Metro Strategy 2030
Background Information
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Section 1: INTRODUCTION

1.1 Context

1.1.1. The overall aim of this strategy is to secure the future of Nexus Metro at the heart of sustainable development across Tyne and Wear and potentially beyond, and to provide a framework for the development of a successful business case that ensures the long-term future of the existing network as a first priority.

1.1.2. In this context the successful introduction of a new fleet of trains is a primary objective. The strategy also investigates the potential for network extensions where a case can be made on customer demand, economic, environmental and social grounds.

Vision

1.1.3. The vision for the Metro Strategy is:

"Delivering a Metro network for the region that is modern, green, inclusive and influential"

1.1.4. Modern: a Metro that meets users’ expectations, and can accommodate and stimulate future demand.

Green: a network that is environmentally positive and has the flexibility to operate into the future, using a range of renewable resources.

Inclusive: a Metro for everyone that is accessible, affordable and creates a stronger society.

Influential: a product that will help shape where people live and businesses locate, to make the region an excellent place to live and work.

Aims

1.1.5. Identified aims that will achieve this vision are as follows:

(i) Infrastructure resilience – to capitalise on investment in engineering and a new train fleet, alongside the application of best practice in network maintenance, to deliver a robust and reliable rail network.

(ii) Increase the proportion of trips made by Metro relative to those undertaken by car along transport corridors where mode choice exists.

(iii) Develop the network to accommodate forecast base-case increases in the level of demand as follows:

2020: 49 million trips per year

2025: 53 million trips per year

2030: 60 million trips per year
(iv) Continue to reduce energy consumption and improve environmental performance as far as practicable, consistent with legislation, technology and operating protocols, progressively maximising the benefits brought about through the use of new equipment.

(v) An annual average increase in operating efficiency resulting in a reduced requirement for operating subsidy over time.

(vi) Ongoing reductions in the level of fraudulent travel through the use of network gating, smart technology and effective evidence-based enforcement.

(vii) Punctuality and reliability – ensure that network performance meets users’ expectations and is in line with comparable networks elsewhere.

(viii) Customer satisfaction – to aim for long-term improvements in recorded customer satisfaction across a range of metrics.

(ix) Increase the proportion of Tyne and Wear households within easy access of a Metro station through a targeted programme of network extensions where funding permits, and where they can be clearly justified by forecast levels of demand. Also, to investigate the construction of additional stations on the existing network, subject to the same criteria.

(x) Increase the volume of interchange between Metro and other travel modes by means of additional stations, network extensions and further Park and Ride sites as required by levels of customer demand.

(xi) Maximise the potential of commercial and development opportunities, particularly in terms of securing maximum planning gain from new developments that can be re-invested in network improvements.

Objectives

1.1.6 These objectives relate to the main sub-sections of the strategy.

- **Introduction, Background and Context:** Ensure that the strategy maintains Nexus Metro’s position at the heart of the region’s integrated transport network and to effectively respond to and benefit from future economic, environmental and social trends.

- **Current and Future Demand:** Produce robust forecasts of future demand on the existing network and potential network extensions, based on internal and external forecasts and data sources.

- **Fleet Replacement** - create a high-level specification for a new fleet that will meet customer needs into the future.

- **Technical Options Appraisal:** Identify options for fleet renewal and assess best practice in terms of electrical, mechanical, environmental, safety and operational practices.

- **Customer Requirements:** Ensure that the requirements of future Metro customers are anticipated and provided for across all aspects of the strategy.
Operating Frameworks: Identify future operational models for the Metro network, taking account of financial, fleet replacement, network and passenger demand considerations.

Network Extensions Appraisal: Provide recommendations for Combined Authority consideration and potential subsequent business cases of on-street and off-street extension corridors.

Financing: Identify potential investment, funding, development and asset opportunities that will enable the successful delivery of the strategy.

Enabling many of the above and at the heart of this strategy is the essential replacement of the current fleet of trains.

Guiding Principles

1.1.7 In addition to these aims and objectives, guiding principles have been followed in the production of this strategy which reflect known constraints and opportunities:

1. The highest priority is the continued operation of the existing Nexus Metro network.
2. The strategy will be driven by robust demand forecasts and customer requirements.
3. A new fleet of trains is essential to the future of Metro, and forms the central technical element of the strategy.
4. Technologies used will be appropriate to prevailing safety and customer requirements, fit-for-purpose and informed by worldwide best practice.
5. Delivery of the strategy will be dependent upon the availability of finance and additionally for extension corridors, the level of associated planned development.
6. Opportunities for closer linkages with the local heavy rail network will be regularly reviewed.
1.2 Policy and Strategy Links

1.2.1. Context

1.2.1.1. The Tyne and Wear Metro in its role as a provider of sustainable urban transport accords with a range of European, national, regional and local policy themes. This section summarises the main drivers of current transport and environmental policy, and demonstrates how the existing network and potential future extensions contribute towards their aims.

International Policy

1.2.1.2. The International Association of Public Transport (UITP) is the world-wide authority on transport planning and its views influence other strata of government and industry. UITP is committed to the expansion of light rail networks. Its official policy position *Light Rail for Liveable Cities* emphasises the benefits that the mode can deliver in terms of increased capacity, speed and regularity, safety and positive environmental benefits. It concludes that transport authorities should have “a clear and solid urban development strategy to make sure that the proposed project is suited for longer-term possible extensions” and “take the chance of a light rail construction to fuel housing, job and public equipment developments along the line. In conclusion, UITP states that it strongly believes in the importance of light rail and its positive contribution to sustainable mobility in the liveable cities of tomorrow, and recommends its worldwide development.

EU Policy

1.2.1.3. European policy is not binding upon EU member states, but Department for Transport objectives are in practice closely aligned. Current thinking is summarised in the 2010 European Commission White Paper¹ which highlights light rail as good practice in terms of ensuring that public transport achieves levels of comfort, quality and speed that meet people’s expectations. It is a quality option that has been the choice of many European cities which have decided to innovate by bringing into service new metro or tram lines. The White Paper endorses the concept of continuous journeys, which means land-use and town planning policies will play a vital role. Main metro, train and bus stations and car parks should be geared towards exchanges between the car and public transport, and should offer related services (e.g. shops), thus encouraging public transport use and reducing pollution.

UK Policy

1.2.1.4. The DfT’s promotion of light rail as an appropriate means of sustainable transport provision is set out in the policy paper *Green Light for Light Rail*². The report highlights the role that light rail, trams and other rapid transit networks can play in improving the attractiveness and quality of public transport in major conurbations. This in turn can promote local economic growth and reduce carbon through modal shift. It emphasises the government’s continuing commitment to promoting such projects, whilst highlighting the need for tight control over costs. By allowing councils to borrow against projected business rate growth to fund future infrastructure developments via methods such as Tax Increment Financing, the DfT intends to accelerate the development of future schemes.

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² Green Light for Light Rail. Department for Transport 2011
1.2.1.5. The document states that the DfT views standardisation of systems and rolling stock as important elements of the cost-saving process for light rail schemes. It cautions against unnecessary overspecification, citing the progress being made by UK Tram, the tram scheme promoters’ body where Nexus is represented, to identify a preferred specification model for light rail operations and to establish a centre of procurement excellence; whilst there are some elements of Metro that are less ‘light rail’ than some networks, it is clearly important that the future network specification is aligned as closely as possible to the outputs of both UK Tram and the South Yorkshire tram-train pilot.

1.2.1.6 In wider policy terms, *Green Light for Light Rail* emphasises the importance of some of the wider benefits of light rail, including environmental and accessibility benefits. It re-iterates the findings of an earlier Transport Select Committee report that successful light rail schemes will possess as many as possible of these attributes:

- Serve a major urban conurbation.
- Have major traffic attractions along or at the end of routes, including Park and Ride sites
- Serve corridors with significant volumes of traffic.
- Provide competitive journey times compared to other modes (car and bus).
- Be able to deliver a level of predictable regular and reliable journey time and service patterns using a high degree of segregation from traffic, with priority at junctions.
- Be perceived as safe.
- Offer good key interchanges with other modes e.g. Park and Ride, bus interchanges.
- Be well related to existing and future land-use developments

1.2.1.7 The government has yet to publish a transport policy which sets out its policy priorities across all modes, however the DfT’s 2012-15 Business Plan sets out how it is required to deliver department’s key priorities. These include a commitment to publish a transport strategy, and refer to light rail specifically in its support of local transport improvements as follows:

*Support sustainable local travel: Support sustainable growth by investing in local transport, decentralising funding and powers, tackling local congestion and making public transport (including light rail), walking and cycling more attractive*.

**Regional Policy**

1.2.1.8 Regional transport policy continues to develop to fill the gap vacated by the abolition of the Regional Spatial Strategies. Strategic planning now takes place at the Local Enterprise Partnership level; a North East LEP Strategic Economic Plan is in preparation building upon the draft city region transport strategy which recognises the current and future contribution of Metro towards the delivery of sustainable transport links across Tyne and Wear and potentially beyond. The creation of a Combined Authority will facilitate the development of regional-scale transport policies and programmes. The future role of Metro in meeting the region’s transport needs will be a key element of Combined Authority transport policy. This strategy demonstrates how Metro will play a key role in
helping to deliver those needs, based on high levels of sustainable access that stimulate economic activity.

**Local Policy**

1.2.1.9 The key transport planning document at local authority planning level is currently the Local Transport Plan\(^3\). The Tyne and Wear LTP 2011-2021 recognises the contribution which Metro makes towards the achievement of its key objectives. It advocates the creation of additional Metro corridors where these are the most appropriate interventions, subject to value-for-money and deliverability considerations, and supports the renewal of the existing network. Better integration with other travel modes including cycling and motoring is also supported.

1.2.1.10 Regular liaison takes place with Tyne and Wear local planning authorities during the development of Local Development Frameworks and Core Strategy documents. It is important that this Metro Strategy and the documents described above are developed in parallel, so that planning policy gains an understanding of proposed Metro enhancements, enabling new development to proceed in as sustainable a way as possible. This will maximise future Metro patronage through the appropriate location of new development within walking distance of current or planned Metro corridors.

**National rail policy**

1.2.1.11 As closer integration with the local heavy rail network is possible in the longer term resulting from advances in technology and safety protocols – for example resulting from the outcome of the ongoing South Yorkshire tram train trail pilot - due account is taken of the planning framework in place for the national rail network. The main influences at present are as follows:

- Network Rail Long-term Planning Process (particularly the Regional Urban Markets Study)
- Individual route utilisation strategies
- Office of Rail Regulation High-level Output Specifications
- DfT rail franchising decentralisation policy, including developments relating to the Rail in the North Executive and the Northern rail franchise

1.2.1.12 Subject to the success of the forthcoming local rail franchise specification partnership that has been established between the DfT and Rail North, there is every prospect of further devolution of the specification and operation of local rail services. This could offer opportunities for Metro to extend its sphere of joint running operations over other routes in the region that are potentially suitable.

1.2.1.13 Longer-term proposals for the Durham Coast line, (including Pelaw – Sunderland), the Ashington Blyth and Tyne line and the Leamside rail corridor are of particular relevance to Metro. Network Rail overhead electrification at 1500V DC is now unique to the Pelaw to South Hylton route and presents a challenge to any proposals to operate electric trains along the Durham Coast or to and from Port of Tyne, as the East Coast Main Line is electrified at 25kV AC. The implications of this for Metro are discussed in Sections 3 and 4, as further electrification of the regional heavy rail network is likely within the lifetime of the next fleet of rolling stock.

\(^3\) Tyne and Wear Local Transport Plan 3, 2011-21 – Tyne and Wear ITA
1.3 Current and Planned Metro Improvements

1.3.1 This section provides a brief overview of the mainly government-funded investment already under way and in planning, that will ensure that Metro’s assets are maintained and improved for the long-term, placing this within the longer–term plans for Metro.

1.3.2 The Metro Reinvigoration programme comprises three phases. Phase 1 is now largely complete and involves provision of a ticketing and gating programme alongside the introduction of smart ticketing products. Phase 2 encompasses the bulk of the asset renewal programme that is currently under way across the network, ensuring that tracks, buildings, systems and stations are kept safe and in the best possible condition. Phase 3 comprises fleet renewal and the construction of network extensions, and is the main focus of this strategy.

1.3.3 Phase 2 of the Metro reinvigoration programme reflects the need to renew many of the essential assets necessary to the safe and efficient operation of the network. It covers an 11-year period from 2009/10 to 2020/2021, covering the network’s operating, renewal and maintenance costs with certain enhancements. 90%-funded by the Department for Transport, it provides the base budget and consequent financial security for a decade of Metro operations, in return for the attainment of demanding operational, commercial and renewals targets. With Nexus now approaching the midway point of the programme, the DfT has indicated its satisfaction with progress to date by confirming the availability of a further three-year roll-forward of funding. Latest cost estimates for the overall Phase 2 Asset Renewal Programme (ARP) are in the region of £389 million, including a 10% local contribution. At this time 50% of the third period of ARP funding has been guaranteed by government.

1.3.4 Subject to full funding of the Phase 2 programme, Nexus will deliver key projects including:

- Renewal of tracks and trackbeds from Tynemouth to Gateshead, including the busiest section of line through Newcastle city centre
- Completing the three-quarter life refurbishment of the Metro train fleet
- Continuing the refurbishment of 45 stations in total, including stations in the Newcastle, Gateshead and South Tyneside areas
- Completing all elements of smart travel by Metro with the Pop card product, including new ticket machine technology, gate lines and validators
- Starting the network-wide replacement of vital overhead power lines, as well as upgrading communications and signalling systems
- Radio replacement
- Replacement of the network traffic management network (PTI)
- Overhead line renewal

1.3.5 Successful delivery of the Metro-reinvigoration programme relies on the collection and interpretation of full and accurate asset information, thus ensuring that investments are made in the required areas of the business at the most appropriate time. The successful implementation to date of the programme confirms the ability of Nexus to manage and deliver complex and expensive renewals projects.
1.3.6 The non-fleet element of the programme covers earthworks, bridges and permanent way, where the guiding principle is to adopt a risk-based and condition-based approach. The overhead line system will be upgraded to an improved specification. Station monitored communication equipment is being replaced during station refurbishment projects, with signalling maintained and upgraded as appropriate pending a decision as to future signalling and control requirements aligned with the long-term requirements of Metro that will be determined by levels of demand and the technical specification of the next fleet of trains. Options are discussed further in Section 3.

1.3.7 In terms of the existing rolling stock, the fleet has undergone a significant condition assessment which determined that they are suitable for continued operation into the 2020s. Of the current 90-strong fleet, 86 units will undergo comprehensive ‘three-quarter life’ refurbishment above floor level incorporating an improved interior layout and specification. More than a third of the fleet has now been refurbished to this standard and the programme is on target for completion by the end of 2015.

