1	1	1	2	3	9	14	
Preston - Samlesbury EZ	7	2	7	1	0		12	12	8	25	58	61	13
Preston - Manchester Airport	39	37	23	6	3		0	1	0	2	8	12	4
Preston - Leeds	67	37	31	7	2	1		0	0	4	11	13	3
Preston - Catterick Garrison	102	5	5	4	4	5	5	3	5	8	8	6	
Samlesbury EZ - Skipton	29	5	6	6	10	9	5	7	5	7	5	7	
Sheffield - Carlisle	157	5	5	2	1	4	3	3	4	3	6	7	
Sheffield - Berwick	194	7	8	3	2	2	2	1	1	1	5	7	
Wetherby - York	19	8	43	16	1		3	2	8	17	9	26	12
Whitehaven - Newcastle International Airport	103		8	4	2	2	2	2	3	4	3	4	0
Crewe - Stoke-on-Trent (Outside of the North)	15	9	41	20	16	15	16	16	17	26	37	50	
Crewe - Birkenhead	39	1	16	6	10	11	17	10	8	10	10	26	
Doncaster - Scarborough	83	2	5	4	4	4	7	5	4	5	4	4	
Doncaster - Sunderland	109	2	3	2	3	2	2	2	2	2	3	3	
Port of Immingham - Barnsley	61	8	13	6	11	8	4	6	5	8	11	10	

Figure F.3: Delay Analysis for each IEC-IEC pair – ordered by best to worst time period

- Less than 8 seconds per mile – **Green**
- Between 8 seconds and 15 seconds – **Amber**
- Greater than 15 seconds – **Red**

Traffic Master OD Pair	Distance (Miles)	Min	N+1	N+2	N+3	N+4	N+5	N+6	N+7	N+8	N+9	N+10	N+11
Barnsley - Skipton	45	10:00	11:00	12:00	18:00	15:00	13:00	14:00	07:00	09:00	16:00	17:00	08:00
Blackpool - Hull	139	18:00	10:00	11:00	12:00	09:00	07:00	14:00	15:00	13:00	17:00	16:00	08:00
Blackpool - Bridlington	148	11:00	10:00	12:00	13:00	14:00	18:00	09:00	15:00	16:00	08:00	17:00	07:00
Carlisle - Newcastle	59	18:00	11:00	13:00	12:00	10:00	14:00	09:00	15:00	17:00	16:00	08:00	07:00
Colne - York	57	18:00	07:00	13:00	14:00	10:00	11:00	12:00	09:00	17:00	16:00	15:00	08:00
Crewe - Manchester	36	10:00	11:00	13:00	12:00	18:00	14:00	09:00	15:00	16:00	17:00	07:00	08:00
Crewe - Sheffield	59	13:00	14:00	11:00	18:00	12:00	10:00	15:00	07:00	17:00	16:00	09:00	08:00
Crewe - Carlisle	144	10:00	18:00	11:00	12:00	13:00	09:00	14:00	07:00	15:00	16:00	08:00	17:00
Crewe - Newcastle	174	18:00	13:00	12:00	11:00	14:00	10:00	15:00	16:00	17:00	09:00	07:00	08:00
Darlington - Carlisle	77	11:00	12:00	13:00	14:00	18:00	10:00	15:00	07:00	09:00	17:00	16:00	08:00
Ellesmere Port - Manchester	39	10:00	11:00	18:00	12:00	13:00	14:00	09:00	07:00	15:00	08:00	16:00	17:00
Ellesmere Port - Port of Immingham	145	18:00	13:00	11:00	07:00	14:00	10:00	12:00	09:00	15:00	16:00	17:00	08:00
Ellesmere Port - Teesport	147	18:00	09:00	10:00	12:00	11:00	14:00	13:00	07:00	15:00	08:00	17:00	16:00
Fleetwood - Lancaster	25	18:00	12:00	13:00	11:00	10:00	09:00	15:00	14:00	17:00	08:00	16:00	07:00
Fleetwood - Darlington	110	18:00	10:00	13:00	11:00	12:00	14:00	09:00	15:00	17:00	08:00	16:00	07:00
Keswick - Newcastle International Airport	82	13:00	14:00	12:00	11:00	18:00	10:00	15:00	09:00	16:00	17:00	08:00	07:00
Lancaster - Newcastle	116	13:00	12:00	14:00	11:00	10:00	18:00	09:00	15:00	16:00	08:00	17:00	07:00
Leeds - York	25	13:00	12:00	11:00	14:00	10:00	18:00	15:00	09:00	16:00	17:00	07:00	08:00
Leeds - Sheffield	36	13:00	12:00	14:00	11:00	10:00	18:00	15:00	09:00	16:00	17:00	07:00	08:00
Manchester - Port Salford	6	18:00	13:00	12:00	11:00	14:00	10:00	15:00	16:00	09:00	17:00	07:00	08:00
Manchester - Liverpool	34	18:00	10:00	12:00	13:00	11:00	09:00	14:00	15:00	17:00	16:00	08:00	07:00
Manchester - Leeds	43	13:00	12:00	14:00	11:00	10:00	18:00	15:00	09:00	16:00	17:00	07:00	08:00
Manchester - York	66	13:00	18:00	11:00	12:00	14:00	10:00	15:00	16:00	07:00	09:00	17:00	08:00
Manchester - Hull	97	18:00	10:00	12:00	13:00	11:00	14:00	09:00	15:00	17:00	16:00	08:00	07:00
Newcastle - Berwick	62	18:00	13:00	12:00	11:00	14:00	10:00	15:00	09:00	16:00	17:00	07:00	08:00
Northallerton - Selby	55	13:00	12:00	14:00	11:00	10:00	18:00	09:00	15:00	16:00	07:00	17:00	08:00
Penrith - Darlington	58	13:00	12:00	14:00	11:00	18:00	10:00	09:00	15:00	16:00	07:00	17:00	08:00
Port of Barrow - Sellafield inc. Moorside	43	18:00	10:00	14:00	11:00	09:00	13:00	15:00	17:00	12:00	16:00	08:00	07:00
Port of Barrow - Skipton	71	18:00	17:00	12:00	11:00	14:00	13:00	10:00	09:00	15:00	16:00	08:00	07:00
Port of Immingham - York	57	13:00	18:00	12:00	14:00	11:00	10:00	09:00	15:00	07:00	16:00	17:00	08:00
Port of Liverpool - Teesport	142	18:00	11:00	13:00	10:00	12:00	09:00	14:00	15:00	17:00	16:00	08:00	07:00
Preston - Samlesbury EZ	7	18:00	13:00	12:00	11:00	10:00	15:00	14:00	09:00	17:00	16:00	08:00	07:00
Preston - Manchester Airport	39	18:00	13:00	12:00	14:00	11:00	15:00	10:00	09:00	16:00	17:00	08:00	07:00
Preston - Leeds	67	18:00	10:00	09:00	15:00	13:00	12:00	14:00	17:00	16:00	11:00	08:00	07:00
Preston - Catterick Garrison	102	18:00	07:00	09:00	11:00	10:00	13:00	12:00	14:00	15:00	16:00	08:00	17:00
Samlesbury EZ - Skipton	29	18:00	10:00	09:00	13:00	12:00	15:00	14:00	17:00	08:00	16:00	11:00	07:00
Sheffield - Carlisle	157	18:00	10:00	09:00	13:00	12:00	17:00	15:00	14:00	16:00	08:00	11:00	07:00
Sheffield - Berwick	194	18:00	07:00	11:00	09:00	10:00	13:00	12:00	14:00	15:00	16:00	17:00	08:00
Wetherby - York	19	18:00	14:00	13:00	15:00	12:00	11:00	10:00	09:00	16:00	17:00	08:00	07:00
Whitehaven - Newcastle International Airport	103	18:00	10:00	09:00	13:00	17:00	15:00	07:00	16:00	12:00	08:00	14:00	11:00
Crewe - Stoke-on-Trent (Outside of the North)	15	18:00	18:00	18:00	18:00	18:00	18:00	18:00	18:00	18:00	18:00	18:00	18:00
Crewe - Birkenhead	39	7:00	18:00	16:00	17:00	14:00	10:00	13:00	11:00	15:00	09:00	08:00	12:00
Doncaster - Scarborough	83	18:00	16:00	14:00	10:00	07:00	11:00	17:00	13:00	15:00	12:00	09:00	08:00
Doncaster - Sunderland	109	18:00	07:00	10:00	14:00	15:00	13:00	11:00	12:00	09:00	16:00	08:00	17:00
Port of Immingham - Barnsley	61	18:00	10:00	11:00	09:00	12:00	13:00	14:00	15:00	07:00	16:00	17:00	08:00

Average maximum speed

Figure F.4: Average speed analysis for IEC-IEC pair ordered by best to worst time period.

As this is using the same ordering of time period as the previous Figure F3, in terms of best to worst, the RAG analysis for time periods N+1 to N+11 reflects the delay performance.

- Less than 8 seconds per mile – **Green**
- Between 8 seconds and 15 seconds – **Amber**
- Greater than 15 seconds – **Red**

Average maximum speed has been coloured using a more graduated RAG profile in terms of meeting the following criteria:

Average Maximum Speed

Less than 35 mph – oranges and reds

35 – 45 mph – yellows and ambers

Greater than 45 mph - Greens

Traffic Master OD Pair	Distance (Miles)	Min	Maximum Speed (mph)	N+1	N+2	N+3	N+4	N+5	N+6	N+7	N+8	N+9	N+10	N+11
Barnsley - Skipton	45	10:00	28	28	28	27	27	27	26	26	25	22	22	22
Blackpool - Hull	139	18:00	55	54	54	54	54	53	53	52	51	51	44	44
Blackpool - Bridlington	148	11:00	47	45	45	45	45	45	44	44	44	43	39	38
Carlisle - Newcastle	59	18:00	44	43	43	43	43	43	43	42	42	42	42	40
Colne - York	57	18:00	29	29	28	28	28	27	27	26	25	24	22	20
Crewe - Manchester	36	10:00	37	36	36	36	35	34	32	31	30	29	25	24
Crewe - Sheffield	59	13:00	30	30	29	29	29	29	28	28	27	26	26	25
Crewe - Carlisle	144	10:00	57	56	56	56	55	54	54	53	53	53	50	46
Crewe - Newcastle	174	18:00	44	44	44	44	44	43	42	41	39	37	37	35
Darlington - Carlisle	77	11:00	51	50	49	49	49	48	48	48	47	47	46	46
Ellesmere Port - Manchester	39	10:00	46	45	45	44	44	44	39	39	39	35	34	31
Ellesmere Port - Port of Immingham	145	18:00	53	52	52	52	52	51	50	50	44	43	43	43
Ellesmere Port - Teesport	147	18:00	48	48	48	48	48	47	47	46	41	40	39	39
Fleetwood - Lancaster	25	18:00	32	30	29	29	29	29	28	28	27	27	27	25
Fleetwood - Darlington	110	18:00	49	47	46	46	46	45	45	45	44	44	44	44
Keswick - Newcastle International Airport	82	13:00	50	46	46	46	45	45	44	44	44	43	43	43
Lancaster - Newcastle	116	13:00	52	50	49	49	49	49	49	49	48	48	45	45
Leeds - York	25	13:00	32	32	31	31	31	31	30	30	29	29	26	26
Leeds - Sheffield	36	13:00	44	44	42	41	40	40	40	39	38	34	31	30
Manchester - Port Salford	6	18:00	20	19	19	19	19	17	17	17	15	14	13	12
Manchester - Liverpool	34	18:00	36	36	36	35	35	34	31	29	29	28	25	25
Manchester - Leeds	43	13:00	38	38	38	38	38	36	36	35	31	30	29	28
Manchester - York	66	13:00	35	35	34	34	34	33	33	33	30	30	28	26
Manchester - Hull	97	18:00	46	46	46	46	46	46	46	45	41	41	41	39
Newcastle - Berwick	62	18:00	48	47	47	46	46	46	45	45	45	45	45	44
Northallerton - Selby	55	13:00	51	51	51	51	51	50	50	50	50	49	49	48
Penrith - Darlington	58	13:00	53	52	51	51	51	51	50	50	50	49	49	49
Port of Barrow - Sellafield inc. Moorside	43	18:00	39	37	37	36	36	35	35	34	34	34	34	34
Port of Barrow - Skipton	71	18:00	43	43	40	40	39	38	38	38	38	37	37	37
Port of Immingham - York	57	13:00	36	36	36	35	35	35	35	34	34	34	33	30
Port of Liverpool - Teesport	142	18:00	44	43	43	43	43	42	42	41	39	37	35	35
Preston - Samlesbury EZ	7	18:00	26	26	26	26	25	24	24	24	24	22	18	18
Preston - Manchester Airport	39	18:00	48	48	48	48	47	46	46	44	43	41	37	32
Preston - Leeds	67	18:00	51	51	51	51	50	49	49	46	44	43	35	34
Preston - Catterick Garrison	102	18:00	54	51	51	51	51	50	50	50	50	50	48	48
Samlesbury EZ - Skipton	29	18:00	42	40	40	40	40	39	39	39	39	39	38	38
Sheffield - Carlisle	157	18:00	53	52	51	51	51	51	50	50	49	49	49	48
Sheffield - Berwick	194	18:00	53	52	52	52	51	51	51	51	49	48	48	47
Wetherby - York	19	18:00	37	37	37	36	35	34	34	33	32	32	29	26
Whitehaven - Newcastle International Airport	103	18:00	42	42	42	41	41	41	41	41	41	41	41	39
Crewe - Stoke-on-Trent (Outside of the North)	15	18:00	31	29	27	27	27	27	27	26	25	23	23	22
Crewe - Birkenhead	39	07:00	34	34	32	32	31	31	31	31	31	29	29	27
Doncaster - Scarborough	83	18:00	47	46	45	45	45	45	45	45	45	45	45	43
Doncaster - Sunderland	109	18:00	52	51	51	51	51	51	50	50	50	50	50	50
Port of Immingham - Barnsley	61	18:00	42	40	39	39	39	38	38	38	37	37	37	36

Reliability

Figure F.5: Percentage of journeys within 20% of the quickest for each IEC-IEC pair ordered by time period

- Analysis based on Minimum Journey Time + 20% (in seconds)
- Less than 20% above Minimum Journey time - **Green**
- Greater than 20% above Minimum Journey time – **Red**
- Further Reliability Analysis based on total number of journeys within 20%.
- Above 90% - **Green**

Rank	Traffic Master OD Pair	Distance (Miles)	Min Time	Min Time (+ 20%)	18:00	17:00	16:00	15:00	14:00	13:00	12:00	11:00	10:00	09:00	08:00	07:00	Reliability
1	Carlisle - Newcastle	59	4781	5738	6%	12%	3%	4%	5%	4%	4%	4%	5%	3%	7%		100%
2	Darlington - Carlisle	77	5460	6552		4%	4%	3%	11%	7%	6%	8%	6%	5%	5%	1%	100%
3	Fleetwood - Darlington	110	8029	9635	6%	13%	7%	9%	11%	12%	8%	9%	12%	10%	5%		100%
4	Keswick - Newcastle International Airport	82	5928	7113		16%	8%	16%	16%	13%	13%	14%	11%	10%	9%	9%	100%
5	Lancaster - Newcastle	116	8095	9714	15%	14%	8%	5%	5%	5%	4%	5%	6%	6%	7%		100%
6	Manchester - Hull	97	7536	9043	13%	18%	2%		0%	1%	0%	0%	3%	13%	14%	1%	100%
7	Newcastle - Berwick	62	4607	5529		11%	7%	7%	8%	9%	6%	3%	7%	5%	5%	3%	100%
8	Northallerton - Selby	55	3856	4627	1%	4%	2%	7%	3%	2%	3%	1%	3%	4%	0%		100%
9	Penrith - Darlington	58	3942	4730		6%	4%	7%	9%	7%	4%	7%	8%	3%	3%	2%	100%
10	Port of Barrow - Sellafield inc. Moorside	43	3975	4770		6%	13%	14%	9%	14%	14%	14%	11%	14%	9%	5%	100%
11	Port of Barrow - Skipton	71	5999	7199		7%	14%	13%	15%	15%	14%	14%	12%	10%	6%	0%	100%
12	Preston - Catterick Garrison	102	6789	8147	7%	8%	6%	6%	7%	7%	5%	8%	12%	12%	9%		100%
13	Samlesbury EZ - Skipton	29	2480	2976	6%	7%	7%	12%	10%	6%	8%	6%	8%	6%	8%		100%
14	Sheffield - Carlisle	157	10683	12819	7%	7%	3%	2%	6%	5%	4%	6%	4%	9%	10%		100%
15	Sheffield - Berwick	194	13233	15880	11%	11%	4%	3%	3%	2%	2%	1%	2%	8%	10%		100%
16	Whitehaven - Newcastle International Airport	103	8747	10497		9%	4%	3%	3%	3%	2%	3%	4%	4%	5%	1%	100%
17	Doncaster - Scarborough	83	6308	7570	2%	6%	5%	5%	5%	9%	6%	5%	6%	5%	5%		100%
18	Doncaster - Sunderland	109	7522	9026	2%	5%	2%	4%	2%	3%	3%	3%	3%	5%	4%		100%
19	Port of Immingham - Barnsley	61	5276	6331	10%	15%	7%	13%	10%	5%	7%	5%	9%	12%	12%		100%
20	Crewe - Sheffield	59	7058	8470	3%	18%	9%	3%		5%	9%	4%	13%	14%	22%	1%	91%
21	Crewe - Carlisle	144	9130	10956	5%	7%	2%		2%	3%	2%	4%	7%	13%	24%	7%	91%
22	Fleetwood - Lancaster	25	2832	3398		20%	10%	11%	11%	20%	13%	14%	30%	18%	9%	7%	91%
23	Port of Immingham - York	57	5641	6770	8%	22%	6%	2%	2%	4%	5%	5%	6%	5%	10%		91%
24	Crewe - Birkenhead	39	4146	4976	1%	15%	5%	9%	10%	16%	9%	7%	10%	10%	24%		91%
25	Blackpool - Hull	139	9153	10984	25%	23%	5%	2%	1%	1%		1%	2%	7%	8%	0%	82%
26	Blackpool - Bridlington	148	11404	13684	22%	21%	8%	5%	3%	3%	3%	3%	5%	6%	6%		82%
27	Colne - York	57	7024	8428	14%	43%	8%	1%		6%	4%	8%	17%	20%	31%	4%	82%
28	Crewe - Newcastle	174	14275	17130	20%	27%	6%	1%		0%	0%	1%	3%	12%	20%	5%	82%
29	Leeds - York	25	2779	3335	0%	27%	10%	4%		5%	3%	8%	11%	9%	25%	5%	82%
30	Manchester - York	66	6825	8190	17%	31%	7%	1%		1%	2%	2%	7%	15%	23%	4%	82%
31	Port of Liverpool - Teesport	142	11731	14078	23%	25%	6%	1%	1%	1%	1%	3%	3%	11%	16%		82%
32	Preston - Samlesbury EZ	7	970	1164	1%	5%	1%	0%		9%	9%	6%	18%	42%	44%	9%	82%
33	Preston - Manchester Airport	39	2911	3494	49%	31%	9%	4%		0%	1%	0%	3%	11%	17%	6%	82%
34	Preston - Leeds	67	4716	5659	52%	44%	11%	3%	1%		0%	1%	5%	16%	18%	5%	82%
35	Wetherby - York	19	1832	2199	8%	45%	16%	1%		3%	2%	8%	17%	9%	27%	12%	82%
36	Barnsley - Skipton	45	5711	6853	10%	27%	6%		1%	4%	5%	8%	15%	26%	28%	0%	73%
37	Ellesmere Port - Manchester	39	3078	3693	29%	48%	16%	1%	2%	4%	3%		4%	18%	33%	16%	73%
38	Ellesmere Port - Port of Immingham	145	9924	11909	23%	21%	5%		1%	1%	1%	2%	4%	19%	22%	5%	73%
39	Ellesmere Port - Teesport	147	10926	13111	21%	23%	6%		1%	1%	1%	2%	4%	18%	24%	4%	73%
40	Leeds - Sheffield	36	2957	3548	15%	40%	12%	0%		3%	7%	9%	9%	29%	46%	9%	73%
41	Crewe - Manchester	36	3535	4242	24%	44%	14%		2%	6%	2%	1%	8%	25%	50%	20%	64%
42	Manchester - Port Salford	6	1095	1314	19%	45%	19%		4%	2%	2%	5%	16%	54%	70%	34%	64%
43	Manchester - Leeds	43	4027	4833	31%	37%	8%		1%	0%	2%	0%	9%	26%	26%	7%	64%
44	Crewe - Stoke-on-Trent	15	1758	2110	8%	35%	17%	13%	13%	14%	13%	14%	22%	32%	43%		64%
45	Manchester - Liverpool	34	3364	4036	24%	44%	19%	1%		3%	3%	1%	7%	30%	47%	25%	55%

Dashboard mock up

A user friendly excel based dashboard mock up with interim data from the pilot work is shown below in **Figure F.6**. This provides the user with the functionality to undertake a series of pre-set analyses based on filters such as origins, destinations and mileage bands. It also provides details on the make-up of the journey in terms of the MRN and SRN, and how the performance of that IEC-IEC journey pair compares with others from that origin.