1.3.8 The 60 existing stations can be broadly divided into:

- Underground – subject to ‘Section 12 regulations’\(^4\), e.g. Monument
- Transport interchanges e.g. Heworth, Four Lane Ends
- ‘Out of town’ halts e.g. Howdon
- Heritage stations e.g. Tynemouth

1.3.9 Station investment decisions include assessments related to train to reducing platform-to-train gaps, viable alternatives to stepped access, tactile paving, stair nosings and rails, platform surfacing, improved security through improved lighting and clear lines of sight, and better signage. This approach is influenced by the business objective of increasing patronage and social and legal objectives related to improved accessibility. The programme is sufficiently flexible to cater for the unexpected, as is normal practice for an asset portfolio of widely varying age and condition.

**Phase 2 programme plan**

1.3.10 The outline programme below explains progress to date, and demonstrates how the phasing of events has been flexed to reflect emerging issues and priorities.

- **Civil Engineering** Bridges and structures, earthworks, drainage
- **Permanent Way** All plain-line track refurbished or renewed as required by condition
- **Switches and Crossings** Refurbished or renewed as required by condition
- **Power and Overhead Line** Overhead line renewal as required, depot transformer renewal
- **Stations and Depots** Rolling programme of station refurbishments, depot maintenance
- **Communications** CCTV, radio system and public address enhancements
- **Signalling** Cable replacement, signal replacement as required by condition

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\(^4\) Fire Precautions (Sub-Surface Railway Stations) Regulations 1989
Electrical and mechanical  All lifts and escalators to be renewed
Fleet  Current fleet ‘¾ life’ refurbishment completed by end-2015
Capital Maintenance  On-going programme as required by asset condition

1.3.11 The scale of this programme is such that it will safeguard the operation of Metro at its current levels and future-proof the network for expansion, or the more extensive use of existing assets. Whilst the future level of services will be governed by customer demand and the technologies used to deliver those services will accordingly vary, the asset renewal programme provides a strong foundation for the network to accommodate additional demands going forward.

Above: some of the key work progressing as part of Metro Asset Renewal Plan (ARP) Phases 1 and 2
1.4 Market Research

1.4.1 Since the beginning of Metro operations in the 1980s, research into customer requirements and preferences and the influences underlying them has been undertaken with the aim of ensuring that services have continued to meet the needs of those who use them, and to identify and react to changing patterns of demand over time.

1.4.2 Some changing trends which have taken place over time include:

- A decline in passenger flows related to reductions in heavy industry, especially shipbuilding, along the banks of the Tyne which has been most apparent along the Wallsend and South Shields corridors.
- Higher levels of out-of-centre employment activity e.g. Nissan, Doxford International Business Park, Cobalt Business Park in locations away from the Metro network.
- Higher levels of out-of-town retail activity, with a corresponding reduction in town and city centre activity at locations which are normally better-served by the Metro network.
- Deregulation of the bus industry in 1986 which reduced the level of bus/Metro integration and increased the level of competition along parallel transport corridors.
- Fluctuations in the level of patronage by older customers, partly related to changes in the level of fares concessions available, and also in connection with higher levels of car ownership and lower levels of evening travel amongst this age cohort.
- The shift from local rail to Metro services between Sunderland and intermediate stations to Newcastle in 2002.
- A long-term increase in demand for Sunday services following changes to Sunday trading hours in 1994.
- Changes to the ‘evening economy’ especially with regard to later retail opening hours and alterations to licensing laws resulting in staggered pub closing times.
- Increased competition from the taxi and private hire sector, especially for group travel.
- Modal shift from car to Metro (and to a limited extent from bus to Metro) resulting from the impacts of increased road congestion.
- Increased environmental awareness amongst customers, leading to a conscious switch towards the use of more environmentally-friendly modes such as Metro.
- An increase in the number of students in further and higher education with a propensity towards lower car ownership and higher use of public transport.

1.4.3 The most pervasive trend of all over this period has been a steady increase in the levels of car ownership across the Tyne and Wear area. The impact of this trend plus those outlined above upon demand is analysed in section 2.
1.5 Benchmarking With Other Networks

1.5.1 The concept of benchmarking is commonly defined as “the process of gathering information about other companies in the same industry to compare performance against and to use to set goals”. It is widely used across many industries to assess how individual organisations can improve performance across a range of metrics. Such comparisons can be valuable in identifying new processes and practices that will reduce costs, increase levels of safety and improve customer satisfaction.

1.5.2. The process has limitations. In the case of light rail networks, every network differs in terms of its assets, customers and competitors; therefore the extent to which they can be validated and compared with one another is finite. For example, Metro is arguably unique in terms of its combination of voltage requirements, joint running and the mixture of below-ground and surface-level operation. Despite this, there is much that can be gained from benchmarking individual elements of light rail operation in an attempt to achieve best practice, knowledge-sharing and economies of scale.

1.5.3 Nexus is a member of the international NOVA group of metro networks which aims to share best practice and achieve world-wide collaboration across the industry. In 2012, Nexus participated in an international benchmarking exercise which compared key performance indicators across a range of subjects, involving 14 medium-sized light rail networks. Details of the study’s findings in relation to the performance of other networks are commercially confidential, but the range of subjects analysed and an indication of Metro’s relative performance is discussed below.

Benchmarking Principles

1.5.4 Key performance indicators enable performance to be compared on a universally consistent and understandable basis between organisations. Structured KPI comparisons, based on the Harvard Business School balanced scorecard model, can be used for:

- Direct comparisons – to better understand the differences between operators
- Internal motivation – setting targets for improved performance
- Identifying high priority problems, strengths and weaknesses
- Supporting dialogue with government, regulators, and other stakeholders

1.5.5 Benchmarking was undertaken around the following key themes:

- Growth, learning and innovation
- Financial
- Capacity provision and utilisation
- Service quality
- Reliability and availability
- Safety and security
- Environment

Benchmarking of specific network characteristics

1.5.6 In terms of passengers carried per network kilometre, Metro’s performance reflects the comparatively low density of population, longer than average distances between stations on
sections of the network compared with other light rail networks, and competition from other modes of transport. This demonstrates the potential for the existing Metro network to accommodate significantly increased patronage levels.

1.5.7 In the context of other UK rail networks, a high-level comparison with Scotland’s railway is as follows:

- Around 50% of annual patronage
- Around 20% of the number of the stations
- Around 20% of the number of daily weekday departures

1.5.8 This comparison highlights the intensive operation of Metro within a small geographical area.

1.5.9 Metro scores amongst the lowest in terms of operated passenger capacity in relation to network size, indicating the capacity for potential extensions to feed into the existing network, and the comparatively low frequency of services outside of the central Newcastle/Gateshead corridor. This is in itself reflective of the lower than average levels of population density within accessible distances of the network as a whole.

1.5.10 Metro achieves an average score in terms of commercial revenues meeting operating costs. Most light rail networks require some degree of financial subsidy, some to a much greater extent than Metro, although some non-European networks are substantially profitable. Metro has one of the best scores in relation to operating costs per revenue car kilometre, indicating that the current fleet is highly efficiently managed, but one of the poorest in terms of operating costs per passenger journey, reflecting the low overall quantum of passenger numbers.

1.5.11 Comparing network staff numbers with the total number of passengers carried, Metro also fares well, reflecting the substantially unstaffed nature of the network, but here operational factors come into play to a greater extent; for instance the London Underground could only function to the intensity it does with the level of station staff it employs. Nevertheless Metro’s position in the study as the lowest-cost operator in terms of staff costs across a range of metrics per revenue car kilometre including maintenance, train service and station operations indicates that the network as a whole performs efficiently when benchmarked with its peers.

1.5.12 Energy usage by Metro was greater than the study average, both in term of kilowatt hours per train kilometre operated and per passenger carried, although the latter figure was more anomalous than the former. This reflects the age and characteristics of the traction technology used on the network and the disproportionate influence of ‘fixed’ energy consumption on a network with relatively few train movements. Carbon emissions per passenger kilometre are also high, again reflecting passenger load factors and the use of outmoded rolling stock.

1.5.13 Metro has a higher than average incidence of crimes per million passenger journeys, although the actual figures are lower than are often perceived by users and non-users. Nevertheless the comparative data highlight the need for continued vigilance to achieve the safest possible conditions for customers and staff.

1.5.14 In terms of levels of fare evasion, Metro had historically one of the higher incidences, but the proportion decreased markedly over the period of the study, from around 8% of journeys in 2002 to
around 4% in 2010. This will fall further with the implementation of the gating programme at key Metro stations during 2014.

1.5.15 Fares revenue per passenger journey for Metro is around the average of the networks included within the study. This is a key indicator of how well a light rail operator is able to persuade its local regulatory authority to allow it to charge a commercial fare. When compared with the cost per passenger journey, it gives a quick view of the degree to which passengers fund its operations. This indicator is affected to a greater extent than some others by the influence of national and local government policies towards the funding of light rail networks, alongside the economic characteristics of the areas they serve.

Summary

1.5.16 The headline conclusions of the study as described above highlight both the benefits of benchmarking as a technique and the risks of attributing too much store to what may sometimes be irrelevant comparisons between networks operating across different environments and societies. Nevertheless in some areas such as energy consumption and operating costs, there is a degree of operational commonality which suggests the potential for information sharing to achieve optimum operating performance. Metro fares well in term of operational efficiency and costs, less so in terms of efficiency of use of the available network and passenger capacity, and energy consumption. Details of the outcomes of the benchmarking study have been used to inform various aspects of the strategy.
1.6 Case Studies

1.6.1 Included as Appendix 1 are a number of case studies which provide background context on similar light rail networks elsewhere in the UK, and one heavy rail urban network which has similarities with Metro. In each case, an outline of its history and operation provides a fuller picture of UK light rail development and the future plans for each network. They show how the development of new UK light networks has evolved since Metro opened in 1980 in terms of roles and functions, and the means by which they are delivered.

1.6.2 The case studies show that light rail is playing an ever-greater role in the delivery of urban transport solutions, and that new technology can enable Metro to employ proven on-street and off-street solutions to deliver future demand requirements and customer expectations.
Section 2: CURRENT AND FUTURE DEMAND

2.1 Introduction

2.1.1 The forecast increases in demand for Metro over the period to 2030 shown at paragraph 2.5.2.4 confirm that the existing network will struggle to cope with future demand. Whilst off-peak capacity is ample and represents a challenge for Nexus to fill, peak-time trains are already full and standing over much of their route. The looming capacity challenge requires investment in additional trains, in signalling and control equipment that can move more trains through the central corridor between Pelaw and South Gosforth, and stations infrastructure for effective passenger throughput.

2.1.2 Network extensions will bring benefits to the areas they serve, but will generate similar issues of route capacity, interaction with other highway users in the case of on-street infrastructure, and increased pressure on key destinations on the existing network; hence the need for robust forecasting techniques to paint as accurate a picture as possible of how many people can be expected to use Metro in the decades to come.

2.1.3 The purpose of this section of the strategy is to interpret historical, observed and forecast demand patterns to ensure that Metro has the infrastructure it needs to meet the key objectives outlined in section 1. The forward strategy then becomes an informed reaction to customer demand, preferences and expectations, rather than merely justifying the continued operation of Metro for its own sake.
2.2 Analysis of historical and current drivers of demand

2.2.1 The main factors influencing past and present demand for Metro can be summarised as follows:

- Population
- Gross value added, as a measure of economic activity
- Levels of unemployment
- Rates of car ownership
- Road fuel costs
- Level of Metro fares relative to bus fares and fuel
- Size of the economic travel-to-work area
- Impacts of congestion

2.2.2 Population: Tyne and Wear’s population dropped steadily from 1981 to 2001 before stabilising during 2001-2011. Recent census data suggest that the population may now be slowly increasing.

<table>
<thead>
<tr>
<th>Year</th>
<th>Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>1981</td>
<td>1.156 million</td>
</tr>
<tr>
<td>1991</td>
<td>1.123 million</td>
</tr>
<tr>
<td>2001</td>
<td>1.087 million</td>
</tr>
<tr>
<td>2011</td>
<td>1.104 million</td>
</tr>
</tbody>
</table>

2.2.3 An indication of GVA trends over time can be gained by reference to work undertaken by Durham Business School into long-term population and economic trends. A trend of regional GVA over the period 1981-2011 is as follows:

<table>
<thead>
<tr>
<th>Year</th>
<th>GVA Index (2010 = 100)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1981</td>
<td>61</td>
</tr>
<tr>
<td>1986</td>
<td>63</td>
</tr>
<tr>
<td>1991</td>
<td>74</td>
</tr>
<tr>
<td>1996</td>
<td>79</td>
</tr>
<tr>
<td>2001</td>
<td>86</td>
</tr>
<tr>
<td>2006</td>
<td>100</td>
</tr>
<tr>
<td>2011</td>
<td>101</td>
</tr>
</tbody>
</table>

Despite the disparity in levels of economic activity between the North East and the UK as a whole over this period, GVA has consistently increased over this 30-year period. One of the main historical correlations with heightened levels of GVA is higher rates of car ownership.

2.2.4 Historical unemployment rates have fluctuated between 4% and 12% over the period of Metro operation, with the median rate closer to the upper end of this range. The periods of highest unemployment were experienced during 1982-87; 1991-94, and 2008-12. Although there is some degree of correlation between rates of unemployment and propensity to travel, this is complicated by historic trends towards higher rates of car ownership during periods of lower unemployment.

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5 Long Term Employment and Demographic Projections - Report prepared for the Joint Planning Teams of Newcastle City Council and Gateshead Council Prepared by the Policy Research Group (PRG) Durham Business School/St Chad’s College

6 These figures refer to the wider North East rather than specifically to the Tyne and Wear area
Whether this behavioural relationship continues going forward is currently the subject of debate; there is emerging evidence that behaviour of younger adults may be less likely to follow this trend.

2.2.5 The relationship between road fuel costs and Metro patronage is also partial. Lower petrol and diesel costs are often paralleled by lower electricity costs due to commodity market linkages, so that driving costs fall at the same time as lower input costs for Metro. However there is evidence that large increases in road fuel costs may create additional patronage on public transport in general, and Metro in particular (Metro being less immediately impacted by oil price spikes than bus operations)

### Petrol Costs per litre 1980-2010

<table>
<thead>
<tr>
<th>Year</th>
<th>Cost per litre</th>
</tr>
</thead>
<tbody>
<tr>
<td>1980</td>
<td>28.2p</td>
</tr>
<tr>
<td>1985</td>
<td>43.9p</td>
</tr>
<tr>
<td>1990</td>
<td>46.9p</td>
</tr>
<tr>
<td>1995</td>
<td>60.1p</td>
</tr>
<tr>
<td>2000</td>
<td>85.5p</td>
</tr>
<tr>
<td>2005</td>
<td>87.9p</td>
</tr>
<tr>
<td>2010</td>
<td>115.5p</td>
</tr>
</tbody>
</table>

2.2.6 More recent thinking suggests that the marginal cost of car use may vary from that historically observed, with the more widespread introduction of hybrid and electrically-powered vehicles, and a higher proportion of motoring costs being accounted for by servicing, insurance and parking.