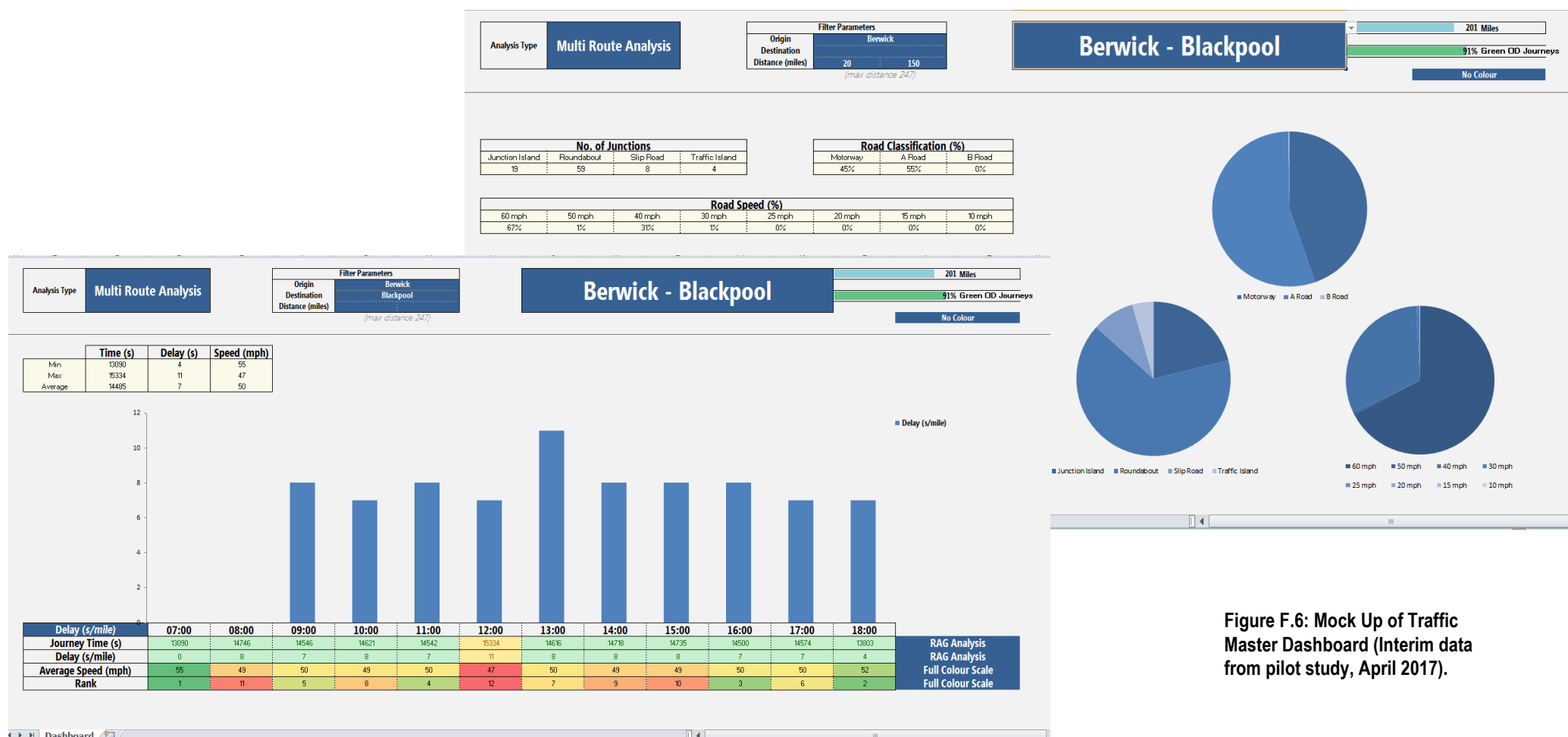
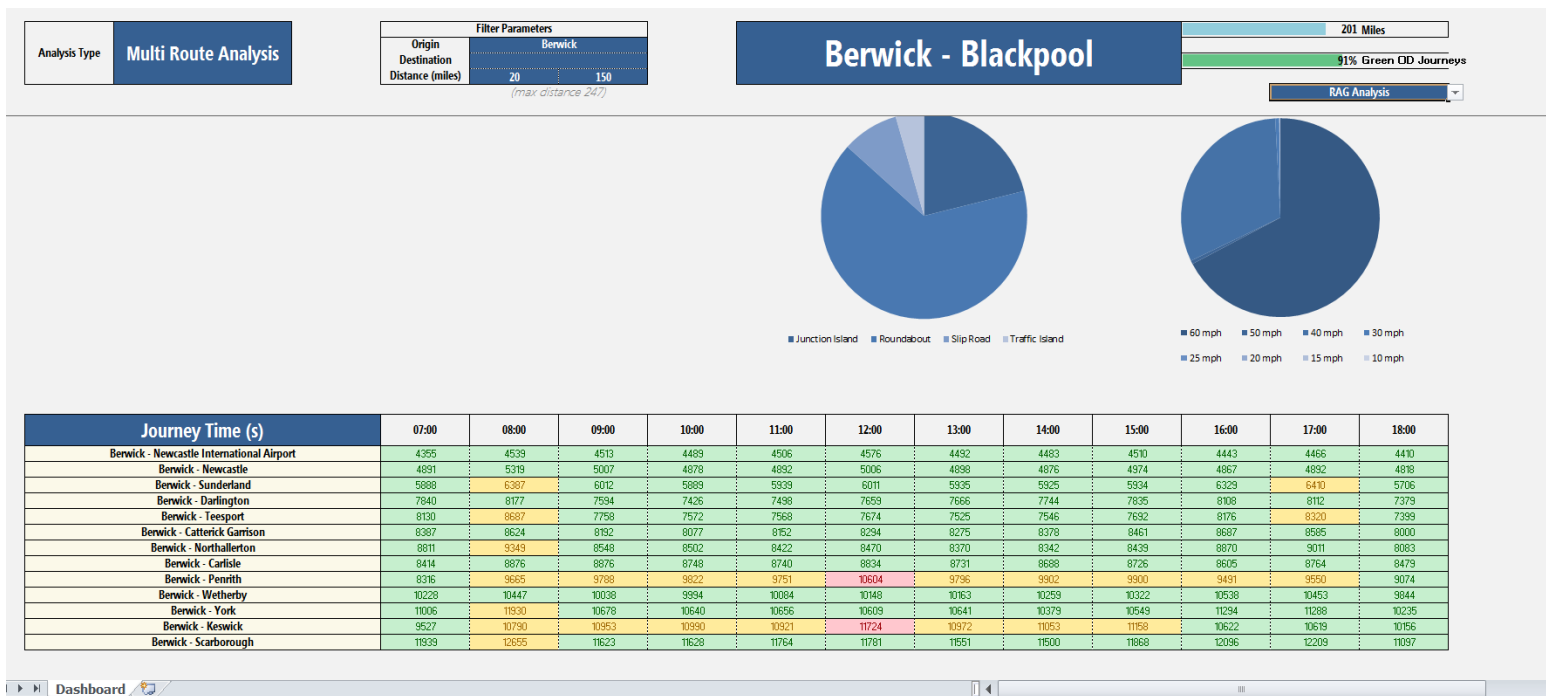


Figure F.6: Mock Up of Traffic Master Dashboard (Interim data from pilot study, April 2017).



Given the importance of freight and goods to the economy, Traffic Master also usefully provides us with the ability to split performance between Cars and Light Goods Vehicles / Heavy Goods Vehicles in future.

Alongside this TfN is seeking formal agreement with DfT on the collation of a pan-Northern dataset to expand this for future years and also allow the analysis of any seasonal variability.

Efficiency (Vehicle Occupancy) and Journey Quality

TfN have had early engagement with market research organisations concerning the potential for pan-Northern related transport surveys. This could involve questions on:

- **Vehicle occupancy** to act as a proxy for behavioural change.
- Business and road user perception of **journey information** provision and pan-Northern **road condition**.

Alongside these questions other data will be required to enable meaningful conclusions to be drawn that can then be used to help Partners target interventions and investment that makes it easier for people to change travel behaviours and make the most efficient journey and for users to experience an improvement in aspects of their journeys that matter to them and their business.

Efficiency (Adaptive Roads) and Resilience

Initial exploratory data requests have been useful to understand the type of data that is held by partners, and its variability, given that there is no statutory reason for collecting this data.

- **Feedback on % roads that are adaptive** – through an initial GIS based data collection exercise (partially complete) and then a mapping and interpretative exercise to broadly define specific areas of the network as “adaptive” based on set criteria of what an adaptive network comprises. This would be refreshed through lighter touch updates using the mapping created, with more periodic refreshes to consider whether the definition of “adaptive” is still true.

Dialogue with partners during the initial data exploration phase has provided some useful commentary on what could be considered an adaptive network (described in Section 6). This has raised the need to reflect the geographical variability of the MRN for the North, and the needs of Local Rural, Local Urban and Strategic network operators and their road users to make informed decisions.

Dialogue with both local and strategic partners has also raised important questions about what may be considered adaptive when implemented may not be now, given that technology has moved at a pace and some assets may no longer work effectively. Looking further to the future this Conditional Output may evolve to become the percentage of journeys that are adaptive with connected vehicles and smart-phones. Ultimately this is about providing road users with the best information to enable them to complete their journey by the most efficient mode, as well as allowing network operators the opportunity to manage often variable and dynamic traffic flow with minimum impact on the efficiency of the network. If a section of road is considered adaptive then it can provide that economic efficiency functionality.

- **Annual feedback on the number of road closure events on defined corridors** – specific corridors and sections of the MRN have a greater impact on the economy where they are not available than others. This is clear from the evidence base and dialogue with partners. For some journeys (especially those in coastal or mountainous environments) there are few if any practical alternatives if a road is closed. For other roads the scale of the impact (such as incidents on the SRN) is disproportionate on the adjacent MRN and its ability to serve the local economy than others (e.g. incidents on the M56, M6 or M62 causing unreliable journeys and delays within IECs such as Warrington. Incidents on the denser parts of the MRN generally have a lesser impact given the range of alternatives available.

Taking such an approach reduces the volume of data, and provides TfN and Partners with a meaningful set of data to better inform targeted interventions. A catch-all data request for the whole MRN is not currently achievable, and does not provide the meaningful data to make informed decisions. Ideally the metric would cover the duration of the closure but this data is not currently collected consistently, and to begin with a metric focussed on the number of events provides a starting point by which to measure the resilience of the network.

It is proposed that TfN works with Partners to agree the broad corridors of the MRN by which to base this measure, with an initial starting point being the SRN, and MRN links at elevated risk of snow and flooding (using the maps provided in **Appendix G**). Discussion with Highways England reveals that such data can be made available through the various Operational Plans which have been developed to reflect years of experience in managing that section of the network.

Sporting and cultural events (such as marathons, carnivals, cycling stages, accommodating sports matches etc.) would not be included given that these have a positive economic impact themselves (which likely outweighs the economic cost of closure) and generally occur when the economic role of the road is reduced (for example Sundays or inter-peak hours).

Appendix F. Maps of Resilience Variables and Safety Performance on the MRN

Maps are provided for the following:

- Annual Rainfall
- Days of Snow
- High Risk of Flooding from Rivers and Sea
- Safety – EuroRAP Road Risk 2010-2012

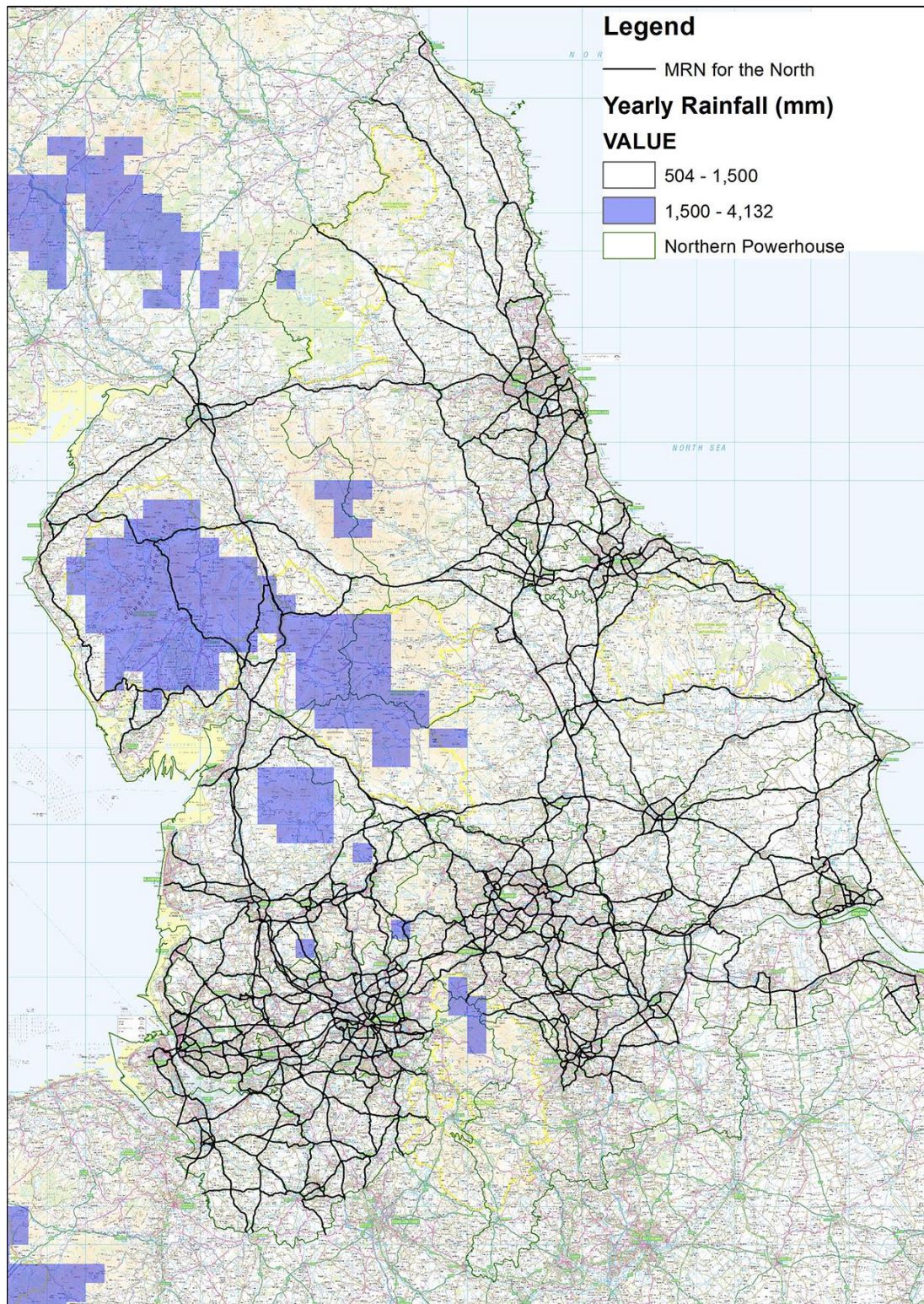


Figure G.1: Heavy Rainfall and the MRN, Source: Met Office

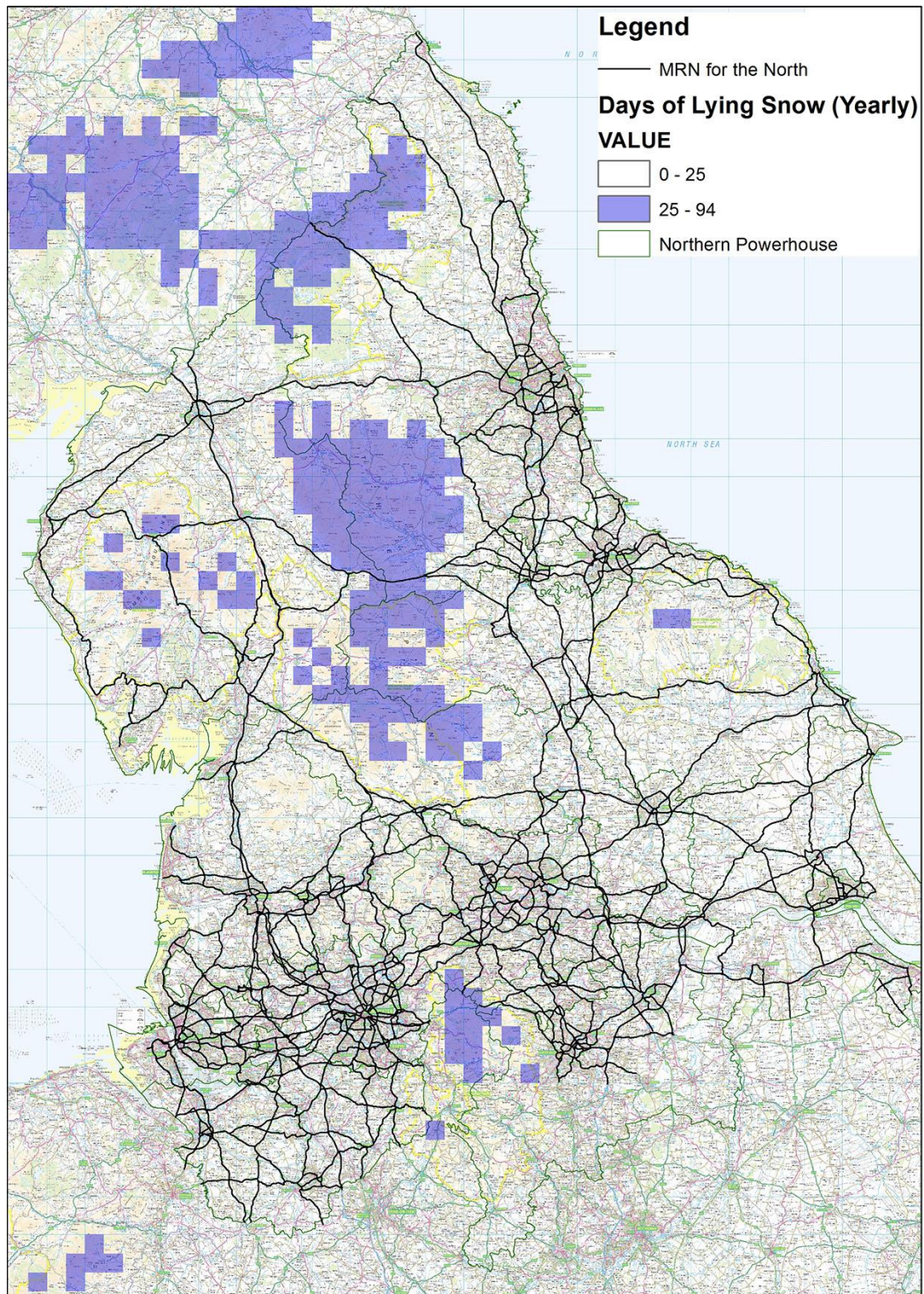


Figure G.2: Long lying snow cover and the MRN, Source: Met Office

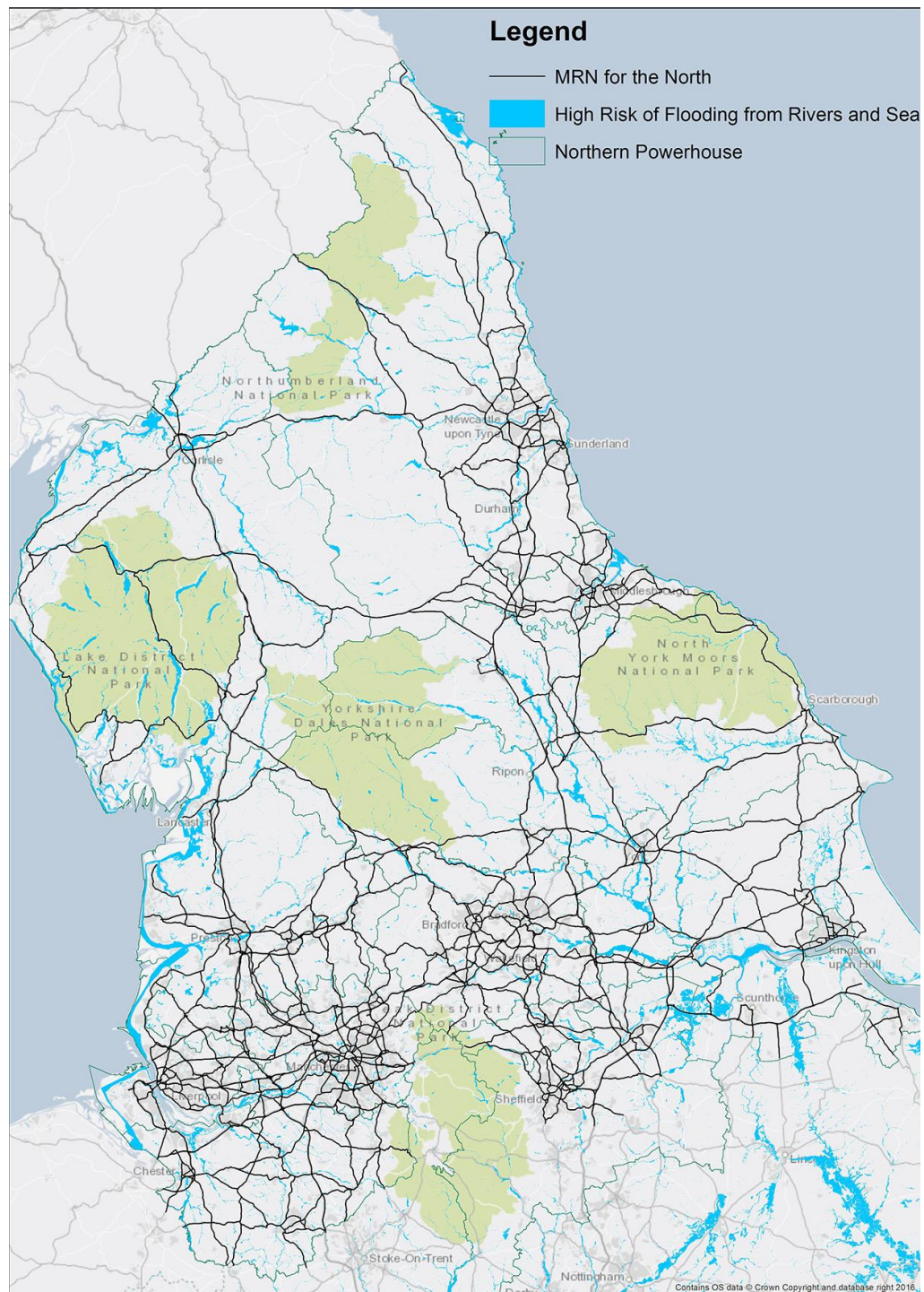


Figure G.3: High Risk of Flooding from the Rivers and Seas and the MRN, Source Environment Agency