2.2.7 The size of the economic travel to work area has tended to increase over time as employees show a willingness to commute further to work. This finding strengthens the case for Metro extension corridors which extend the reach of the network beyond traditional boundaries. The trend is quantified by a 28% increase in commuting into Tyne and Wear between the 1991 and 2001 censuses – from 64,500 to 82,600. But this trend is not common across the workforce, and tends to be concentrated in middle-aged professionals and students. There remain problems of some communities being unable or unwilling to consider job opportunities in unfamiliar locations, which the simplicity of Metro as a concept can help to address.

2.2.8 Congestion on the highway network is increasing if not as serious or widespread as in some conurbations. The worst delays often occur in those locations where there are otherwise the greatest level of opportunities, such as the NewcastleGateshead Accelerated Development Zone and the Cobalt and Doxford business parks, Team Valley and Metrocentre. These are amongst the locations where Metro extensions are proposed to alleviate such congestion, and to provide sustainable access for all. Sections of the heavy rail network are also experiencing congestion due to insufficient capacity; these pressures will increase as demand continues to rise. The East Coast Main Line is an example of an area where aspirations for increased local services could be frustrated by insufficient line capacity. Metro offers an opportunity to relieve transport congestion through operation on-street, and on parallel disused rail corridors, such as stretches of the Leamside line between Pelaw and Washington/South Hylton.

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7 Source: DfT
2.3 Demand Modelling

2.3.1 Methodology

2.3.1.1 Modelling of demand for new and additional public transport facilities has been extensively refined over time, with a standard suite of models and processes used to define levels of predicted demand which then form the basis for the production of a full business case. Modelling techniques appropriate to the characteristics of Metro are a fusion of general transport models and those specific to light rail networks. The principal modelling techniques used to appraise the demand for public transport and the rationale behind the methods applied in the production of the Metro Demand Study are described below.

**Census-based catchment area trip-rate estimation**

2.3.1.2 A basic method of demand estimation is provided by applying average trip rates based upon the population and number of jobs in 800 metre catchment areas surrounding new and existing stations. The Tyne and Wear MetroExtensions Feasibility Study applied a weighted average trip rate taken of 98 per year across comparable UK light rail networks to apply network extension corridors as follows:

<table>
<thead>
<tr>
<th>Network</th>
<th>Route length (2005)</th>
<th>Population within 800m of a stop (2001 census uplifted by Tempro database)</th>
<th>Annual patronage (million)</th>
<th>Trips per person per year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tyne and Wear Metro</td>
<td>78</td>
<td>315,555</td>
<td>37</td>
<td>117</td>
</tr>
<tr>
<td>Croydon Tramlink</td>
<td>38</td>
<td>205,712</td>
<td>22</td>
<td>107</td>
</tr>
<tr>
<td>Manchester Metrolink</td>
<td>39</td>
<td>190,823</td>
<td>20</td>
<td>103</td>
</tr>
<tr>
<td>Midland Metro</td>
<td>23</td>
<td>121,250</td>
<td>5</td>
<td>41</td>
</tr>
<tr>
<td>Sheffield Supertram</td>
<td>48</td>
<td>160,835</td>
<td>13</td>
<td>80</td>
</tr>
<tr>
<td>Nottingham Express Transit</td>
<td>14</td>
<td>81,872</td>
<td>9</td>
<td>104</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>-</td>
<td><strong>1,076,047</strong></td>
<td><strong>105</strong></td>
<td><strong>98</strong></td>
</tr>
</tbody>
</table>

10 DfT statistics for Light Rail Patronage 2004/05
2.3.1.3 For the existing Metro network, a trip rate of 117 per year results from the application of this method of demand estimation. This method provides an historical proxy of average demand but does not take account of location-specific factors, or of the impact of known future developments.

Passenger Demand Forecasting Handbook

2.3.1.4 PDFH is the product of over two decades of research on rail demand forecasting on the national rail network, providing guidance on aspects such as the effects of service quality, fares and external factors on rail demand. It is recognised within the industry as the key source of evidence in this area, but it is not wholly compatible with light rail networks because of their differing characteristics. In the case of the Tyne and Wear network however its ‘heavy rail’ ancestry and the longer distances between stations render PDFH potentially more relevant than on light rail networks. ‘Heavy rail’ trips between Sunderland and Central Station demand are estimated via PDFH, for instance. In the respective studies for Metro extensions and demand which inform this strategy the PDFH has not been used, although some of the assumptions which underpin it have been included within the parameters of the MVA demand forecasting model.

Direct Demand Model (‘MVA Model’)

2.3.1.5 The forecasting approach adopted in the preparation of the Metro demand study model\textsuperscript{11} is that of a direct demand, elasticity-based model which employs observed (historical) relationships between demand and explanatory variables from historic data on the existing network, combined with additional evidence as required from comparable UK networks to estimate future-year demand. In basic terms, the demand between any Metro station pair for a given ticket type is a function of the following variables:

- Fares
- In-vehicle time for Metro
- Headway for Metro
- Endogenous variables, such as Metro punctuality, reliability, number of interchanges
- Exogenous variables related to population characteristics and land-use such as employment, retail sales, regional GVA
- Explanatory variables related to competing modes such as bus fares, car parking charges and supply, car times
- One-off or regular events which have a predictable effect on Metro demand such as sporting events and engineering works

2.3.1.6 Station catchments were produced using the lowest level of spatial detail, Census Lower Super Output area, with overlaps dealt with in individual circumstances. Each market segment was subjected to econometric modelling to identify statistically significant drivers of Metro demand with plausible behavioural properties. This process safeguards against importing behavioural evidence

\textsuperscript{11} Tyne and Wear Metro Demand Forecasting Study. MVA Consultancy/The Denvil Coombe Practice 2012
from elsewhere, and highlights the importance of specific local factors upon demand for Metro, such as student travel and concessionary travel.

2.3.1.7 A version of the model that Nexus can interrogate and manipulate to assess the impact of a wide range of interventions has been supplied. The outputs of the model runs use the principles described, with the caveat that depending upon the use to which they may be put, results may need to be cross-checked with the outputs of the Tyne and Wear model as described below.

**Tyne and Wear Transport Planning Model (TPM3)**

2.3.1.8 Transport planning across the Tyne and Wear area has been based for some time on a robust modelling system comprising a demand model, a highway assignment model and a public transport assignment model forming a unified multi-modal modelling system. The public transport model uses CUBE/TRIPS software and uses the same zoning system as the other models within the suite listed above. A model such as TPM would have a role in providing evidence on the social and environmental benefits of new stations and extensions i.e. changes to the existing Metro network. In a critique\(^\text{12}\) of TPM3 on the basis of its use as supporting information for a future business case, it is noted that it can be used alongside the direct demand model produced by MVA, as the outputs of the latter are unlikely to be comprehensive enough to provide the sole source of modelling assumptions.

2.3.1.9 It is for the reasons outlined in this section that the direct demand model is proposed to inform future business cases. It is also proposed that TPM3 should be used to provide contributing data in its capacity as a multi-modal validation tool.

2.3.1.10 Transport Analysis Guidance (TAG) Unit 3.15.3 provides advice on forecasting patronage for major public transport schemes\(^\text{13}\). In terms of factors affecting the underlying demand for travel, the three main categories identified are as follows:

- Demographic, economic and behavioural trends
- Land-use developments
- Measures to influence the demand for travel

2.3.1.11 The same forecasts, land-use assumptions and uncertainties should be common to both the MVA direct demand model and TPM3. Consistency of approach is also proposed for patronage forecasting and factors affecting the cost of travel.

2.3.1.12 The extent of the enhancements required to TPM3 to enable it to replicate the direct demand model Metro forecasts will depend on the sources of Metro patronage that accompany future changes to the existing network. If significant numbers of Metro passengers are expected to transfer from bus or rail, then that would require the public transport trip matrices and assignment model in TPM3 to be enhanced; if this process was also anticipated from car, the TPM3 highway reassignment model would also need to be enhanced.

\(^{12}\) Tyne and Wear Transport Planning Model – The Denvil Coombe Practice 2012

\(^{13}\) Forecasting and Sensitivity Tests for Public Transport Schemes, DfT 2009
2.3.1.13 The recommendation for the Metro Strategy in terms of demand modelling is therefore that the direct demand model produced by MVA is used as the basis for future business cases, with the public transport trip matrices and assignment model in TPM enhanced as required to deal with the impacts of anticipated transfers between bus and rail to Metro.

2.3.2 Demand modelling of identified planning scenarios

2.3.2.1 The impact of a number of planning scenarios has been modelled, separately and in combination where required, to inform the submission of a business case for network renewal and extensions. In a number of cases at this stage only broad trends and assumptions can be assessed however in each case the key trends, impacts and modelling methodology are described.

Central and/or local government highway demand management measures

2.3.2.2 These can be sub-divided into three categories:

- Highway capacity restrictions on a corridor or area basis
- Parking charges and/or restrictions on a corridor or area basis
- Road user charging and/or workplace parking levies

2.3.2.3 Highway capacity restrictions can involve the closure of roads or a reduction in their total effective capacity through road-space reallocations or lower speed limits. At present all regional highway authorities adopt similar policy stances by maximising road-space reallocation in favour of vehicles other than cars, generally not promoting new road construction or capacity, and seeking to reduce overall vehicle speeds, often across extensive residential areas. The net effect of such measures is to reduce the attractiveness of car travel (and in some cases bus travel, depending on the effectiveness of priority measures) relative to Metro, however to date the overall impact has remained relatively low although there are several corridors where highway congestion at peak times is such that it encourages migration towards Metro as a mode of commuter travel. Fundamental changes to the role and function of the local highway network, such as route closures and road-user charging, cannot be predicted at this time and will reflect political, economic and environmental factors. They are seen as unlikely to take place over the short to medium-term. Changes of this scale would require recalibration of TPM3 to assess the resulting impact upon future demand for public transport. For the purposes of the strategy, no major changes to the local and strategic highway network going forward are assumed and no route closures to traffic for on-street Metro operation are considered.

2.3.2.4 The cost, availability and duration of parking in urban centres can be an important determinant of driver behaviour for those with access to a car. TRL Report 593 states that restricting parking tends to have a positive effect on public transport use, but there is no clear pattern from the cross-elasticities derived from this evidence. Currently there is some variation amongst the Tyne and Wear authorities in the application of charges and restrictions, with examples of their being used both to encourage and discourage car journeys to and from urban centres according to circumstances. This is a reflection of an inherent conflict between revenue-raising requirements and sustainable transport aspirations. In recent years the cost of parking has risen in excess of the Retail Price Index and the rate of new parking provision has slowed, however there are no immediate signals that the
basic offer is likely to alter in the foreseeable future. Additional Park and Ride proposals for the Newcastle and Gateshead areas are under consideration by district councils and by Nexus; should these be implemented then existing parking patterns could change, with the likely outcome being a reduction in the amount of commuter car trips into urban centres.

2.3.2.5 There are currently no plans the areas served by Metro to introduce a hypothecated revenue flow linking parking receipts and enhanced public transport provision. This has however been taken a stage further in Nottingham, with the introduction of a workplace parking charge introduced under the enabling legislation of the Transport Act 2000.

**Case Study Nottingham Workplace Parking Levy**

- This has been in place since October 2011 and applies to all employers located within the City of Nottingham providing more than 10 parking spaces for employees to use.
- All money raised from the levy must be invested into improving local transport for Nottingham by law. The levy will provide funding for the second phase of the Nottingham Tram network (NET), the redevelopment of Nottingham Railway Station and supported bus networks.
- The 2014/15 levy is £362 per parking space. It is estimated that the workplace parking levy will bring in an average of £14 million per year over a 23-year period (approx. £322 million).
- The latest estimate of population of the City of Nottingham is 306,700 and of the Greater Nottingham area 675,600.

2.3.2.6 The Nottingham levy is expected to pay for one-third of the cost of extensions to the existing tram network. Despite some opposition to the principle from local businesses, the levy is now generating a revenue stream for extensions as well as having an impact upon land-use planning decisions and employees’ travel behaviour. Whilst a workplace parking levy could represent a welcome development in terms of funding streams for Metro, it is unlikely to be adopted in the Tyne and Wear area for the foreseeable future.

**Road user charging**

2.3.2.7 Public opposition to congestion charging continues in the UK, although there are occasional signs that the concept may form part of future English transport policy In inner London, the daytime congestion charge is now an accepted element of public policy, however in Manchester and Edinburgh local referenda led to public rejection of the proposals, despite the prospect of an accompanying funding package for transport improvements. For the purposes of the strategy whilst the potentially major implications of area-wide road-user charging are noted, it is assumed that they will not be introduced in the region for the foreseeable future.

2.3.2.8 Short of the introduction of a workplace levy or congestion charge, there is evidence that other measures in relation to parking may alter commuter behaviour, in particular meaningful reductions in the amount of all-day parking. These could be introduced within the context of a complementary package of policy instruments.
**Fuel prices and vehicle use**

2.3.2.9 Fuel costs for road users are governed to some extent by government fiscal policies and also by commodity markets and security of supply. UK vehicle miles in 2011 at 303 billion\(^\text{14}\) have decreased by 3.3% since their 2007 peak. Some observers suggest that the era of ‘peak car’ has arrived, beyond which further increases in vehicle mileage are less likely. An alternative explanation may be that the relationship between vehicle use and demand for transport and levels of economic activity is relatively inelastic, reflecting the impact of the recent economic downturn. A similar impact has recently been felt in terms of Tyne and Wear Metro and local bus patronage.

2.3.2.10 Over the longer term the worldwide supply of oil-based fuels is forecast to reduce, although the onset of the ‘peak oil’ scenario where annual output consistently declines continues to be pushed back as further reserves are accessed. Despite future uncertainty surrounding energy resource availability, there is general consensus that a combination of declining supplies of oil-based products and an increase in renewable energy generation will result in major changes to the existing ‘energy mix’ over the next generation of Metro operations. The implications for Metro demand as for transport in general could be a shift towards electrically-powered travel and a possible increase in demand, as car use becomes less convenient and more expensive.

2.3.2.11 The impact of changes in energy policy and supply in relation to Metro demand are anticipated to be at worst, neutral and on balance, favourable, as resources become more constrained and Metro is able to benefit from the security of supply of electricity generated from a range of energy sources.