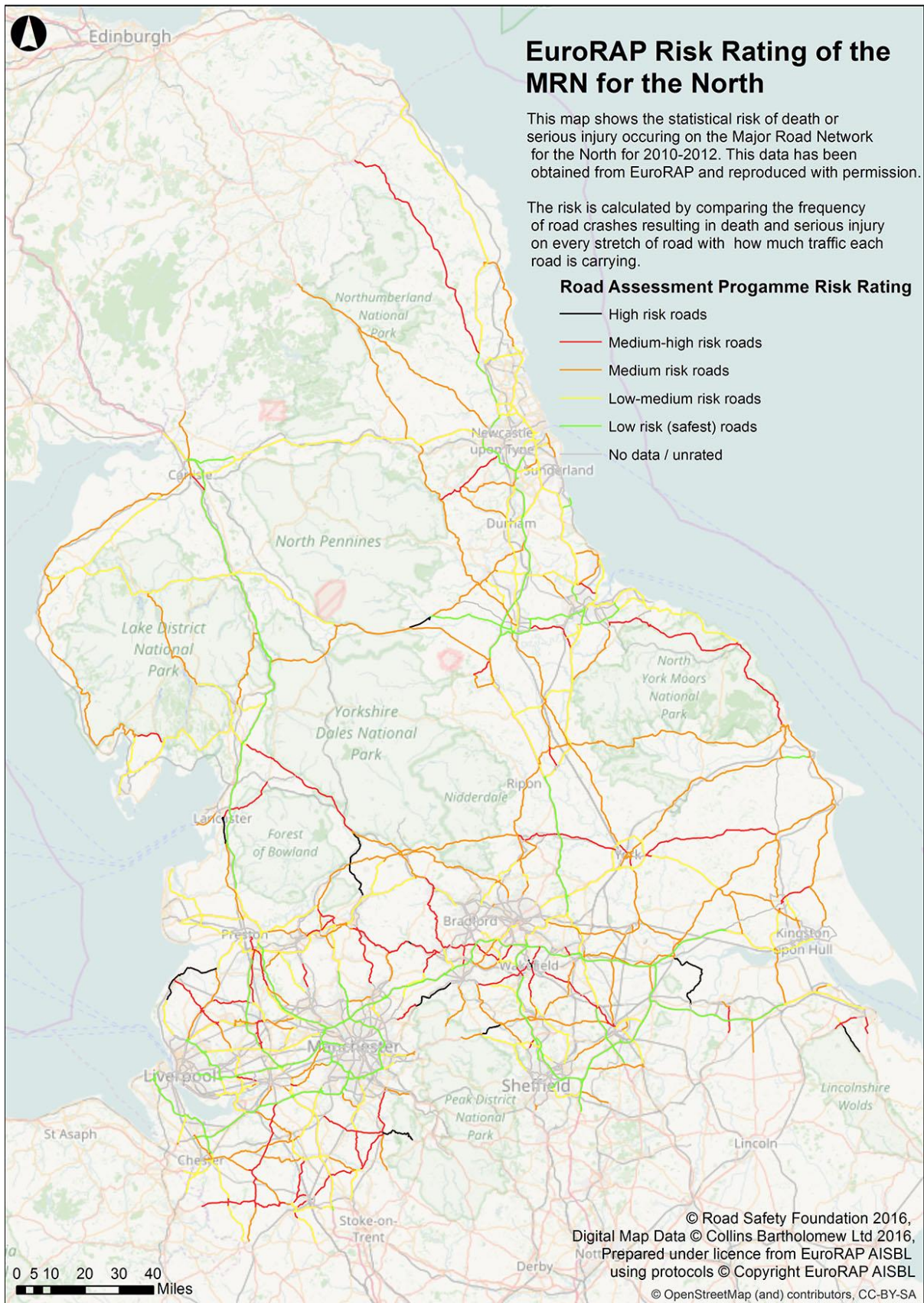


Figure G.4: EuroRAP Risk Rating of the MRN (2010-2012)

Appendix G. Summary of Smart Assets, January 2017

LEP or Network Operator	Sub-region	SMART Motorway	Expressway	Ramp Metering	ANPR Camera	CCTV Camera	SWISS	UTMC	UTC Controller	Strategic VMS	MIDAS Loops	SCOOT/ MOVA
North East	Tyne & Wear / Northumberland	N/A	N/A	N/A	✓	✓			✓	✓		
North Yorkshire	All	N/A	N/A	N/A		✓				✓		✓
Sheffield City Region	Sheffield City	N/A	N/A	N/A	✓	✓	✓			✓		✓
Sheffield City Region	Doncaster	N/A	N/A	N/A	✓	✓		✓		✓		✓
Greater Manchester	All	N/A	N/A	N/A		✓				✓		✓
West Yorkshire	All	N/A	N/A	N/A	✓	✓			✓	✓		✓
Cumbria	All	N/A	N/A	N/A						✓		✓
Highways England	All HE	✓	✓	✓	✓	✓				✓	✓	
Liverpool City Region										✓		
The Humber						✓			✓	✓		✓

Appendix H. Technology Drivers (2017 to 2030+)

Connected and Autonomous Vehicles

The Government has set up the Centre for Connected and Autonomous Vehicles to place the UK at the vanguard of these emerging technologies. Current pilots include the A2/M2 Connected Corridor, HGV platoon trials, autonomous vehicle pilots in 4 urban areas and a gradual development and adoption of forms of assisted automation so that these are becoming more part of the mainstream. The potential for full automation becoming prevalent in new cars is likely beyond 2030. The Government has been proactive in providing a regulatory framework for testing, with related work around insurance, the behavioural response to new technology and cyber security ongoing.

Research by KPMG &SMMT (2015) suggests that all new UK cars sold from 2026 will have connected technology as standard, providing the opportunity for real-time information to be shared between vehicle to vehicle and vehicle to infrastructure, in time diminishing the need for hard engineering such as gantries on smart motorways.

There is a potential opportunity for the North to capitalise on innovation in human interaction design, connectivity and networks, real-time control, localisation and mapping, data analytics and simulation, and cyber security. This includes car manufacturers and research institutions amongst other firms already based in the North including Nissan, Jaguar Land Rover, University of Leeds Institute of Transport Studies, Lancaster University and University of Sheffield.

Forecasts that 25% of UK cars sold will have fully autonomous capability by 2030, with premium brands an early adopter of such technology. Functionality could include certain situations such as remote parking and automated driving in particular environments, with full end to end functionality beyond 2030. Benefits include safety and enhanced productivity, although care will be required around how these are not used and applied to the detriment of healthy lifestyles as a result of enhanced motorised mobility. 94% of road deaths and injuries have human error as a key cause – highly autonomous vehicles could have a transformational impact on road safety, potentially saving 25000 serious accidents and 2500 lives between 2014 and 2030. Enhanced productivity by freeing up road users time from driving has the potential to add £51bn of value add to the UK economy by 2030 at 2014 prices

Intelligent Transport Systems

SCOOT is largely at the peak of its current potential. TfL is working with TRL and industry partners through its SITS project to understand the potential for further incremental improvements through innovative system learning so that there is a semi degree of automation in response to incidents and variability on the ground. Connected vehicles also provide a further opportunity as probes for partner's ITS expanding the ability of these systems to take into account performance of non-signal controlled assets effectively. In specific areas there is also the potential to widen what we give priority to away from the traditional bus priority systems to cater for real-time demand in other modes, such as cyclists in urban areas (either through SIM card fitted bikes or apps), and freight traffic either in response to port operations or increasing pollution.

Smart Motorways

Highways England in 2017/18 will be introducing its CHARM modular system for technology interface to the SRN. It provides the potential to easily add new modules to the system (such as perhaps linking signals on an interfacing part of the MRN managed by local authorities, or pollution equipment) to trigger responses in how the network is managed such as variable speed limits and diversions.

The greater penetration of connected vehicles has longer term implications for how we use technology on smart motorways and expressways. While the issue of enforcement will require careful consideration, it is plausible to consider the removal or non-replacement of gantries and related VMS in the 2030s as the value to users diminish.

Network Incident Response

The use of drones and their potential to understand incidents and resolve them are currently limited – this would be useful for sections of the MRN lacking CCTV. While currently used for some visual bridge inspections, they are limited by CAA regulations around the distance and visibility of the drone from the operator. Likewise the potential for connected vehicles to stream live photos and videos during incidents is also potentially valuable although data protection issues require resolution.

Electric Vehicles

Vehicle manufacturers are investing in developing more desirable electric cars with performance and range similar to conventional vehicles. The expansion of fast charging technology and longer-term potential for graphene has the opportunity to rethink how this is best managed. Induction technology along main roads has been previously touted, yet it is struggling to prove its worth for lower energy small household appliances. The greater likelihood is that fast charging terminals at service stations for 50 mile top ups in 5 minutes, and lower speed, lower energy charging solutions at locations where cars are left for long period of time (such as car parks) will prove more practical to deliver, with considerations such as the scale of the energy network provision important.

Mobility as a Service

This represents a shift away from individually owned modes of transport to a tailored service. This could be for both people and goods, allowing people to pay a subscription or pay as you go formula and then consume public transport, taxis, bicycles, car rentals etc. as part of that package. Such an approach if marketed and bundled successfully would contribute to reduced car ownership and the valuation by users of the true rather than the marginal cost of that mode. The potential already exists to provide this service through smart card and app technology, although collaborative partnerships will be required to make this real. Ford is one example of a traditional vehicle manufacturer which is embracing this concept.

Smart and integrated mobility

For transport, advances in Information Communications Technology will have far-reaching impacts, making it more integrated, efficient, comfortable and eco-friendly. Machine to-machine (M2M) technology will increase efficiency by automating tasks and providing real-time analysis through the use of sensors inserted into objects and systems. Big data and the Internet of Things will allow transportation modes to communicate with each other and with the environment, paving the way for truly Integrated and inter-modal transport solutions that maximise efficiency gains. Cloud-based services will become more widespread driven by the uptake of smarter mobile devices and faster connectivity.

Information was drawn from documents such as:

- KPMG & SMMT, 2015, *Connected and Autonomous Vehicles – The UK Economic Opportunity*
- Centre for Connected & Autonomous Vehicles, 2016, *The Pathway to Driverless Cars – Connected and Autonomous Vehicles in the UK in 2016*
- *Auto Express*, Special Issue No.1456, 18 January 2017.
- As well as Jacobs' experiences in developing ITS and Smart Motorway schemes for the likes of Local Authorities, Highways England and Transport Scotland.

Appendix I. RIS2, Strategic Study and Large Local Major Schemes under development in the North, March 2017

Scheme	Status
M60 Simister Island interchange	RIS2 (from RIS1)
A1(M) Doncaster Bypass	RIS2 (from RIS1)
M1 Junctions 35A-39	RIS2 (from RIS1)
A1 Redhouse to Darrington	RIS2 (from RIS1)
M1/M62 Lofthouse Interchange	RIS2 (from RIS1)
A64 Hopgrove Junction	RIS2 (from RIS1)
Northern Trans-Pennine	Strategic Study
Trans-Pennine Tunnel	Strategic Study
Trans-Pennine Tunnel wider impacts study	Strategic Study
Manchester North-West Quadrant	Strategic Study
Business Case Development	
Tees Valley east-west connections	Large Local Majors Fund
New Tees Crossing	Large Local Majors Fund
Warrington Waterfront Western link	Large Local Majors Fund
Sheffield City Region Innovation Corridor	Large Local Majors Fund
A500 Dualling (Cheshire)	Large Local Majors Fund
A1079/A164 Jocks Lodge Junction	Large Local Majors Fund

Appendix J. Portfolio of Pan-Northern Connectivity Priorities

As noted in the main body of the Major Roads Report, thirteen broad corridors for further study have been identified. These have arisen out of the development of the MRN, appraisal of the baseline performance of the MRN, the demands on it, and the resulting strategic gap with an understanding of the recent investment and some of the plans for advancement in RIS1 and beyond. The tables below provide brief supporting details on each the thirteen connectivity priorities, describing:

- Geographical coverage and impact.
- Justification at a pan-Northern level using the criteria presented in Section 9.
- Anticipated benefits including Northern Powerhouse Independent Economic Review (NPIER) sectors, drawing upon information from Partners' studies.
- Schemes that are currently in progress (either in terms of construction or development), or other schemes that are not currently funded that could make a contribution to solving the strategic gaps. It is important to note that these unfunded schemes will have to compete with ideas that arise out of further studies to get into investment programmes for 2020-2025, 2025-30 and so on.

TfN will take these priorities forward alongside those from the Integrated Rail Report to undertake further study work in 2017/18 to inform the STP.

Ref	LEP / Combined Authority Area(s)	Intervention Name, Description and Location	Pan-Northern Justification	Anticipated Benefits (including NPIER economic sectors)	Complementary proposals include but are not limited to the following
1	NECA / Tees Valley / York, North Yorkshire and East Riding	A1 Scotch Corner to Scotland Phased interventions to enhance the A1 and cross links to the parallel A19, ensuring the major north-south route east of the Pennines provides a level of service and resilience that is both consistent and appropriate to the needs of Important Economic Centres it links and strategic journeys that it facilitates	<ul style="list-style-type: none"> • Supports key growth locations along this corridor including Newcastle Airport • Improves resilience / connectivity between Important Economic Centres across the MRN for north-south connectivity. • Short to medium river crossing capacity issues on the River Tyne because of the need for large maintenance schemes, limiting access to larger and heavier vehicles 	<ul style="list-style-type: none"> • Agglomeration benefits through enhanced connectivity between the North Yorkshire, Tees Valley, North East LEPs and Scotland • Supports key sectors especially advanced manufacturing, health and digital sectors. • Logistics and international connectivity benefits to Ports of Tyne, Tees, Sunderland; Newcastle Airport, Durham Tees Valley Airport • Enhances connectivity to Scotland by road. • Supports International Advanced Manufacturing Park (IAMP) NSIP and existing production at Nissan • Benefits for Enterprise Zones and NaREC advanced renewable energy at the Port of Blyth. • Tourism benefits to Northumberland as a result of A1 improvements. 	Funded RIS1 Schemes <ul style="list-style-type: none"> • A1 N of Ellingham, Morpeth to Ellingham • A1 Technology Enhancements • Scotswood to North Brunton; Coal House to Metro Centre; Birtley to Coal House Recent and planned investment in <ul style="list-style-type: none"> • Newcastle Airport, Durham Tees Valley Airport and the Ports of Tyne, Tees and Sunderland Connectivity Priorities 1, 2 and 3 complement each other in terms of access and resilience

Ref	LEP / Combined Authority Area(s)	Intervention Name, Description and Location	Pan-Northern Justification	Anticipated Benefits (including NPIER economic sectors)	Complementary proposals include but are not limited to the following
2	NECA / Tees Valley / York, North Yorkshire & East Riding	A19 Expressway A programme of targeted improvements to the A19 corridor and cross links to the parallel A1. This includes a new River Tees Crossing, and interface with Energy Coasts Access Improvements and A1 Scotch Corner to Scotland	<ul style="list-style-type: none"> • Supports key growth locations and hubs for international connectivity at along this corridor. • Improves resilience / connectivity between key economic centres across the MRN for north-south connectivity, especially when the A1(M) corridor is capacity constrained. 	<ul style="list-style-type: none"> • Agglomeration benefits through enhanced connectivity between the York, North Yorkshire & East Riding, Tees Valley and North East LEPs • Support key sectors especially advanced manufacturing and energy. • Logistics benefits to Ports of Tyne, Tees and Sunderland plus Durham Tees Valley Airport. • Supports International Advanced Manufacturing Park (IAMP) NSIP and existing production at Nissan. Partners are looking to accelerate IAMP development early through planning permissions • Wynyard 	<p>Funded RIS 1 Enhancements include</p> <ul style="list-style-type: none"> • A19 Technology Enhancements • A19 Silverlink, Testos, Norton – Wynyard <p>Schemes in development include</p> <ul style="list-style-type: none"> • A19 Tees Crossing Local Major <p>Unfunded schemes</p> <ul style="list-style-type: none"> • A19/A168 improvements between Dishforth and Teesside to Expressway Standards <p>Connectivity Priorities 1, 2 and 3 complement each other in terms of access and resilience</p>

Ref	LEP / Combined Authority Area(s)	Intervention Name, Description and Location	Pan-Northern Justification	Anticipated Benefits (including NPIER economic sectors)	Complementary proposals include but are not limited to the following
3	York, North Yorkshire & East Riding / Tees Valley / Cumbria / Lancashire / Scotland Continues over page	<p>(Nuclear and Wind) Energy Coasts Access Improvements</p> <p>Package of schemes to improve accessibility and resilience of the MRN to open up access to nuclear and wind energy opportunities and complementary port, employment and housing opportunities to develop a legacy for this £25Bn+ mega investment</p> <p>Provides links between energy sectors on East and West Coasts of Northern England and the MRN for onward connections to Northern England and Southern Scotland</p> <p>Extends and enhances A66 / A69 commitments in RIS2.</p> <p>Improves access to key railheads for national and pan-Northern journeys such as Darlington HS2 and Carlisle</p> <p>Builds on access improvements already delivered between the M6 and Port of Heysham / Heysham Nuclear Power station in Lancashire</p> <p>The intention is that this not</p>	<ul style="list-style-type: none"> Potential to unlock access Nationally Significant Infrastructure at Moorside, alongside aspirations for the Port of Workington along the west coast, and lock those benefits in as a legacy Potential to improve / open up access to similar / complementary growth clusters to the industry on both coasts. Enhancements would support supply chain growth and creation of clusters. Improvements would also help to extend travel to work areas linking population centres and locations for housing growth with employment opportunities where there is often a demographic gap No secondary alternative to the SRN in many cases 	<ul style="list-style-type: none"> Agglomeration benefits for the energy / process sectors at a local and pan-Northern scale Port industry growth in Teesport and Workington alongside existing facilities at Barrow and Heysham Moorside Nuclear Power Station NSIP by 2024 Potential future longer-term investment at Hartlepool Nuclear Power station Low Level Waste Repository West Lakes Science Park contains a range of firms in the nuclear / energy sector together with the Nuclear Technology Innovation Gateway which provides a state of the art nuclear focussed R&D and innovation facility including presence for the University of Manchester and the National Nuclear Laboratory Clusters of advanced manufacturing in Furness, and their links with Lancashire. For instance Waterfront Business Park is well located to support the advanced manufacturing, energy and defence sectors, including BAE investment in Barrow 	<p>Schemes recently completed</p> <ul style="list-style-type: none"> M6 to Heysham Link <p>Schemes funded</p> <ul style="list-style-type: none"> A69 junction improvements at Corbridge and Hexham <p>Schemes and studies in development</p> <ul style="list-style-type: none"> Strategic studies for the A66 and A69 corridors A1 (M) to Teesport Local Major Tees Valley East-West Connections (A1 (M) and the A66 to the North West of Darlington) <p>Schemes currently unfunded</p> <ul style="list-style-type: none"> A171 Improvements A590, A595, A66 packages (Cumbria) resulting from joint work on the West of the M6 Strategic Study by Highways England and Cumbria CC Carlisle Southern Bypass <p>Connectivity Priorities 1, 2 and 3 complement each other in terms of access and resilience</p>

Ref	LEP / Combined Authority Area(s)	Intervention Name, Description and Location	Pan-Northern Justification	Anticipated Benefits (including NPIER economic sectors)	Complementary proposals include but are not limited to the following
3	York, North Yorkshire & East Riding / Tees Valley / Cumbria / Lancashire / Scotland (continued)	(Nuclear and Wind) Energy Coasts Access Improvements (continued)	<ul style="list-style-type: none"> Potential to unlock access to Nationally Significant Infrastructure at Teesport and to employment projects along the east coast, including the construction and servicing of Dogger Bank wind farms Significant impact of major housing on the SRN without alternative additional provision (St Cuthberts, Wynyard, North of Darlington). This housing is needed to support the growth in NPIER employment sectors Improve access to high quality visitor destinations, relevant to the NPIER recognition to quality of life considerations. These include internationally renowned destinations such as Hadrian's Wall World Heritage Site, Northumberland Dark Skies Park, Lake District, Northumberland and North Yorks Moors National Parks amongst others 	<ul style="list-style-type: none"> Lillyhall Industrial Estate, and Kingmoor Park Enterprise Zone. Improved access to £2bn York Potash development near Whitby Maximise benefits associated with potential trans-Pennine improvements to A66 and A69 and previous and current investment in Carlisle Airport and Durham Tees Valley Airport Unlock major housing including St Cuthberts Garden Village, Wynyard and North of Darlington and mitigate that impact on the SRN Wider benefits for UK plc in terms of both providing new sources of energy and its transmission to decarbonise energy supply 	

Ref	LEP / Combined Authority Area(s)	Intervention Name, Description and Location	Pan-Northern Justification	Anticipated Benefits (including NPIER economic sectors)	Complementary proposals include but are not limited to the following
4	York, North Yorkshire & East Riding, and the Humber	<p>Port of Hull to A1 / M1 and westwards</p> <p>Package of improvements to enhance the road links between the Port of Hull, York and the A19, A1(M) / M1 and westwards. Interfaces with Highways England A63 improvements in Hull.</p> <p>Includes a study of a future Hull Ring Road and longer-term improvements to the A63 beyond the lifespan of the current Highways England interventions</p>	<ul style="list-style-type: none"> • Supports key growth locations at either end of and along this corridor • Improves resilience / connectivity between Important Economic Centres across the major road network for north-south and east-west connectivity. 	<ul style="list-style-type: none"> • Provides greater efficiency and connectivity to Port of Hull / Grimsby and Immingham from North Yorkshire, Tees Valley, North East, Cumbria and Scotland, maximising the benefits of investments in A66 and A69 corridors for an alternative trans-Pennine corridor away from the M62 • Supports key sectors including logistics, advanced manufacturing and the energy sector, with the Humber being the UK centre for offshore wind manufacturing and servicing. • International connectivity benefits through Port of Hull, Grimsby and Immingham; and Humberside Airport • Able Marine Park NSIP • York Housing and Employment growth 	<p>RIS1 Schemes in delivery</p> <ul style="list-style-type: none"> • A1(M) / A59 Junction 47 Improvement (due for construction 17/18) • A63 Castle Street, Hull <p>Local Majors under Development</p> <ul style="list-style-type: none"> • A1079 Jocks Lodge <p>Unfunded schemes include</p> <ul style="list-style-type: none"> • Other A1079 various junctions and corridor improvements • A1237 York Northern Outer Ring Road • A1237/A59 York to Harrogate • Longer term improvements to the A63. • A63/ Humber Corridor Strategy and Brough relief Road <p>Complements Connectivity Priority 5 in providing the potential for a viable alternative trans-Pennine corridor away from the M62 or A66 between the Port of Hull and M6 enhancing the resilience of the economy and transport network</p>