2.3.2.12 The impact of changes to the existing Metro demand scenario can be summarised as follows:

- **Highway demand management policies** – potentially a strong increase in demand but politically sensitive and more likely to be implemented at a regional or national level.

- **Workplace parking levies** – longer-term outcomes from Nottingham will be influential, likely to be beneficial in terms of encouraging modal shift through employers and in terms of a funding stream for network enhancements promoting further patronage growth, but potentially politically risky for other areas to consider.

- **Energy policies and supply** – a net beneficial impact on patronage as costs rise and the supply of oil-based fuels is potentially constrained in the future.

**2.3.3 Accuracy of Demand Forecasting**

2.3.3.1 The accuracy of demand forecasts derived from modelling continues to be an issue across all areas of transport infrastructure planning. Metro is no exception to this, although there are benefits to be gained from the experiences of previous network extensions. The most recent of these is the extension from Sunderland to South Hylton in 2002 over a route which had been without rail services for almost 40 years. In this case the demand forecasts prepared in support of the business case proved to be initially over-optimistic, but have moved closer to reality as travel patterns evolve in response to new provision.

\(^\text{14}\) Transport Statistics 2012 DfT.
2.3.3.2 The long-term and complicated nature of forecasting processes makes it difficult to anticipate changes and control for errors in model forecasts. In some cases, factors outside the control of the planning agency, such as macro-level economics, can influence the travel patterns of individuals, but are not necessarily easy to predict and incorporate. Fyvbjerger\(^\text{15}\) cites the concept of “planning fallacy” whereby scheme proponents tend towards an ‘inside view’ focusing on the constituents of the specific planned action, rather than on the outcomes of similar actions already completed.

2.3.3.3 Differences between predicted and actual demand for selected UK light rail networks are shown in the table below:

**Predicted and actual demand for UK light rail networks\(^\text{16}\)**

<table>
<thead>
<tr>
<th>Network</th>
<th>Expected annual patronage at network maturity (typically five years)</th>
<th>First full year patronage (millions)</th>
<th>Patronage 2002/03 (millions)</th>
<th>Patronage 2010/11 (millions)</th>
<th>Difference between 2002/03 patronage and expected annual patronage</th>
<th>Difference between 2010/11 patronage and expected annual patronage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sheffield Supertram</td>
<td>22.0</td>
<td>6.6 (1995/96)</td>
<td>12.0</td>
<td>15.0</td>
<td>45% shortfall</td>
<td>32% shortfall</td>
</tr>
<tr>
<td>Midland Metro Line One</td>
<td>8.0</td>
<td>4.8</td>
<td>5.0</td>
<td>4.8</td>
<td>38% shortfall</td>
<td>40% shortfall</td>
</tr>
<tr>
<td>Croydon Tramlink</td>
<td>25.0</td>
<td>15.0 (2000/01)</td>
<td>19.0</td>
<td>27.9</td>
<td>24% shortfall</td>
<td>12% excess</td>
</tr>
<tr>
<td>Manchester Metrolink Phase 1</td>
<td>12.0</td>
<td>11.0 (1993/94)</td>
<td>19.0</td>
<td>19.2</td>
<td>5% excess</td>
<td>7% excess</td>
</tr>
<tr>
<td>Manchester Metrolink Phase 2</td>
<td>6.0</td>
<td>3.0 (2001/02)</td>
<td>19.0</td>
<td>19.2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2.3.3.4 Further demand risks exposed by this study include predicted changes in land-use and increased development density around stations failing to materialise, and over-estimation of demand for airport links. It challenges the perception that projects are unique and cannot therefore be

\(^{15}\) Quality Control and Due Diligence in Project Management: Getting Decisions Right by Taking the Outside View Fyvbjerger, Said Business School 2012  
\(^{16}\) Green Light for Light Rail, DfT 2011
accurately benchmarked, an assertion supported by DfT in its insistence of the application of optimism bias.

2.3.3.5. The demand study for Metro takes account of these trends underlying major scheme forecasts in the preparation of the theoretical background to the model structure, nevertheless the above points are salient in the context of those uncertainties inherent in every major programme which cannot be entirely quantified, or eliminated.

2.3.3.6 Forecasts for the existing Metro network are less likely to be affected by these factors unless the basic structure of the network alters substantially or demand is strongly influenced by external factors. A large amount of actual and trend data is available in respect of historic patronage which can be used to benchmark against the demand study’s conclusions.

2.3.3.7 The conclusions that can be drawn from the above analysis are that the best demand forecasts are based on robust evidence and can be nuanced in the light of experiences learned from elsewhere. Notwithstanding this, every situation differs in the detail, and all forecasting is vulnerable to the impacts of controllable and random influences between the time of their production and scheme implementation.
2.4 Land-use Planning

2.4.1 Current Situation

2.4.1.1 Future patterns of land-use are critical to the future of Metro and in particular to the prospects for corridors designated as potential network extensions. This section outlines the high-level context which underpins the topic and provides the framework for the conclusions set out in the sections which deal with future forecasts and the prioritisation of extension corridors. The demand forecasting ‘Black Book’\(^\text{17}\) notes that there is a reasonable amount of evidence of the links between light rail and economic development and growth, to a greater extent than for bus. It cites Tyne and Wear as an area where this trend has been observed, although it notes that in general the timescale for the effects of new public transport networks on land-use to be fully felt may be around 20 years, and that land-use impacts are greatest when transit developments take place just prior to an upswing in regional economic growth. Forecasting such events is clearly not possible; therefore this strategy needs to be guided by observed consequential impacts elsewhere in the UK, including previous expansion of the Metro network such as the 2002 Wearside extension.

2.4.1.2 National planning policy has recently undergone substantial change, with a streamlining of guidance via the National Policy Planning Framework and a stronger presumption in favour of development, alongside a declared aim of increasing the influence of ‘localism’ by placing more responsibility for land-use decisions at the local community level via the Localism Act 2012. The influence of these policies is now starting to be felt as more planning decisions and forecasts are being judged according to these criteria. Alongside the decentralisation of centrally-imposed planning targets, land-use planning and the economic development agenda is being more closely linked at a regional and sub-regional level through the Local Enterprise Partnership framework. The North Eastern LEP area covers Tyne and Wear, Northumberland and County Durham, so the future development of the Metro network needs to be planned and delivered in line with the LEP’s growth agenda and travel-to-work areas, and the strategic direction of the Combined Authority. In this regard the conclusions of the North East Independent Economic Review and the development of the Strategic Economic Plan are relevant to the development of a robust business case for Metro, aligned closely to the region’s economic and planning priorities.

2.4.1.3 Land-use policy and the Metro network should enjoy a symbiotic relationship. The permanence and visibility of Metro should be a powerful influence favouring the sustainable development of locations within easy walking distance of stations. In practice, the pace of change can quickly impact on Metro patronage in either direction – such as the effects of the large-scale closure of the shipbuilding industry on lower Tyneside which generated many trips to and from that location when Metro opened in the 1980s. That area’s designation in large part as an Enterprise Zone should help to reverse the trend in due course. Conversely, the expansion of the further and higher education sector in Newcastle and Sunderland in particular, has increased the level of travel demand by campus users considerably, with currently about 90,000 students and staff in central Newcastle and 15,000 in Sunderland\(^\text{18}\) visiting daily in term-times, a substantial proportion of whom regularly use Metro.

\(^\text{17}\) The demand for public transport – a practical guide. Balcombe et al, TRL Report TRL593
\(^\text{18}\) Telegraph University Guide, 2011
High-level analysis of major land-use proposals adjacent to existing network corridors

2.4.1.4 This section considers existing Metro corridors. Potential network extensions are considered in Section 7. These proposals have been taken account of in the preparation of the Metro demand forecasting study.

Airport – Regent Centre

- Airport - Increase in passenger and freight flows leading to further development at Newcastle International Airport (passenger numbers estimated to increase to over 10 million per year)\(^{19}\)
- Callerton Parkway / Bank Foot – Proposed residential development ‘Callerton Park’ of up to 3000 dwellings in three areas south and west of the corridor by 2030\(^{20}\).
- Kingston Park / Bank Foot - proposed neighbourhood growth area of up to 850 additional dwellings
- Regent Centre - potential redevelopment of the existing under-utilised office complex

South Gosforth – Coast

- Four Lane Ends - Quorum Business Park - build-out to completion of the retail area
- Northumberland Park – further development of Cobalt Business Park and land north of station for residential purposes
- Substantial residential development west and north of Rising Sun Park, and also between Shiremoor and Wellfield

\(^{19}\) Source Newcastle International Airport Limited
Coast – Wallsend

- North Shields – Smith’s Dock residential and retail development
- Hadrian Road / Wallsend – Tyne North Bank Enterprise Zone industrial development

Wallsend – St James

- Ouseburn Valley commercial and residential development
- Science City

Central Station

- Development south of the station

Gateshead – Heworth

- Town Centre/East Gateshead/Baltic redevelopment completion

Hebburn – Jarrow

- Industrial and residential development

Jarrow - South Shields

- South Shields centre retail redevelopment

Pelaw – Sunderland

- Mixed-use development at Monkton

Sunderland – South Hylton

- City centre redevelopment
- Pallion/Claxheugh substantial residential development

2.4.1.5 Known major land-use planning proposals which are in prospect in south east Northumberland and north and east Durham have also been examined in the context of their providing additional origins or destinations that could influence direct or indirect demand for Metro. In Durham the County Durham Plan suggests the following areas of development that are potentially relevant:

- Seaham – 950 dwellings by 2030

2.4.1.6 Northumberland is proposing the following, either related to the Ashington Blyth & Tyne corridor, the Airport branch or the existing route at Northumberland Park/Four Lane Ends Park and Ride:

- South East Northumberland New Growth Point – incorporating the Blyth and Wansbeck districts and the Blyth Estuary Enterprise Zone.
Large-scale residential development proposed in the Ponteland area

**Analysis**

2.4.1.7 Forecasting land-use patterns can only attempt to define the future landscape of the region. This is a strategy for development of Metro that will help shape travel and land-use patterns across the region for decades to come. The emphasis in planning terms needs to be on ensuring the active support of stakeholders at all levels that will help ensure that sustainable development is concentrated along corridors easily accessible by Metro, and that any network extensions are planned and promoted in the knowledge that Metro will facilitate access requirements arising from future land-use planning decisions. One of the trends since the opening of Metro in the 1980s has been an increase in the amount of development in locations which Metro cannot serve. The future priority in terms of large-scale development should be to maximise the use of brownfield and greenfield sites close to the existing network, then along corridors where there is consensus that the nature and scale of development is proportionate to a network extension, or where Metro would be key to opening-up sustainable transport opportunities.

2.4.1.8 Current trends which may influence the future development of land-use planning across the region include:

- Growth in the renewable energy sector, particularly along the Tyne and Wear river frontages and enterprise zones
- Pressure on secondary retail centres resulting from increased internet shopping
- Continuing growth in the higher and further education sector resulting from increases in the school leaving age
- Accelerated rates of house-building in both urban and suburban locations to address a nationwide shortage

2.4.1.9 In conclusion, there is likely to be substantial development across the region in the decades to come. Wherever possible, this should be concentrated in areas that are currently served by Metro, or can easily be connected later if Metro is to play its full part in the region’s future economic growth. This can be achieved through effective liaison between transport and planning disciplines over the individual and collective impact of land-use planning decisions.
2.5 Future Demand for the Existing Network

2.5.1 Introduction

2.5.1.1 Although an important aim of the strategy is to plan a future for Metro which sees the network play an increasing role in the area’s transport needs through the opening of new routes, its primary responsibility is to ensure that sets a framework for the continued operation of the current network and to consider what enhancements and improvements are needed, including new stations, additional Park and Ride provision and additional or amended services. As part of a range of planning scenarios, this section considers predicted demand for the period to 2030 for the current extent of Metro operations.

2.5.1.2 It is recognised that one or more of the following scenarios could play out over time and in such situations, the Metro demand model can be re-calibrated to reflect their impacts:

- No network extensions
- No major changes to bus services within Metro’s operating area
- No significant fiscal or highway demand management changes affecting the demand for public transport
- No major land-use changes

2.5.1.3 It is recognised that the probability of all of these parameters continuing to apply as set out above is low, and it is unlikely that the economic and social landscape of 2030 will be the same as today’s in all respects. Among the potential changes which have been identified are:

- Changes to the operating structure of the rail network which could result in local rail operations across the wider region being performed by Nexus, or alternatively Metro operations being subsumed within an enlarged regional rail franchise.
- Changes to the ownership and operational arrangements of the Pelaw to South Hylton section of the network.
- Changes to bus networks.
- Changes to the relative burden of taxation applied to public transport and private motoring journeys resulting in modal shift towards or away from Metro.
- Land-use changes gather pace as the economy improves. Much has changed since the design of the original network in the 1970s, including the demise of coal mining and shipbuilding and the construction of Metrocentre, Doxford Park and Cobalt amongst others. However, the regional economic forecast commissioned by Nexus21 to inform the demand study suggests that the timing of a return to vigorous economic expansion across the Tyne and Wear area may be well into the next decade, which makes forecasting the rate of growth in later years particularly difficult. What does appear to be a long-term trend is a lower rate of capital expenditure by central and local government than historically.
- Developments along the existing network which prompt additional stations or Park and Ride facilities.

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21 Regional Economic Forecast - Arup 2012
2.5.1.4 With the timing or probability of so many of the changes outlined above uncertain or doubtful, it is therefore considered prudent to include within the strategy a “low growth” scenario which takes account of an environment of low or no growth in population, employment and regional GVA over the period to 2030, as a yardstick against which to judge the more optimistic demand projections.

2.5.2 **Metro Demand Study**

2.5.2.1 To provide an independent forecast of future demand for Metro, Nexus commissioned a demand forecasting study to provide a range of forecasting scenarios for the existing network and identified potential network extensions. The details of the extensions forecasts are covered in detail in Section 7, although it is worth noting here that there is a range of impacts – mostly beneficial in demand terms – of the introduction of new route corridors upon existing network operations, mainly in terms of higher frequencies and increased journey opportunities.

2.5.2.2 The study adopted the forecasting approach of a direct demand, elasticity-based model employing observed historical relationships between demand and explanatory variables from historic data on the existing network, combined with additional evidence from comparable UK urban rail networks to estimate future year demand. Data to support demand and revenue forecasts included Census Lower Super Output Area details as well as the use of regional-level datasets. Each of the existing stations was allocated a catchment area with the impact of changes to population, land-use and travel times analysed at that level.