Ref	LEP / Combined Authority Area(s)	Intervention Name, Description and Location	Pan-Northern Justification	Anticipated Benefits (including NPIER economic sectors)	Complementary proposals include but are not limited to the following
5	Liverpool City Region / Lancashire / Greater Manchester / York, North Yorkshire & East Riding / West Yorkshire CA	Central Trans-Pennine Corridor Connectivity Phased improvements to MRN connections between Liverpool City Region, Central and East Lancashire, Greater Manchester, and Yorkshire.	<ul style="list-style-type: none"> • Supports key growth locations at either end of and along this corridor. • The M62 in its current form provides the only dual carriageway link across the Pennines within the North, and is prone to reliability and resilience issues constraining economic potential • Improves resilience / connectivity between Important Economic Centres across the Pennines. • Ultimately provides an enhanced and more resilient M6-A1(M) link, with strengthened onward links to international connectivity assets such as Port of Liverpool, Leeds Bradford Airport and the Port of Hull with onward links via Connectivity Priorities 4 and 6. 	<ul style="list-style-type: none"> • Productivity, agglomeration & freight benefits of enhanced connectivity by road for advanced manufacturing and energy prime capabilities and supporting enabling capabilities • Potentially improves access to Leeds Bradford Airport from East Lancashire and North Yorkshire • Supports growth in Preston, Blackburn with Darwen, East Lancashire, North Leeds, Bradford, and Harrogate and the Northern Gateway in Greater Manchester 	<p>RIS1 schemes in delivery</p> <ul style="list-style-type: none"> • A5036 Port of Liverpool Access Improvements to the M58 • A1(M) / A59 Junction 47 Improvement (due for construction 17/18). • M62 Junction 20 to 25 <p>Local schemes in development and delivery</p> <ul style="list-style-type: none"> • Preston, South Ribble and Lancashire City Deal • A650 Keighley (WY+TF) <p>RIS2 schemes in development</p> <ul style="list-style-type: none"> • M1/M62 Lofthouse Interchange • A64 Hopgrove Junction <p>Unfunded schemes include</p> <ul style="list-style-type: none"> • M65 Gateway Improvements J2-6 • A59 Climbing Lanes including Kex Gill, Harrogate Relief Road <p>Complements Connectivity Priorities 4 and 6 by providing both enhanced connectivity and resilience across the Pennines and to international connectivity assets.</p> <p>Given potential impacts on the A56(T)/M66 corridor and M61 it has a relationship with the</p>

Ref	LEP / Combined Authority Area(s)	Intervention Name, Description and Location	Pan-Northern Justification	Anticipated Benefits (including NPIER economic sectors)	Complementary proposals include but are not limited to the following
6	West Yorkshire CA / York, North Yorkshire and East Riding	<p>Leeds City Region North West Quadrant</p> <p>A new or enhanced connection between the A1(M), Leeds Bradford Airport, the Central Trans-Pennine Corridor and the M62/M606 to the east of Bradford. Facilitates improved connectivity and network resilience across the MRN in multiple LEP regions and employment growth aspirations in the polycentric and economically diverse West Yorkshire / Leeds City Region in particular around Leeds Bradford Airport.</p> <p>Further work would be needed to understand how to align with WY+TF schemes</p>	<ul style="list-style-type: none"> Improved connectivity and network resilience between North Yorkshire, West Yorkshire, Lancashire and Greater Manchester. Improves surface access to Leeds Bradford Airport 	<ul style="list-style-type: none"> Freight and Passenger Airport access at Leeds Bradford Airport Supports growth across multiple NPIER sectors across a diverse polycentric economic geography within the West Yorkshire / Leeds City Region. Facilitates WYCA SEP2 Employment Growth priority areas associated with M62 and Leeds Bradford Airport Employment Zones 	<p>Committed RIS1 Schemes</p> <ul style="list-style-type: none"> M62/M606 Chain Bar M62 Junctions 20 to 25 Smart Motorway <p>Major economic and international connectivity growth</p> <ul style="list-style-type: none"> Leeds Bradford International Airport growth and employment M62 Employment Zones <p>West Yorkshire + Transport Fund Schemes in development</p> <ul style="list-style-type: none"> A65 Leeds Bradford Airport Link Road Bradford-Shipley Corridor East Leeds Orbital <p>Future Schemes</p> <ul style="list-style-type: none"> South East Bradford Access Route Shipley Eastern Bypass A59 York to Harrogate Leeds City Region post NGT (Next Generation Transport) schemes. <p>Complements Connectivity Priority 5 in terms of providing both enhanced connectivity and resilience across the Pennines.</p>

Ref	LEP / Combined Authority Area(s)	Intervention Name, Description and Location	Pan-Northern Justification	Anticipated Benefits (including NPIER economic sectors)	Complementary proposals include but are not limited to the following
7	Sheffield CR / West Yorkshire CA / York, North Yorkshire & East Riding / D2N2	<p>A1 / M18 Improvements (Doncaster to Sheffield, West Yorkshire & Nottinghamshire)</p> <p>Improvements to the A1 between Darrington and M1/M18 junction - upgrading to motorway standard as part of providing a consistent level of service between the M18 at Doncaster and Newcastle.</p> <p>Improvements in level of service on the A1 corridor south of Doncaster into Nottinghamshire to complement Midlands Connect aspirations for additional north-south connectivity and resilience.</p> <p>Consideration given to the suitability of existing links between Doncaster and Sheffield via the M18 and M1 in the context of the current Local Major / RIS2 study around J33 and J35 of the M1 to tackle pollution issues as well as facilitate advanced manufacturing growth at AMID</p>	<ul style="list-style-type: none"> Improved connectivity and resilience of this key North-South link, providing benefits across multiple LEP areas, especially Sheffield CR and York, North Yorkshire & East Riding extending through to West Yorkshire / Tees Valley / NECA and Midlands Connect M1 to Nottinghamshire and Derbyshire already improved to 4 lane all running – this provides additional north south connectivity and resilience looking forward to 2050 	<ul style="list-style-type: none"> Network resilience in vicinity of Doncaster/ Sheffield/ Rotherham/ Barnsley/ A1(M) / M18. Potential relief of M1 through Sheffield City Region with its known air quality problems Benefits to key industry sectors including Advanced Manufacturing, Energy and Logistics. Benefits to intermodal rail freight terminal at Doncaster plus Doncaster/Sheffield Airport. Major future growth in Sheffield CR and West Yorkshire CA adjacent to corridor such as South Kirkby EZ, Langthwaite Grange, Rossington and DN7 Complements Midlands Connect growth aspirations for Nottinghamshire and Derbyshire 	<p>RIS2 schemes in development</p> <ul style="list-style-type: none"> A1 Redhouse to Darrington Sheffield CR Local Major / RIS2 studies into Sheffield Innovation Corridor and Advanced Manufacturing and Innovation District (AMID) associated with J33 to 35 of the M1. <p>Other aspirations</p> <ul style="list-style-type: none"> Midlands Connect aspirations for further north-south connectivity and resilience. <p>Sheffield City Region Integrated Infrastructure Plan priorities in development</p> <ul style="list-style-type: none"> M1 J36 to Dearne Valley Corridor. Doncaster Sheffield Airport Corridor. DN7 Initiative. <p>Interfaces with Connectivity Priority 8 in the Doncaster area</p>

Ref	LEP / Combined Authority Area(s)	Intervention Name, Description and Location	Pan-Northern Justification	Anticipated Benefits (including NPIER economic sectors)	Complementary proposals include but are not limited to the following
8	Sheffield CR / West Yorkshire CA / Humber / Greater Lincolnshire	<p>South Humber Trans-Pennine Connectivity</p> <p>A broad corridor between the M1 in the west around Barnsley and Sheffield to the M18/M180 and the Humber Bridge onward to the Ports of Hull, Grimsby and Immingham which would interface with a future Trans-Pennine Tunnel or shorter-term solutions for the corridor between Greater Manchester and the Sheffield City Region.</p>	<p>Long term connectivity and 'missing link' between M180 and a potential enhanced trans-Pennine connection.</p> <p>Provides a complete second east/west coast trans-Pennine connection.</p>	<ul style="list-style-type: none"> Freight, logistics and energy sector benefits Supports growth at Ports of Hull, Immingham and Grimsby Supports major employment and housing growth in the Dearne Valley aligning with Sheffield CR objectives Network resilience in vicinity of Sheffield/ Rotherham/ Barnsley/ Doncaster / M1/ A1/ M18. Provides a complete second east/west coast trans-Pennine connection and alternative route to the M62 corridor. Potentially maximise benefits of investment in an enhanced trans-Pennine connection and its business case Able Marine Energy Park NSIP and further potential NSIPs on the South Humber Bank Major future growth in Sheffield CR and West Yorkshire CA adjacent to corridor such as South Kirkby EZ, Langthwaite Grange, DN7 and Rossington 	<p>RIS2 schemes in development</p> <ul style="list-style-type: none"> Sheffield CR Local Major / RIS2 studies into Sheffield Innovation Corridor and Advanced Manufacturing and Innovation District (AMID) associated with J33 to 35 of the M1. Complements the ongoing Midlands Connect study into improving access to the South Humber Bank and Humber Bridge along the A15 / A46 corridors from Lincoln and Nottinghamshire. <p>Sheffield City Region Integrated Infrastructure Plan priorities in development:</p> <ul style="list-style-type: none"> M1 J36 to Dearne Valley Corridor. Doncaster Sheffield Airport Corridor. DN7 Initiative. <p>Interfaces with Connectivity Priority 7 in the Doncaster area</p>

Ref	LEP / Combined Authority Area(s)	Intervention Name, Description and Location	Pan-Northern Justification	Anticipated Benefits (including NPIER economic sectors)	Complementary proposals include but are not limited to the following
9	Sheffield City Region / Greater Manchester CA / West Yorkshire CA / D2N2 / York, North Yorkshire and East Riding / Lancashire	<p>Short Term improvements before a Trans-Pennine Tunnel</p> <p>Various corridor enhancements to cater for initial growth to mid-2020s and resilience prior to the opening of a Trans-Pennine Tunnel. These could include but not limited to:</p> <ul style="list-style-type: none"> • Central Trans-Pennine corridor (see E above) • M62 Corridor and link to M1 beyond existing smart motorway plans • A628 Woodhead Pass and issues around Tintwistle and Hollingworth • A619 / A623 / A6 Corridor in Derbyshire and Greater Manchester, • Northern Powerhouse Rail • M67 Corridor 	Caters for initial growth to mid-2020s and enhanced resilience on this key trans-Pennine corridor	<ul style="list-style-type: none"> • Modest economic benefits – maintains a business as usual trajectory albeit supporting major local developments on corridors such as the M62 in West Yorkshire • Does not provide the transformational stimulus required • Potential impacts on the Peak District National Park such as those associated with the A619 / A623 / A6 corridor which would require careful study and mitigation • Supports Greater Manchester Spatial Framework's Eastern Gateway and improves access to Airport Gateway 	<p>RIS1 schemes in development and delivery</p> <ul style="list-style-type: none"> • Mottram Moor, • A57-A57(T) Link, • A628 Climbing Lanes • M62 J20-25 Smart Motorway <p>RIS2 schemes in development</p> <ul style="list-style-type: none"> • M1/M62 Lofthouse • M60/M66 Simister Island <p>WY+TF Schemes in development</p> <ul style="list-style-type: none"> • A62 & A644 Huddersfield <p>Unfunded Local major schemes</p> <ul style="list-style-type: none"> • North Kirklees Orbital <p>Complements / interfaces with Connectivity Priorities 5 and 8</p>