2.5.2.3 In terms of the existing network (as well as the extensions) three separate scenarios were posited as follows:

- High Growth – envisaging faster economic growth in certain industrial sectors
- Core forecast – assuming a policy neutral environment and a return to economic growth
- Low Growth – where employment and population stagnate at 2011 (base year) levels

2.5.2.4 The forecast change in passenger numbers on the existing network is shown below, excluding the impact of any subsequent network extensions.
2.5.2.5 In terms of the existing network the demand study describes routes as follows:

- Corridor 1: North Tyne loop
- Corridor 2: South Shields
- Corridor 3: South Hylton
- Corridor 4: Airport

2.5.2.6 Predicted rates of growth vary according to the predicted changes to population and land-use that relate to each corridor. The highest rate of growth is attributed in absolute terms to the South Shields corridor because of the known development proposals located along it, with the highest growth in percentage terms—across all growth scenarios—anticipated for the Airport corridor, where continued growth in passenger numbers and associated employment has been forecast by the airport operator. The Pelaw to South Hylton corridor displays the lowest rate of passenger growth across all scenarios.

2.5.2.7 Translated into revenues, the demand picture alters somewhat, largely due to the assumption made that concessionary travel will comprise one of the strongest growth components. Whilst welcome in terms of social inclusion, an unbalanced growth in the number of reduced-fare passengers would impact upon network profitability in the long-term. Although adult full-fare customers will continue to form the most lucrative passenger cohort in terms of revenue per passenger kilometre travelled, continuing efforts be needed to ensure that this section of the market remains robust. In this context, the customer requirements section of the strategy will be important in terms of attracting and retaining full-fare passengers. Predicted percentage increases in demand by ticket type under the ‘core’ (middle growth) scenario are below:

<table>
<thead>
<tr>
<th>Ticket type</th>
<th>Forecast Year</th>
<th>Percentage Increase</th>
<th>Demand Forecast</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2020</td>
<td>2030</td>
<td>2020</td>
</tr>
<tr>
<td>Adult Single</td>
<td>34.5%</td>
<td>62.9%</td>
<td>5.547m</td>
</tr>
<tr>
<td>Adult Daily</td>
<td>20.1%</td>
<td>42.7%</td>
<td>13.265m</td>
</tr>
<tr>
<td>Adult Season</td>
<td>19.0%</td>
<td>31.8%</td>
<td>7.188m</td>
</tr>
<tr>
<td>Student Season</td>
<td>-0.3%</td>
<td>4.0%</td>
<td>1.158m</td>
</tr>
<tr>
<td>Child Single</td>
<td>30.7%</td>
<td>74.5%</td>
<td>8.59m</td>
</tr>
<tr>
<td>Child Daily</td>
<td>23.5%</td>
<td>58.5%</td>
<td>2.710m</td>
</tr>
<tr>
<td>Young Persons Season</td>
<td>16.1%</td>
<td>16.7%</td>
<td>8.19m</td>
</tr>
<tr>
<td>Concession</td>
<td>102%</td>
<td>289%</td>
<td>11.316m</td>
</tr>
<tr>
<td>Unknowns22</td>
<td>Constant</td>
<td>Constant</td>
<td>2.545m</td>
</tr>
</tbody>
</table>

2.5.2.8 The key points highlighted by the demand study model outputs are that by 2030, concession travel will increase from 15.3% of the existing passenger total to 27.3%, with adult ticket products declining proportionately over the same time periods from 64.8% to 57.5%, with consequent implications for

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22 Unknowns comprise fraudulent travel and staff travel
future revenue generation. Increases in the rate of child travel will have a similar impact of lesser magnitude.

2.5.2.9 The level of fares charged for Metro and for other public transport modes will also influence future passenger demand. Historically Metro fares have risen in line or slightly higher than the Retail Price Index however this has proven insufficient to bring in the revenues required to re-invest in the network to any meaningful extent. However Nexus is also aware of the sensitivity of its fare-paying customers towards fares increases, and the total and marginal costs of using other travel options.

2.5.3 External factors affecting future demand levels

2.5.3.1 The model outputs are a best estimate, independently derived, of the likely trajectory of existing patterns of demand and projected changes in factors such as land-use changes and GVA growth, as described above. These need to be balanced by an evaluation of potential changes across a variety of subjects, the impacts of which can then be modelled to assess the implications on passenger demand and revenue.

2.5.3.2 Impacts which fall into this category include:

- Changes in the level and availability of concessions for eligible passengers
- The impact of relative changes in fuel costs for private and public transport
- Fiscal changes including those relating to car use
- Behavioural change
- Highway demand management policies at national and regional levels
- Impact of bus operations

2.5.3.3 Taking these in turn, the potential individual and cumulative impacts can be assessed initially at a quantitative level, as follows:

(i) Future travel concessions are prone to political decision-making and budgetary concerns, with the medium-term prospect suggesting that the nature and scope of free or reduced-rate travel may be curtailed in a climate of constricted public sector finances. Should the levels of ENCTS concessions be altered at a national level this could have implications for Metro use particularly in terms of multi-modal trips or where there is a material disparity between the level of concessions offered to bus and Metro users. Also, should GVA and longevity increase as predicted, this may affect propensity to use public transport as the proportion of older people with access to private transport increases, all else being equal. Changes to the level of concessions offered to this passenger cohort are likely to result to in low demand elasticities being displayed.

(ii) On the assumption that Metro continues to use electric traction in the future, the relationship between crude oil costs and the costs of electricity generation will be a valid determinant of future demand. Predicting future trends is difficult. Conventional thinking suggests that over time the cost of crude oil will increase as the demand curve exceeds available supplies. However geopolitical events could also have an influence along with the impact of economic cycles, and the bulk cost of
electricity is also expected to increase in real terms as the concept of a ‘carbon price’ exerts itself in terms of the need to increase the proportion of energy generated from renewable sources. Therefore the impact of fuel costs is uncertain, although on balance a well-used Metro network benefiting from the latest technological efficiencies will command a competitive edge on the assumption that energy costs continue to display a rising trend in general. The inputs to the Metro demand model include assumptions as to future fuel costs. The introduction of a new fleet with improved engineering and environmental performance to the existing rolling stock would also influence outcomes.

(iii) Changes to fiscal policies relating to travel are similarly difficult to predict, however it appears unlikely that these will reduce costs in the future in the context of security of supply and the continuing requirement to reduce the environmental impact of transport. However these could also affect Metro operations adversely if patronage growth fails to outstrip real-terms increases in operating costs.

(iv) Despite the reluctance of both local and central government to implement highway demand management measures on a widespread scale, there are continuing economic and environmental arguments that suggest that over time their introduction is more likely to take place. Should this prove to the case then this would prove beneficial to Metro, the extent to which would depend upon how widely they were applied within its catchment area.

2.5.3.4 In summary, the most likely impacts arising from the above factors are as follows:

- Changes to concessionary travel terms – reductions in patronage, little revenue impact, overall impact neutral
- Relative changes in fuel costs – potentially beneficial to Metro
- Changes to fiscal policies – neutral or beneficial to Metro
- Demand management measures – beneficial to Metro

2.5.3.5 The detailed impact of such changes can be modelled by the Metro demand model once their magnitude can be quantified. The impacts of any demand management measures will be more difficult to quantify as it is impossible to predict at this time where or whether they will be implemented; any such measures outside of the Tyne and Wear area could also have an effect within the conurbation.

2.5.4 Potential New Station Sites on Existing Network

2.5.4.1 Alongside the network extension possibilities described in Section 7 there is some potential for additional stations on the existing Metro network. Stations such as Palmersville, Pelaw and Northumberland Park have been added since the original service patterns were introduced, although none have opened since Simonside in 2008 or are currently in planning. To ensure a consistent approach, all of the sites discussed below have been identified as potential station sites in the respective local plans and development frameworks of the five district councils.

2.5.4.2 New stations may be desirable for a number of reasons. The most common is that they respond to demand from adjacent housing or retail development that has taken place since the network
opened. In other locations there may be strategic interchange opportunities that justify the provision of a station on a green-field site, whilst at others it may have been seen as too difficult or expensive to introduce a new station at the time the network was originally planned.

2.5.4.3 The aggregate impact of additional stations has to be considered in terms of line capacity, especially in terms of signalling, additional operational costs and potential abstraction from adjacent stations. The impact on journey times for longer-distance fare-payers, important in revenue terms, also needs to be taken into account. The positive side of the case for additional stations in certain locations is in terms of the potential for developer contributions towards construction costs and net additional revenue.

2.5.4.4 The sites which have been identified in district plans are described below in alphabetical order. There are no firm plans to develop these further at this stage, but they are included within the strategy as longer-term possibilities. Other sites may become available in the future but these are not considered within the strategy at this time.

**High Lane Row**

2.5.4.5 This site was referenced in the second Tyne and Wear Local Transport Plan as a ‘highway congestion intervention’ and in Policy SA2 of the South Tyneside Local Development Framework as a location where the site will be safeguarded for the purposes of Metro station construction. The location lies midway between Hebburn and Jarrow stations, and would be potentially abstractive from both given the distances between them. The proposal has the support of South Tyneside Council and would improve sustainable access to this area of Hebburn. Dual-tracking of the South Shields route would provide a potential trigger for consideration of a station at this location; at present the single line formation with passing loops does not allow for any additional station calls. Dualling of the South Shields route is a strategy recommendation, and the circumstances surrounding this location can be reviewed as and when this is implemented.

**Monkton Fell**

2.5.4.6 A site between Pelaw and Fellgate at Monkton Fell on the Network Rail-owned Sunderland line is identified within South Tyneside Council’s LDF, primarily as a means of improving public transport access to the adjacent Monkton Business Park. Were this to be progressed further it would require an analysis of line capacity as well as forecast levels of demand, because the route is currently operating close to its maximum capacity. Approval from Network Rail would therefore depend upon their being satisfied on this measure.

**Pallion area**

2.5.4.7 The current Sunderland Unitary Development Plan – to be superseded by the LDF Core Strategy during 2016 - identifies two locations to the east and west of the existing Pallion station, that the UDP considers may be appropriate to serving the accessibility needs of potential new development. It is understood that these will not be specifically identified within the adopted LDF.
Other locations

2.5.4.8 Core Strategies for other areas also seek to protect and promote Metro corridors and support the provision of additional stations to serve potential future development. Nexus has and will continue to work with local authorities in developing plans to add stations to the existing network.

2.6 Conclusions and Recommendations

2.6.1 The above analysis suggests that future demand for the existing network is predicted to increase, but that the magnitude of that increase could vary according to a number of circumstances that may or may not be controllable, and may be random or linked to trends. There is much that Metro can do to influence future demand, and Section 5 of the strategy shows how customer requirements will be anticipated and catered for to ensure that services and facilities meet users’ expectations.

2.6.2 Trends in land-use policy will be important in encouraging growth in demand for the existing Metro network. Rail’s greatest strength and weakness are certainty and immobility. It can be easier to situate development alongside an existing corridor than to build new lines to access remote sites. Taking account of all other factors, it follows that close liaison with planning authorities and a mutual understanding of each other’s needs and those of developers will be important to ensure that Metro can play a full part in meeting the region’s sustainable transport needs.

2.6.3 The following recommendations therefore relate to demand for the existing network:

- Monitor existing and predicted future demand for Metro closely.
- Monitor regional and national economic and planning trends.
- Maximise demand through the delivery of reliable services that meet customer requirements.
- Liaise closely with the Local Economic Partnership to ensure the optimum locations of development proposed within the Strategic Economic Plan.
- Liaise with district planning authorities to ensure that the principles and detailed design of developments are planned so as to maximise accessibility by Metro.
- Work with local authorities on the introduction of new stations on the existing network where these are justified by demand, sought by local communities and are operationally feasible.
Section 3: FLEET

3.1 Fleet Renewal Options

3.1.1 The most important outcome of this Metro Strategy will be the replacement of the existing fleet of trains with a new fleet delivering improved customer benefits, operating cost savings and ensuring the long-term future of the existing network. The current vehicles once refurbished will provide a further decade of service meeting current customer needs; longer-term, analysis of the costs of further refurbishment versus fleet replacement suggests that a new fleet will be cost-effective over their design life as well as being the only way of ensuring that Metro meets user requirements and takes advantage of new technology across every facet of the journey experience.

3.1.2 This section summarises the main areas that Nexus is developing to identify the optimal fleet specification taking account of customer requirements, network constraints and technological opportunities.

3.1.3 The current Metro vehicles were constructed in the mid-to-late-1970s, and have served their purpose well. During their 35-year lifespan they have undergone two significant refurbishments, to renew technical equipment and improve the passenger experience. The second (‘3/4 Life refurbishment’), to be completed by 2015, is expected to extend their life up to around 2025.

3.1.4 Trains are comprised of two separate, coupled vehicles in normal operation, but, apart from at relatively short peak hours, there is usually considerable spare passenger capacity in this arrangement.

3.1.5 At this stage, no detailed assessment has been undertaken about a potential third ‘Life Extension’ refurbishment in 2025. Challenges likely to be faced at that date include obsolescence of 50-year old components, poor state of the bodywork, the need to comply with disability access legislation, and external factors such as rising energy costs and the potentially changing position on electrification of Network Rail lines in the region. These all tend to suggest that a further refurbishment would be technically difficult, and almost certainly uneconomic when calculated over only an additional 10-12 years of vehicle life. Finally, issues experienced in 2013-14 in terms of fleet reliability have the potential to continue or worsen as the fleet gets older.

3.1.6 While it is recommended that a more formal consideration of the opportunity for a Life Extension refurbishment should be undertaken, the remainder of this section works on the assumption that a new fleet will be designed and procured, with a date of entry into service of around 2025.

3.1.7 A series of issues and ideas related to new vehicles are described below. These will be subject to more detailed technical assessment and design as part of this Metro Strategy.

Overall vehicle construction

3.1.8 New vehicles will probably be constructed of lightweight, potentially composite, material, so as to reduce traction energy demand. Nevertheless, they will need to meet the crash-worthiness requirements of joint ‘tram-train’ type operation on Network Rail lines.
3.1.9 New vehicles will be of standard gauge and are likely to be of standard UK external width (i.e. 2.65m), and an appropriate height for the Nexus overhead line equipment (OLE) and on-track structures, as well as those on Network Rail tracks. However, this should not preclude the possibility of dimension changes to the width, if, for example, this would assist with accessibility regulations.

3.1.10 Vehicle length is affected by a number of factors:

- Passenger demand, both now and in the future; should demand be satisfied by more trains, or longer/shorter trains?
- Market research indicating passenger demand for more frequent services and better actual/perceived personal security
- Technical issues such as articulation, number of bogies and amount of maintenance required as trains get longer or shorter, as well as whether the signalling system could handle additional trains, if this were necessary
- Platform lengths; most Nexus stations are only able to take trains of total length about 60 metres

3.1.11 The length of light rail vehicles currently in operation varies widely between networks; some examples are discussed further in Appendices 1 and 3, together with further ideas on this issue.

**Internal layout**

3.1.12 Current Nexus Metro vehicles are 28 metres long, and can carry around 210 passengers at ‘crowded’ levels of 4/m², with a maximum of 300 passengers at ‘crush loading’ levels of 6/m².

3.1.13 It is recognised that there is always a trade-off between amounts of seating and standing, and that naturally most passengers would prefer to have a seat. However, as at 2013 the median time on Metro journeys is slightly less than 10 minutes, and given the forecasts for increased patronage in future, there is a case to be made that there could be a lower density of seats in any new vehicles. Alternatively, seating could be made more space-efficient, such as being 100% longitudinal, or with a proportion being ‘fold down’ seats, to assist with peak hours loadings.

3.1.14 Nexus Metro ‘3/4-life refurbishment’ carriages contain 66 seats in their 28m length, or 2.3 seats per linear metre. This figure is somewhat higher than many UK comparators, again supporting the potential for a reduced seating level in a new fleet, should this prove feasible (sometimes technical issues such as under-floor equipment can prevent this).

3.1.15 It will also be important to provide suitable, adequate space for wheelchair users, items of luggage, and potentially full-size bicycles (the latter almost certainly being prohibited at peak times however). Passenger feedback indicates that the current number of wheelchair spaces is adequate, but that additional ‘flexible’ space is needed for luggage and bicycles.

**Passenger amenity**

3.1.16 New vehicles will comprise the latest standards of passenger amenity and information. While some of these may change depending on future technological progress, but are likely to include:

- Information screens and/or displays
• Wi-Fi facilities built-in
• Improved temperature control, which may or may not be provided through formal ‘air conditioning’

3.1.17 On-train passenger communication with Metro control staff may also be specified, dependent on the level of passenger demand for this facility, and an analysis of the operational resources required to deliver it.

Energy efficiency

3.1.18 New vehicles will need to be highly energy efficient, in terms of the energy used both by on-board equipment, and the overall traction energy.

3.1.19 Metro vehicles do not currently benefit from the facility to be able to recover energy during braking, which is now standard on almost all new light rail vehicles. This will certainly be specified, and could lead to a traction energy saving of around 15-20%, or possibly more if it is decided that recovered energy will be stored on-board (in which case a relevant energy storage device will be required). See Section 4.2 and Appendix 4 for more details.

Vehicle floor height and RVAR access, doors

3.1.20 The issue of vehicle access height (i.e. high / low floor) must also be considered, or whether there should be a mixture of both types in a new fleet, depending on whether there is any new on-street operation.

3.1.21 One option would be to follow the example of Manchester Metrolink, with a single fleet of high-floor vehicles for both on-street and track-based operation. Direct transitions from track-based to on-street operations may be fewer in number in Tyne and Wear than in Manchester, but the lower procurement and maintenance costs of a single fleet specification may potentially outweigh the need for high platforms in any potential on-street operation. On the other hand, this would require more obtrusive and expensive platforms on-street, and there would be implications for technical matters such as the wheel-rail profile.

3.1.22 The other key option is to have a mixed fleet with two vehicle types, i.e. high-floor for on-track, and low floor for any on-street operation. Low floor vehicles are more convenient for passenger accessibility, and both platforms and vehicles are generally less expensive. In this scenario, it would be felt that a consistent overall Metro ‘branding’ should overcome any difference in passenger perceptions between the two vehicle types. However, low-floor vehicles could not transition to on-track operation, reducing their flexibility, and also implying that a separate depot would be required.

3.1.23 Current Nexus Metro vehicles do not meet the national regulations for disability access known as the Rail Vehicle Accessibility Regulations, which must be met by 2020. Various interim and permanent solutions to meet RVAR are currently being investigated, some of which involve modifications to platforms, which is outside the scope of this section. However, one option is that vehicles could have a mechanically-extendable ramp on-board; this would need to be specified for the new vehicles if it were agreed to be taken forward.
3.1.24 The current ‘plug’ doors on Metro vehicles are not ideal in terms of maintenance and health and safety, as well as disabled access. Door design is a further key issue that will need to be examined in the design of a new vehicle.

**Operating voltage**

3.1.25 As discussed in more detail in Section 4, it is suggested that new vehicles could be specified with dual-voltage equipment on board, or at least that this facility be provided for in their design.

**Vehicle top speed**

3.1.26 Current Metro vehicles have a top speed of 80km/h, though this speed is only attained on limited sections of the network. The scheduled average speed over a full run is 36km/h including station stops, on both Yellow and Green lines.

3.1.27 In terms of flexibility of operation, there may be some benefit to considering a moderately higher top speed of up to 100 km/h in a new vehicle. While recognising that worldwide Metro vehicles are generally designed for modest-speed, frequent-stop operation, a higher top speed could, for example, allow:

- The potential of operating more Metro trains on the Sunderland extension which has wider station spacing, or better compatibility with other future Network Rail joint operation elsewhere in the North East region.
- Better potential for ‘express’ limited-stop Metro services on either the Sunderland line, or even on the existing Metro network, subject to installation of relevant passing place(s) if necessary.
- Improved capability to recover in the event of network disruption.

3.1.28 The Sheffield ‘tram-train pilot’ vehicles operate on-street at standard traffic speeds, but then have a maximum speed on Network Rail tracks of 110 km/h. It is recognised, however, that a higher top speed for a new Nexus vehicle would involve other technical considerations such as impact on the Nexus permanent way / bridge structures, changes to braking and signalling systems etc.

**Driverless operation**

3.1.29 There is potential on Nexus’ own track-based network that a future vehicle could be operated in a ‘driverless’ mode for some or all of the time. More detailed discussion of this option is in Section 4.4.

**Economic assessment**

3.1.30 It is important to stress that all options for a new Nexus Metro vehicle’s design, overall fleet numbers etc., need to be assessed in terms of their ‘whole life’ economic cost/benefit ratio, and take into account the operational requirements and characteristics of the Nexus Metro network.
3.2 Conclusions and Recommendations

3.2.1 It is recommended that:

- A study be commissioned as a priority, to establish the maximum train throughput using Nexus’ existing signalling system
- An assessment be carried out into the financial and practical implications of a further, final refurbishment of the existing Nexus vehicles in 2025, compared to procurement of a new fleet
- Further technical investigation and economic assessment be undertaken of options for the design of a new Nexus Metro vehicle type or types
Section 4: TECHNICAL OPTIONS APPRAISAL

4.1 Introduction

4.1.1 The purpose of this section is to cover the major technical areas, other than fleet renewal covered in Section 3, that are being assessed by Nexus as part of continuing work into defining the specification of a completely refurbished Metro system. Elements of this section build on the work currently under way as part of the Asset Renewal Programme (Metro Reinvigoration Phase 2). The outcome of the process will be the delivery of a network that supports the operation of robust and reliable services and which can accommodate future customer requirements and increased demand.

4.1.2 The main areas covered are:

- Power supply and energy recovery
- Depot – options for future stabling, servicing and overhaul facilities
- Signalling and control – the safe and flexible operation of the network
- Energy supply, efficiency and renewables – ensuring sustainable continuity of operation

4.1.3 Throughout this process Nexus will remain open-minded as to the optimal methods of delivering Metro safely and efficiently, with the capacity to increase its future sphere of operation both in terms of increased demand and any potential network extensions.

Above: a Nexus Metro train on the Queen Elizabeth II bridge
4.2 Metro Power Supply and Energy Recovery

4.2.1 Metro vehicles are currently supplied by 1500 volts direct-current (1500V DC) from an overhead ‘catenary’-based cable system, the only remaining example of this voltage in the UK. The other main power supplies in UK operation are:

(a) 25,000 volts alternating-current (25kV AC) overhead, which is used on all recently electrified mainline routes, including the East Coast Main Line etc.

(b) 750V DC ‘third rail’, used on mainlines in the South East for historical reasons, plus Merseyrail; it is proposed to progressively upgrade these to 25kV AC in the coming years due to operational issues

(c) 750V DC overhead; used by almost all tram networks in the UK, e.g. Nottingham, Manchester, Edinburgh etc. (Blackpool and Glasgow are the only exceptions at 600V DC)

Current situation at Metro

4.2.2 The nine traction substations and ten distribution substations are all working satisfactorily despite approaching their formal design life of 40 years; however, all substations are anticipated to require renewal within the period covered by this Strategy.

4.2.3 In late 2013, a decision was taken by Nexus to fully replace Metro’s overhead line equipment (OLE) on a ‘like for like’ basis, i.e. replacing worn catenaries and power cables with ones of identical design and cross-sectional area, using funds allocated from the ARP Phase 2. It was recognised that there may be a need for a further OLE upgrade in future, depending on decisions taken on regenerative braking on a new vehicle fleet (see below).

Regenerative braking

4.2.4 Trains require electrical energy to accelerate away from stations, but some of this energy is recovered (or ‘regenerated’) from the braking system when they brake approaching the next station. In current Nexus Metro vehicles, this energy is dissipated as heat, some of which is used to heat the carriages in winter, but most of which is wasted.

4.2.5 Modern light rail networks worldwide seek to recover energy from braking, which can be quite considerable, and can also helpfully smooth out the ‘spikes’ in power demand on the OLE.

4.2.6 The energy is recovered by using motors and electrical/electronic systems designed to do so, which current Nexus Metro vehicles do not possess. There are several ways in which the recovered energy can be re-used:

a) Feeding the recovered energy directly into the overhead line, for use by other trains. As an enhancement to the option above, it is possible to install ‘reversible substations’, which will feed recovered energy from the OLE back into the National Grid.

b) Charging or topping-up an on-board energy storage system.

c) ‘Track-side’ energy storage, in which recovered energy is fed via the OLE into energy storage units situated next to the track, at substations or locations where de/acceleration takes place.
4.2.7 Given the high cost of traction energy to Nexus, and the likelihood that this may increase significantly above inflation in future, it is recommended that Nexus assess in more detail all of the options in 4.2.6, at the appropriate stage of design for renewal of both the fleet and the substations. More detail on these options is provided in Appendix 4.

Voltage change

4.2.8 It has been considered whether the Metro overhead cable voltage should be changed from 1500V DC to a more typical value, either 750V DC or 25kV AC, at the time of fleet and substation renewal. However, both options would require very substantial capital costs over and above those already required, and almost certainly a significant period of total shutdown of the network. For example, conversion to 750V would require at least twice the number of substations, full replacement of all overhead cables, and most or all masts. Furthermore, 25kV AC operation is to all intents and purposes unfeasible due to the increased ‘air gaps’ required between the cables and any surrounding structures, which could not be achieved on Nexus’ network, particularly in the tunnels.

4.2.9 Finally it is worth noting that, although not the normal on-street voltage in the UK, 1500V DC is actually permitted for on-street operation under UK regulations. 25kV AC is completely unacceptable for on-street operation.

4.2.10 This means that Nexus could feasibly retain a consistent 1500V DC OLE voltage for both track-based and any on-street operation; this would have a number of operational advantages. Alternatively, an on-street operation could run on a more typical 750V DC; this could tie in with the scenario where a completely separate low-floor fleet were procured.

Fleet operating voltage

4.2.11 Despite the firm rejection of 25kV on Nexus’ network, the potential for direct operation on the 25kV national network has considerable strategic attraction. Outside the Metro network, only the ECML is currently electrified in the North East region; nevertheless this is unlikely to remain the case forever, especially when considering the likely Year 2070 design life of a new Metro fleet. Indeed, Nexus was consulted by Network Rail in 2013 about extending electrification to mainline routes in the region, as part of a national consultation on this issue. Electrification of the existing regional rail network to say Ashington, Hexham or Teesside would also offer clear opportunities for Metro to expand regionally if a new fleet could operate at 25kV AC.

4.2.12 It should be noted that Nexus’ access agreement to the Network Rail tracks to Sunderland expires in 2032, and this timeframe is also one in which the existing Sunderland electrification infrastructure may need substantial renewal, some 30 years after installation. Furthermore, while no specific plans have come forward, this timeframe is seen as a key one during which NR may also consider electrification of the wider Durham Coast Line at the standard 25kV AC. In this scenario, NR will be very likely to consider the existing 1500V DC electrification to Sunderland (owned and operated by them) as being an ‘obstacle’ requiring conversion to 25kV AC, rather than renewal at 1500V DC.

4.2.13 There is an obvious option to take advantage of the capital cost-effectiveness of retaining 1500V DC on the Metro network, while also allowing operation at 25kV AC: dual-voltage trains, which can easily and automatically swap between voltages when moving from one network to another. This facility is commonly found on Continental trains and light rail vehicles, such as those in Karlsruhe. It
is also planned on the new Sheffield tram-train and Merseyrail vehicles (albeit 750V/25kV rather than 1500V/25kV).

4.2.14 In effect, the high capital costs and inflexibility involved in converting or providing different voltages on the overhead power supply, are swapped for a more modest capital cost for the provision of dual-voltage equipment on the vehicles, and potentially slightly increased maintenance (revenue) costs due to more complex on-board equipment.

4.2.15 While it is possible that routine 25kV operation might not come into effect until a few years after a new fleet entered service, installing dual-voltage at the point of manufacture will be more cost-effective than a later retrofit, and offer full ‘future-proofing’. If capital cannot be sourced to actually install dual-voltage equipment in the first instance, the vehicle design should be optimised to permit a lower-cost upgrade to dual voltage at a later date.

Recommendations

4.2.16 It is recommended that:

- Nexus retain 1500V DC operation for its own on-track network, and investigate the implications of either extending this to on-street operation or using 750V DC in a separate on-street fleet.

- A dual-voltage 1500V DC / 25kV AC facility be considered as a key specification for a new fleet.

- The energy-efficiency benefits of regenerative braking are substantial and should be considered in detail in the design of both new vehicles and renewed substations.

- Nexus monitor and feed into Network Rail’s plans for future regional roll-out of electrification.

Pictured: A Nexus substation, and a Metro train passing under the Overhead Line Equipment
4.3 Metro Depot Assessment

4.3.1 The current Metro depot at South Gosforth was originally constructed in the 1920s. Numerous additions and refurbishments to the building have taken place over the years (for example an automated train washing system was installed in 2012), and the facility is operating safely. The site is also in a very good position strategically on the network, with two rail access points.