Ref	LEP / Combined Authority Area(s)	Intervention Name, Description and Location	Pan-Northern Justification	Anticipated Benefits (including NPIER economic sectors)	Complementary proposals include but are not limited to the following
10	Greater Manchester CA / Cheshire and Warrington / Liverpool CR / North Wales	<p>Cheshire Science Corridor and Atlantic Gateway</p> <p>A broad fan of connectivity, resilience and journey quality improvements between Manchester in the east and the Liverpool City Region, Cheshire and Warrington and North Wales in the west, along corridors such as the M6, M62, M56, M58, M53, A55, A494 and A580.</p> <p>The initial primary focus is on alternatives to the M6 and M62 however there is a need to consider options beyond Smart Motorways on these two corridors if the proposed strategic 'gaps' above do not deliver transformational growth.</p>	<ul style="list-style-type: none"> Provides improved access from Manchester Airport including its HS2 station and Airport City Enterprise Zone, and Enterprise Zones and NPIER clusters within North Cheshire and Warrington, the Liverpool City region including John Lennon Airport and the Port of Liverpool and North Wales Supports the £400M of deep water container port investment recently completed by Peel Ports at Liverpool2 and ongoing Highways England studies into its improved access Supports recent investment in the commercial market in the Manchester / Warrington area (such as Omega Park) associated with logistics industries Links to current investment associated with the Mersey Gateway Crossing Wider connectivity to national corridors of movement including North East Wales which is very much part of the North's economic geography and the Port of Holyhead 	<ul style="list-style-type: none"> Improves connectivity between Manchester Airport and the Cheshire Science Corridor Enterprise Zones and research and science facilities at Daresbury EZ. Improves resilience of the M56 corridor, and linkages to the M6 and recently improved A556. Potential Eastham Re-refinery NSIP, Port Wirral Liverpool2 and wider Peel Ports investment at Port Salford and Warrington Supports Greater Manchester Spatial Framework Western and Airport Gateways. 	<p>RIS1 and other Local Major Committed Schemes</p> <ul style="list-style-type: none"> M56 J6 – 8 Smart Motorway M53 J5-11 Smart Motorway A5036 Princess Way access to Port of Liverpool Mersey Gateway Bridge M6 J16-J19 Smart Motorway M6 Junction 22 M56 Junction 11a <p>Major economic and international connectivity growth</p> <ul style="list-style-type: none"> Manchester Airport growth and Airport City <p>Large Local Major Schemes in development</p> <ul style="list-style-type: none"> Warrington Waterfront Local Major

Ref	LEP / Combined Authority Area(s)	Intervention Name, Description and Location	Pan-Northern Justification	Anticipated Benefits (including NPIER economic sectors)	Complementary proposals include but are not limited to the following
11	Cheshire and Warrington / Greater Manchester CA / North Wales	<p>Manchester Airport HS2 to North Wales Arc</p> <p>An enhanced east-west corridor of movement that capitalises on the major opportunities provided by HS2 at Manchester Airport and Crewe to benefit Greater Manchester, Cheshire and Warrington, the north Midlands and North Wales.</p>	<ul style="list-style-type: none"> Improves connections across Cheshire and South Manchester, as well as the north Midlands and North Wales. Improves network resilience for the MRN and SRN, and improves linkages to Manchester Airport and its HS2 station and Airport City development from north east Cheshire. Provides enhanced resilience for key components of the SRN by providing alternative routes to the M6 and M56 for sub-regional, yet economically important movement in an area of existing high economic performance and further transformational potential for the North's economy. 	<ul style="list-style-type: none"> Improves access to parts of Cheshire, including the Science Corridor. Manchester Airport City EZ, airport and HS2 station Resilience and connectivity benefits for areas poorly connected to the SRN, and linked to existing schemes. Spreads the benefit of nationally significant infrastructure associated with HS2 to neighbouring areas that are very much part of the sub-region's economic geography Supports key housing and development allocations including Handforth Garden Village and GMSF Airport Gateway Supports Greater Manchester Spatial Framework Western and Airport Gateways. 	<p>Major economic and international connectivity growth</p> <ul style="list-style-type: none"> Manchester Airport growth and Airport City Crewe HS2 Northern Gateway <p>Local Major Schemes in delivery</p> <ul style="list-style-type: none"> A6-MARR <p>Local Growth Fund Schemes in development</p> <ul style="list-style-type: none"> Poynton Relief Road A536 to A534 Congleton Link Road Middlewich Eastern Bypass <p>Ongoing studies and unfunded schemes</p> <ul style="list-style-type: none"> A523 Poynton to Macclesfield A6-M60 Link SEMMMS Refresh / A34 Study (Stockport / Cheshire East led) Manchester Airport HS2 Station Connectivity M56 to J5 of M60 Improvements (Ongoing Study)

Ref	LEP / Combined Authority Area(s)	Intervention Name, Description and Location	Pan-Northern Justification	Anticipated Benefits (including NPIER economic sectors)	Complementary proposals include but are not limited to the following
12	Cheshire and Warrington / Stoke on Trent and Staffordshire	Crewe HS2 Northern Gateway Infrastructure improvements facilitate access to the proposed HS2 Hub at Crewe from across the region and the neighbouring Midlands	<ul style="list-style-type: none"> Provides improved connectivity to the proposed HS2 Hub at Crewe from the MRN, as well as for the Cheshire and Stoke/Staffordshire areas. 	<ul style="list-style-type: none"> HS2 will provide transformational connectivity benefits from Crewe; this package will ensure that these benefits are spread as widely as possible, currently 5m people live within an hour of the Hub. Manchester, Birmingham and London will all be served by HS2 from Crewe. 	RIS1 Schemes in Development: <ul style="list-style-type: none"> M6 Junction 16 Improvements Large Local Major Schemes in development <ul style="list-style-type: none"> A500 dualling (Cheshire) Schemes in development <ul style="list-style-type: none"> HS2 station and related Northern Gateway Development Zone and Midland Connect aspirations North West Crewe Strategy Complements Connectivity Priorities 10 and 11 above.

Ref	LEP / Combined Authority Area(s)	Intervention Name, Description and Location	Pan-Northern Justification	Anticipated Benefits (including NPIER economic sectors)	Complementary proposals include but are not limited to the following
13	Across TfN's Geography – locations to be determined	<p>Strategic Multi-Modal Opportunities</p> <p>A prioritised programme for multi-modal interchange to maximise use of public transport for strategic (such as rail heads and coachways) and last miles city end journeys.</p> <p>Strategic Freight distribution parks and Inland Ports including secure HGV parking.</p> <p>Locations to be determined in conjunction with Partners.</p>	<ul style="list-style-type: none"> • Multimodal opportunities • Improve connectivity between Important and Economic Centres • Environmental considerations for urban corridors 	<ul style="list-style-type: none"> • Agglomeration benefits • Enhanced choice and resilience for key Important Economic Centres pairs • Broaden catchment area and benefits for key public transport investments • Environmental benefits for specific corridors • Support the transport of goods by inland waterway and rail 	<p>Rail schemes in development</p> <ul style="list-style-type: none"> • HS2 • Northern Powerhouse Rail • Planned Manchester Metrolink Extensions <p>Intermodal terminals in development</p> <ul style="list-style-type: none"> • Goole Multi-Modal Terminal supported by the Government's 2017 Industrial Strategy • Port Salford Tri-Modal facility <p>Unfunded intermodal access improvements</p> <ul style="list-style-type: none"> • WYCA desire for improved access to and infrastructure at Stourton (Leeds) and Wakefield Europort

Matrix of Alignment between Interventions and Pan-Northern Criteria

Intervention	Technological and Environmental	Resilience	Multi-modal	International Connectivity Gateways MRN links	Similar / complementary NPIER Capability Clusters links	Important Economic Centres connectivity	Unlocks delivery of NSIP and employment projects	Major local development approvals
1 (A1 Scotch Corner to Scotland)	✓	✓		✓	✓	✓	✓	✓
2 (A19 Expressway)	✓	✓		✓	✓	✓	✓	✓
3 (Energy Coasts)		✓	✓	✓	✓	✓	✓	✓
4 (Hull to A1/M1 and westwards)		✓		✓	✓	✓	✓	✓
5 (Central Trans-Pennine (TP) Connectivity)	✓	✓	✓	Potentially	✓	✓		✓
6 (Leeds CR NWQ)		✓		✓		✓		✓
7 (A1 Doncaster)	✓	✓	✓	✓	✓	✓		✓
8 (S Humber TP Connectivity)	✓	✓		✓	✓	✓	✓	✓
9 (Short-term TP Options)	✓	✓	✓		✓	✓		✓
10 (Cheshire Science Corridor and Atlantic Gateway)	✓	✓		✓	✓	✓	✓	✓
11 (Manchester Airport HS2 to N Wales Arc)		✓	✓	✓	✓	✓	✓	✓
12 (Crewe HS2 N Gateway)			✓	✓	✓	✓	✓	✓
13 (Strategic Multi-Modal Opportunities)	✓	✓	✓	Potentially	✓	✓	Potentially	✓

Existing DfT and TfN Sponsored Studies

Ref	LEP Area (s)	Scheme Name
NWQ	Greater Manchester with Liverpool and Lancashire interfaces	NW Quadrant
TPT	Greater Manchester CA / Sheffield CR / West Yorkshire	Trans-Pennine Tunnel
TPT-WI	Greater Manchester CA / Sheffield CR / West Yorkshire / Derbyshire	Trans-Pennine Tunnel Wider Impacts
A66	Cumbria / NECA / Tees Valley	A66 – A1 (M) to M6
A69	Cumbria / NECA / Tees Valley	A69 – A1 to M6

Complementary Fit of the various studies and Connectivity Priorities

Intervention	1	2	3	4	5	6	7	8	9	10	11	12	13	NWQ	TPT	TPT-WI	A66	A69
1 (A1 Scotch Corner to Scotland)		✓	✓														✓	✓
2 (A19 Expressway)	✓		✓														✓	✓
3 (Energy Coasts)	✓	✓															✓	✓
4 (Port of Hull to A1/M1 and westwards)					✓												✓	
5 (Central Trans-Pennine Connectivity)				✓		✓								✓		✓	✓	
6 (Leeds CR NWQ)					✓													
7 (A1 Doncaster)								✓										
8 (S Humber TP Connectivity)							✓								✓	✓		
9 (Short-term Trans-Pennine Options)					✓											✓		
10 (Cheshire Science Corridor and Atlantic Gateway)											✓			✓		✓		
11 (Manchester Airport HS2 to N Wales Arc)										✓		✓				✓		
12 (Crewe HS2 N Gateway)											✓							
13 (Strategic P&R)																		



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The Major Roads Report is the result of collaboration between Transport for the North, National and Local Partners, and appointed independent consultants working on the evidence base to support development of the Strategic Transport Plan.