4.3.2 However, the current Gosforth Depot has a number of disadvantages:

- as it ages, the building and infrastructure will become increasingly expensive to maintain and provide a modern, high-quality working environment for staff; a number of features are already identified as requiring capital investment in the medium term
- the poor energy efficiency of the building is adding to running costs
- few of the environmentally friendly features often found in modern light rail depots are present, e.g. combined heat and power plant, solar panels, water collection etc.
- the existing depot is somewhat space-constrained for stabling the existing fleet size (however, this may change, depending on the number and design of any new fleet vehicles)
- road access for staff and visitors is not ideal; there is no station attached to the depot as is the case with many modern depots, and car parking is limited
- low-loader access for taking train vehicles on and off the network is almost impossible at Gosforth, with this operation currently taking place at a small satellite siding at Hylton St in North Shields instead (itself not ideal for low-loader access)
- the overall situation of the depot in the heart of an affluent suburb is not ideal, in terms of residential amenity and also of potential for unauthorised access
- the rail management offices are situated on the other side of the depot tracks, with only a pedestrian level crossing connecting the two facilities; vehicles must take a longer route by road

4.3.3 Options to reconfigure Nexus’ depot provision include:

- Retaining the existing Gosforth Depot, with significant refurbishment to keep it ‘fit for purpose’
- Construction of a brand new ‘like for like’ main depot in another location, with disposal of Gosforth
- Provision of additional vehicle ‘out-stabling’ facilities, irrespective of the main depot’s location

4.3.4 Despite a very substantial capital cost, a new main Metro Depot could have a number of advantages:

- A new higher-quality working environment for staff, projecting a better image for Nexus
- Lower running costs through usage of the latest environmental features and energy efficiency
- Potentially a better/customised fit to any new fleet to be procured
- Better access to the trunk road or mainline rail network, for taking train vehicles on and off the Metro network when needed
- Opportunity to consolidate all Metro operational and management functions onto a single site

4.3.5 A considerable number of new light rail depots have been constructed across the UK and Europe in recent years, providing an excellent source of best practice in design and operation. An EU-funded project entitled ‘Tramstore21’, which included Blackpool in its consortium, looked at many issues related to depot construction, and a range of documentation has been made available as a result of
the project. Should a completely new depot eventually be agreed, it is felt that this best practice would help to design a good-quality new depot without ‘re-inventing the wheel’.

### 4.3.6

One or more smaller ‘out-stabling’ facilities will also be investigated. These may help to relieve space pressure on the existing Gosforth depot or a new main depot, while also (depending on location) providing additional flexibility in scheduling, or resilience in the case of major network disruption. Potentially different functions could operate at different sites, e.g. heavy maintenance at the main depot and light maintenance at an out-stabling facility. The rationale for housing an entire fleet at a single location may be less strong in the future if network extensions provide the opportunity for additional stabling locations. Even on the present network there may be scope for the provision of small secure stabling facilities at termini, in the interests of relieving pressure upon a central depot location, and offering new early and late service scheduling opportunities. However, additional stabling locations may also create logistical inefficiencies.

### 4.3.7

It is important to note that in 2014 Nexus is seeking to purchase a disused building and land at the east side of the (heavy rail) Heaton Depot. A business case is being investigated into the establishment of a combined stabling facility and training academy for light rail engineering. If such a facility were eventually constructed, it could act as a medium-sized out-stabling facility as described above. However this should not preclude the investigation of other main depot sites, or smaller out-stabling facilities elsewhere.

### 4.3.8

A sample of sites investigated, and the site of the Heaton Depot, are shown in Appendix 5.

**Recommendations**

### 4.3.9

It is recommended that further work be undertaken to evaluate options for the long-term depot and stabling requirements of a Metro fleet. This work should be split into the following workstreams:

1. Establishment of options and outline costings to refurbish the existing Gosforth Depot to provide long-term sustainability of operations.
2. Estimate the costs of a brand new main depot.
3. Identify and come to an initial view about alternative sites for a new main depot, or out-stabling. This work will inform and be informed by the business case for Heaton Depot described above.
4. Identify the likely disposal proceeds of Gosforth Depot, were it to be sold.

### 4.3.10

The conclusions drawn in these workstreams will then be fed into detailed modelling of timetables, staff rostering, resilience issues, and the nature of any new fleet, with a view to making a final recommendation as to the preferred solution.
4.4 **Signalling and control**

4.4.1 This section discusses Signalling, or the means by which trains are controlled, both to avoid collisions and to ensure smooth and efficient operation.

4.4.2 Several ‘grades’ of signalling and control automation exist on light rail networks, which have been defined by the Union International des Transports Publics (UITP) as shown in the chart below. In order to avoid confusion, the terminology used in the UITP chart will be used throughout the Metro Strategy when referring to signalling and control. It should be noted that these categorisations are ‘in principle’, and do not specify any particular technology to deliver each grade of automation.

<table>
<thead>
<tr>
<th>Grade of Automation</th>
<th>Type of train operation</th>
<th>Setting train in motion</th>
<th>Stopping train</th>
<th>Door closure</th>
<th>Operation in event of Disruption</th>
</tr>
</thead>
<tbody>
<tr>
<td>GoA 0</td>
<td>Driver with no ATP</td>
<td>Driver</td>
<td>Driver</td>
<td>Driver</td>
<td>Driver</td>
</tr>
<tr>
<td>GoA 1</td>
<td>ATP with driver</td>
<td>Driver</td>
<td>Driver</td>
<td>Driver</td>
<td>Driver</td>
</tr>
<tr>
<td>GoA 2</td>
<td>ATP and ATO with driver</td>
<td>Automatic</td>
<td>Automatic</td>
<td>Driver</td>
<td>Driver</td>
</tr>
<tr>
<td>GoA 3</td>
<td>Driverless</td>
<td>Automatic</td>
<td>Automatic</td>
<td>Automatic</td>
<td>Train attendant</td>
</tr>
<tr>
<td>GoA 4</td>
<td>UTO</td>
<td>Automatic</td>
<td>Automatic</td>
<td>Automatic</td>
<td>Automatic</td>
</tr>
</tbody>
</table>

**Categories**

- **GoA 0**: Typically used in tram / on-street operation.
- **GoA 1**: ‘Traditional’ heavy-rail mode of operation.
- **GoA 2**: Operated on many London Underground lines. A driverless GoA3 system operates at the Docklands Light Railway.
- **GoA 4**: Metro networks exist in many countries outside the UK, but there are currently none in the UK, although GoA4 ‘people movers’ operating at some UK airports.

**Current Metro Operation**

4.4.4 Metro currently operates on a standard track-circuit-based fixed-block signalling system with 2- or 3-aspect lit signals, inherited from the former heavy rail network on which it is based.

4.4.5 Metro vehicle control is currently fully driver-operated (UITP: GoA1). Automatic Train Protection (ATP) is provided by an ‘INDUSI’ braking system which applies the emergency brakes if a signal is passed at red. This differs from the standard Network Rail TPWS/AWS system, and INDUSI trackside equipment was installed additionally to TPWS on the Sunderland extension, as the two systems do not interfere with each other.
4.4.6 A ‘Positive Train Identification’ system (PTI) controls the signals at Metro stations, and also the various switches and crossings around the network. Elsewhere the signals operate automatically using a standard fixed-block track-circuit operation.

4.4.7 There is currently a minimum headway of 3 minutes on the central corridor during peak times. It is understood that the current signalling system could permit a 2½ minute headway, but this would require a technical study to confirm.

**Infrastructure and Systems Replacement**

4.4.8 As at 2013, Asset Renewal Programme (Phase 2) funds are being used to:

- Replace the radio communications system with a “Tetra” system, with a 10-15 year lifespan.
- Replace the PTI system – again the new system’s lifespan will be 10-15 years.
- Fund an ongoing programme of testing and replacement of signalling cables where necessary, both along the track and within interlocking control boxes.

4.4.9 It is also anticipated that the INDUSI ATP system will need to be replaced in the mid-2020s, following a refurbishment in the mid-2000s.

4.4.10 It is clear that there is a ‘convergence’ of requirements for signalling and communications systems renewal and replacement in the mid-2020s, around the same time that a new fleet is hoped to enter service. This convergence offers the opportunity to consider a ‘quantum leap’ to a completely new signalling/control and communications system for Nexus Metro. There is the potential that this could lead to more capacity and more efficient operation, while also allowing a considerable reduction in lineside equipment and hence maintenance costs, as well as driver staffing costs. Any new fleet procured and in service by 2025 will be operational until around 2070, and while it is by no means impossible to retrofit vehicles as part of a complete change of signalling/control system, this will be far more cost-effective if done at the time of manufacture. It is also likely that any funders of a new fleet of trains in the Asset Renewal Programme Phase 3 will require evidence that alternative more cost-effective methods of operation have been examined.

4.4.11 Any significant change in this area would involve significant capital expenditure and culture change within Nexus, and should only be proposed if there is clear justification in terms of increased passenger demand, requirement for reduced operational costs, or both.

**Options for new signalling and control systems**

4.4.12 The key options for signalling and control are:

1. Renew the system broadly ‘like for like’, with the possible change from INDUSI to the Network-Rail standard TPWS for the Automatic Train Protection. TPWS could be fitted relatively easily to any new Metro vehicles at the time of manufacture in the 2020s, and also to Nexus tracks, and (as explained above) INDUSI will need renewal or replacement in the same timeframe in any case.

2. Move to a less complex signalling system, based on ‘line of sight driving’ (GoA0). This would allow the removal of much (though not all) trackside signalling and ATP equipment, and give
more control to drivers. This approach has been successfully implemented by Manchester Metrolink for both on-track and on-street operation. However, Nexus Metro vehicles would have to revert to standard heavy-rail protocols when operating on Network Rail lines.

3. Move to a more complex signalling system, namely Communications-Based Train Control (CBTC). In this system, trains are automatically controlled by a central computer to be always more than a safe stopping distance from the train in front. CBTC allows for the minimum train headways and greatest operational efficiencies to be achieved. It also allows for driverless (GoA3) or unattended trains (GoA4) to be implemented. Although CBTC systems are widespread on new Metro networks worldwide, and numerous older networks are undergoing conversion, nevertheless they involve considerable capital and maintenance costs and can normally only be justified if there is sufficient projected passenger growth.

**Driverless trains**

4.4.13 As stated in option 3 above, there may be an opportunity to move from driver-operated to GoA3 or GoA4 train operation on the Nexus-owned network; it would not be permitted for the foreseeable future on Network Rail lines. Both GoA3 and GoA4 would require installation of a CBTC system.

4.4.14 As on Docklands Light Railway, GoA3 operation would allow drivers to move back into the train and carry out a customer service / ticket checking / safety role as ‘train attendants’. This would not only reduce the cost of revenue control and improve customer service levels, but could help to alleviate one of the main issues of concern of Metro passengers, namely perceived personal security risks, thereby boosting ridership. When moving onto Network Rail lines, or potentially when transitioning to on-street operation, train attendants would move to the driver’s cab and take control of the train.

4.4.15 GoA4 would not provide the customer service benefits of the ‘train attendant’ role, but would lead to the maximum operational efficiency and cost reduction. GoA4 would, for example, allow for very flexible re-scheduling or additional scheduling of trains (for example on special event days, or in times of network disruption), at minimum cost, as no drivers would be involved.

4.4.16 Nevertheless, apart from the capital cost, there are several significant challenges in implementing GoA3/4 and a CBTC on the Nexus Metro network, in particular boundary security, level crossings and industrial relations. Early discussions would need to be undertaken with the Office of Rail Regulation.

**Further discussion**

4.4.17 For a further discussion of the options for signalling and control, and a comparison with Manchester Metrolink’s system, please see Appendix 6.

**Recommendations**

4.4.18 That more detailed research be undertaken into the passenger demand rationale(s) and potential benefits and disadvantages of a fundamental change to the Metro signalling and control system, compared to the retention of a broadly like-for-like system.

4.4.19 That Nexus continue its engagement with the COMET/NOVA working group of worldwide Metro networks which is currently examining CBTC and increased automation.
4.5 Energy Supply, Efficiency and Renewables

4.5.1 This section discusses issues around electricity supply, CO₂ emissions on the Metro network, and potential conversion of its electricity supply to a ‘greener’ form. For discussion of energy efficiency in new fleet vehicles and their OLE/propulsion systems, please see Section 4.2.

4.5.2 The amount of energy consumed and CO₂ emissions emitted by Metro per passenger-kilometre is consistently amongst the highest of its worldwide peer group23. This is a result of:

- the overall UK energy generation mix which is used to supply Metro’s electricity (which is heavily dependent on CO₂-emitting fossil fuels)
- lack of regenerative braking and general inefficiency of Metro’s 1970s vehicles
- relatively low service frequency
- relatively low passenger loadings on Metro outside peak hours

Metro performs better in statistics on its energy usage per train-kilometre, and is in the best-performing third in terms of overall energy efficiency (i.e. lowest losses) of its operations.

4.5.3 In the medium/long term, as a large consumer of electricity, Nexus faces a potential financial threat from electricity price rises. General electricity prices have been in a strong upward trend in recent years, and the possibility of future ‘price shocks’ cannot be ruled out, due to external supply restrictions or political developments, such as green taxes, political change in gas-supplying countries such as Russia, or simply the rising costs of extracting increasingly scarce fossil fuels. On the other hand, should the large ‘shale gas’ resources recently discovered in the UK eventually be commercialised, then in the medium term UK electricity prices may stabilise or even fall, albeit that gas is still a fossil fuel with associated CO₂ emissions.

4.5.4 COMET reported in 201224 that almost all member Metro networks worldwide expect electricity prices to increase substantially in the medium term, that London Underground expects a 45% increase, and that the UK’s Ofgem regulator is predicting a possible doubling of prices by 2025. The price per unit paid by Nexus has increased by 10% p.a. between 2010 and 2013.

4.5.5 Furthermore, Ofgem has predicted that UK spare generation capacity will decrease from 14% in 2012 to 2% in 2015, as older coal and nuclear power stations start being permanently closed25. While grid energy can be imported from France and Holland, it will probably be the case that larger industrial/commercial electricity users will be required to implement any demand reductions before domestic customers and critical facilities like hospitals. Nevertheless, widespread ‘brownouts’ seem unlikely; it is more likely that any supply constraints would simply lead to price spikes.

4.5.6 In summary, Nexus Metro faces three key issues with regards to future electricity supply:

- Its large annual expenditure on electricity, which represents well over 10% of total organisational expenditure and is critical to its operation.
- Potentially volatile/unpredictable prices, with the risk of significant increases and supply constraints.

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23 CoMET/NOVA report “CO2 Competitiveness” 2009, and later updates
24 CoMET “Energy Saving Strategies” 2012
• Political/reputational risk from continuing to use the existing UK generation mix, which is predominantly fossil-fuelled, leading to high CO₂ emissions – while other large organisations are increasingly moving towards green energy sourcing, and competing modes of transport are also reducing their CO₂ emissions per passenger-km (more efficient/electric cars etc.).

4.5.7 How Nexus sources and uses energy for operating Metro will be important in terms of containing costs, demonstrating Metro’s environmental sustainability, and attracting future public sector funding. There is an opportunity for Metro to become a national light rail exemplar in sustainable energy use and energy efficiency across all aspects of its operations.

Existing initiatives (demand side)

4.5.8 Nexus has already undertaken or is planning a number of initiatives to reduce energy consumption on Metro. These include:

• Permanent turning off of large ventilation fans in the city centre tunnels, after a study found that this could be done safely.
• Refurbishment and replacement of station escalators, which consume a considerable amount of energy, with models that are much more efficient.
• The installation by our operating partner DBTW of the ‘FASSI’ system in driver cabs, which promotes energy-efficient driving.
• An ongoing programme of replacement of lighting on the network with more efficient lamps.
• Renewal of the Depot transformer (upcoming in July 2014) to reduce energy losses.
• Increase in the level of energy monitoring/metering, to identify issues and opportunities.

4.5.9 It should also be noted that Nexus’ Metro operating concessionaire DBTW has been contractually incentivised to reduce energy consumption.

Opportunities (demand side)

4.5.10 Discussion of braking energy recovery has taken place in Section 4.2. Furthermore, a new modern fleet should inherently be more energy efficient than the existing fleet in all aspects of operation.

4.5.11 Potential ‘network level’ opportunities to reduce energy consumption include:

• Upgrading and refurbishing the Gosforth Depot’s buildings and systems to considerably reduce energy losses and improve efficiency; for example installing a Combined Heat and Power (CHP) unit.
• Running single-car trains off-peak.
• Further reducing losses in the OLE and substations.

Opportunities (supply side)

4.5.12 Apart from the potential for CHP mentioned above, many worldwide Metro networks have in recent years also sought to generate their own energy from renewable sources. In particular, land and building assets can be exploited for the installation of wind or solar power units.

4.5.13 As examples, Transport for Greater Manchester has recently installed an 11kW wind turbine at a train station, and has also installed a similar-sized hydroelectric turbine to power a bus interchange.
from a river which runs alongside it. Merseytravel has installed a 50kW solar array on their headquarters building. On a more substantial scale, Dijon Metro has installed a 1.5MW solar array on the roofs of their depot buildings as part of a refurbishment project, and claim that its annual energy production exceeds that used by the depot.

4.5.14 A similar opportunity to Dijon’s could exist for Nexus’ Gosforth Depot, whose roof is potentially in need of replacement – though it should be noted that solar energy recovery rates in northern England will be substantially less than in central France. Elsewhere, Metro could investigate the installation of other small-scale renewable generators, particularly if assisted by government grants which would improve their economics.

4.5.15 However, a programme of renewables installations such as those described above are unlikely to generate more than 10%-15% of the energy used by Metro as a whole. Further increases in renewable energy supply would have to come by contracting with an external energy supplier to supply the required amount of renewable energy. Possible options in this regard include:

- Contracting with a supplier for a ‘green tariff’. However, this type of tariff does not require installation of new renewable generation, and these tariffs lack environmental credibility.
- Contracting with a supplier of dedicated renewable energy (probably wind power, or possibly one of the two biomass power stations under construction in the North East) to purchase energy from them on a long-term basis, equivalent to Nexus’ full demand. In the case of wind power, the supplier would probably proceed to install new turbines equivalent to Nexus’ demand level. A long-term contract such as this may offer valuable protection from shortages and unpredictability in energy prices (rather than being at the mercy of the markets), while also being able to credibly claim that Nexus were a ‘100% green energy transport network’, and supporting North East industry.

**Recommendations**

4.5.16 It is recommended that:

- Work continue on an ongoing basis to identify and implement cost-effective energy-saving opportunities on Metro
- More work be carried out on the opportunities for renewable energy generation or contracting
- Given its long-term criticality to Metro operation, a formal Energy Strategy be established

Above: Dijon’s newly refurbished (2012) bus/tram depot comprises a 1.5MW solar panel roof installation
Section 5: CUSTOMER EXPERIENCE

5.1 Methodology

5.1.1 Maintaining and expanding the Metro’s customer base is essential to the network’s future. Without a stable and increasing number of passengers, the commercial rationale for service improvements and network extensions is weakened. Metro has built up a strong brand and reputation with its customers over the last 35 years; the challenge is to build on this by enhancing the range and quality of facilities offered. This section explains how customer service requirements will be identified and implemented over the lifetime of the strategy in order to help continually grow the market. They will then inform the future strategy. Required improvements will be identified from the outcomes of customer research, including current non-users, and best practice elsewhere.

5.1.2 It aims to establish a blueprint for all customer-facing elements to ensure Metro offers a consistent and high quality product across the current network and any potential network extensions. This section examines in particular the topics of customer requirements, fares and ticketing, information provision, station facilities, and Park and Ride.

5.1.3 The overall ‘on-train’ passenger experience is covered in greater detail in Section 3, in the context of the optimum train specification required to inform the rolling stock replacement process.

5.1.4 Establishing and maintaining customer loyalty is essential:

“With rising competition, keeping them satisfied may not be enough; organisations should rather work towards maximising customers’ satisfaction as literature proves that only the “very satisfied” customers will be loyal”26

5.1.5 Although all aspects of customer service are important, some factors are consistently rated more highly than others over a period of time. Comparison of the relative importance of customer service attributes between 2009 and 2012 cited by Metro users revealed the top ten were as follows:

(i) Reliability
(ii) Punctuality
(iii) Station cleanliness
(iv) Value for money
(v) Train cleanliness
(vi) Station condition
(vii) Staff availability
(viii) Passenger behaviour
(ix) Train running information

26 Understanding Customer Relationships. Ipsos MORI 2008
5.2 Service Requirements

5.2.1 Customers will always express a preference for service improvements that offer more frequent Metro services or over a longer period of each day than are currently operated. Some customer aspirations, such as 24-hour operation, may not be practicable given the need for network maintenance or justified by demand. Others, such as earlier trains to Airport or increases in service frequencies over certain routes or at particular times of day may potentially be justified, and should then be considered on their merits.

Constraints

5.2.2 The following constraints are assumed as fixed at this time for the purposes of future service patterns and frequencies. These could be altered or removed in future if justified by customer demand or operational changes, but are assumed to be present as part of the base case scenario. Signalling options in particular can be varied substantially to meet future requirements, and platform lengths could also be altered although the feasibility of this could vary with location. Subject to these caveats, the assumed base-case constraints are:

- Maximum signalling capacity in the central corridor of 24 trains per hour in each direction
- Existing platform lengths are retained, capable of accommodating train lengths of up to 60m

5.2.3 Taking the existing fleet as a benchmark, the above constraints suggest a maximum of 1632 seats and a theoretical total capacity of 7200 passengers per hour (crush loading) in each direction through the South Gosforth to Pelaw corridors. In practice the maximum hourly capacity will be lower as services operating full and standing would be unlikely to utilise the maximum theoretical line capacity offered by the existing signalling system due to extended station dwell times. Automated signalling technology offers the potential for higher frequencies; the most frequent UK service is now the 33 trains per hour service operated at peak times on the London Underground Victoria line which equates to a train every 1 minute 50 seconds on average. The previous maximum hourly frequency on the Victoria Line was 27 trains per hour. It is unlikely that customer requirements would dictate this frequency on Metro for the foreseeable future.

5.2.4 Fewer constraints would exist on street-running sections of the network where, within reason, services could operate at whatever frequency is required by demand and the limits of line-of-sight operating practices. In practice most other UK light rail networks operate at lower frequencies as shown below, these relate to individual corridors. Over the central sections of the Manchester, Sheffield, Docklands, Tramlink and Tyne and Wear networks, routes combine to at least double the frequencies shown below.
<table>
<thead>
<tr>
<th>Network</th>
<th>Daytime frequency per hour</th>
<th>Evening frequency per hour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glasgow Subway</td>
<td>15</td>
<td>7.5</td>
</tr>
<tr>
<td>Manchester Metrolink</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Sheffield Supertram</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>West Midlands Metro</td>
<td>7.5</td>
<td>4</td>
</tr>
<tr>
<td>Nottingham Tram</td>
<td>10</td>
<td>6</td>
</tr>
<tr>
<td>Docklands Light Railway</td>
<td>6 to 12</td>
<td>6</td>
</tr>
<tr>
<td>London Tramlink</td>
<td>4 to 8</td>
<td>4</td>
</tr>
<tr>
<td>Tyne and Wear Metro</td>
<td>5</td>
<td>4</td>
</tr>
</tbody>
</table>

5.2.5 The analysis above shows a wide variation in frequencies along light rail corridors and a broad average across these networks of eight services per hour daytime and five services per hour during evenings. The recommendation at this stage is therefore that the existing network and any connected network extensions should continue to operate at least as frequently as at present, and that self-contained network extensions should operate according to levels of forecast and observed customer demand.

Above: Metro’s older and younger customer segments are forecast to increase considerably by 2030
5.3 Rolling stock requirements

5.3.1 The chart above shows the current distribution of trips grouped into distance bands. The mean distance travelled on Metro is 8.2kms. The median distance is 5.8 km; based on an average 36km/h, this results in a median on-board time of slightly under 10 minutes (in addition to a median platform wait time of approx. 4-5 minutes).

5.3.2 This highlights the key function of the existing network as a mover of large volumes of people over relatively short distances. This suggests the need for easy access vehicles with swift acceleration and plenty of non-seating space for passengers’ luggage, buggies and wheelchairs. Were all of the network to share these characteristics, then the customer requirement for vehicle specification would be straightforward; something along the lines of the Docklands model with a large proportion of doors to body length, wide vestibules and a comparatively low number of mainly sideways-facing seats. However the variety of journey patterns on Metro makes for a more complex set of requirements. Although most journey lengths are short there are significant longer-distance flows along such corridors those linking The Coast, South Shields, Sunderland city centre and Airport to central Newcastle and Gateshead. Passengers on these flows pay higher than average fares and have the expectation of a seat for most if not all of their journey. In addition, over a fifth of Metro passengers are classified as older and/or disabled persons, and they too have requirements for seats wherever possible.

5.3.3 This suggests that the detailed specification of the next fleet of trains will require careful consideration of the optimum ratio of seating to standing, with scope for the introduction of improved interior layouts to allow easier internal circulation and offer the flexibility of greater capacity for non-passenger items, all within the constraints of fixed loading gauge dimensions and
the desire to purchase standard vehicles if at all possible to reduce purchase costs. Higher frequencies can increase seating availability per hour but at a higher cost, but this should be considered where justified by demand. Most new light rail vehicles have a slightly lower ratio of seating to overall capacity than existing Metro trains, and whilst there is always scope to adapt to customers’ specific requirements, in practice this can increase costs and in any event scope to achieve this is often compromised by the fixed locations of under-floor equipment.

5.3.4 Competitive journey times can also serve to increase levels of customer demand. As discussed in section 4, Metro’s current maximum operating speed of 80 km/h and rapid acceleration capability result in end-to-end times along most corridors that are faster than travel by bus and often competitive with car when parking times are taken into account on city centre trips. Most new rolling stock can now offer faster top speed, but this may come at the cost of increased energy consumption, and short distances between stations may sometimes mean that this capability cannot be exploited. Were higher network speeds to be considered, more detailed business case analysis would be required to judge whether the additional cost would be recouped by additional fares income attributable to faster journey times, or greater passenger throughput. Customers may express a wish for faster journeys, but along most corridors Metro is already time-competitive with all other modes, particularly city centre to city centre and at peak travelling times. One corridor where higher speeds could potentially be a catalyst for growth in customer demand is the Sunderland/South Hylton corridor, where both station spacing and the signalling configuration appear suitable for higher-speed Metro operations (heavy rail passenger services now operate at up to 70 mph/113 km/h). The same applies to any further extension on Network Rail infrastructure.
5.4 Fares and Ticketing

5.4.1 Public transport users want a simple and affordable range of tickets that makes travelling round Tyne and Wear easy, and helps to make public transport a practical choice. Ticketing should provide a simple range of affordable tickets that are widely available to buy both on and off Metro, and can be used for integrated journeys on Metro and other forms of public transport, maximising the benefits of smart ticketing technology.

Current situation

5.4.2 Metro has a comprehensive range of tickets for travel on the network, and although steps have been taken over recent years to simplify these and the introduction of smart ticketing will further help in this regard. However, the choice of tickets may still be seen as confusing. The structure of Metro ticketing differs from other forms of public transport, for example bus operators each have their own range of tickets and the structure of zones varies significantly. In addition to operator and mode specific tickets, Network Ticketing offers a range of multi-modal tickets, priced at a premium to those of single operators and operating on a further set of zones.

5.4.3 The impact of this is that there are numerous ticketing options that could apply to various journeys, with dozens of different ticket types available. The over-arching picture is currently one of complexity and potential confusion that will be swept away by the full implementation of smart ticketing, where the customer interface will be simple and intuitive.

Proposed future ticketing structure

5.4.4 Product simplification will focus upon single tickets, day tickets, monthly and annual tickets with Metro-only and multi-mode options. Depending on the outcome of changes to the way bus services are delivered across Tyne and Wear, there may be opportunities to align bus and Metro fares zones so that they are common to all public transport modes. Proposals currently under consideration include a network of franchised bus service operations under a Quality Contracts Scheme, or an alternative Voluntary Partnership Agreement proposed by bus companies. A Quality Contracts Scheme could make fares and multi-modal product availability simpler through the introduction of one set of fares zones and greater product harmonisation, whilst a partnership framework could make this more difficult to achieve.

Under-21 fares

5.4.5 Proposals will also seek to improve the affordability and flexibility of Metro travel for customers under the age of 21. As the school leaving age increases and the size of the population cohort in further and higher education also rises, then the need to cater to this market, Metro’s passengers of the future, will become more urgent. A range of student fares will be offered, available on a zonal basis; to qualify customers will need to demonstrate eligibility via a recognised educational establishment.

27 Network Ticketing Limited is a federation of public transport operators offering multi-modal ticketing products. Nexus as Metro and Ferry owner holds a 37% share in the company.
Other products

5.4.6 In addition to these changes other future product plans include extension to the Gold Card concessionary product to permit all day travel on Metro at an appropriate annual cost, and the expansion of corporate and bespoke products.

Fare reviews

5.4.7 Fares will be reviewed on an annual basis to reflect market conditions, customer affordability and operational costs. If the Metro network is extended to new corridors then it is proposed that the zonal fare structure will also apply to these new services.

Smart Ticketing

5.4.8 Smart ticketing will make it easier to apply innovative solutions to meet customers’ requirements, such as a daily price cap where the cost of a customer’s daily travel will not exceed the price of the relevant day ticket for the trips they have undertaken.

Above: smart ticketing and gating of key stations have given passengers more choice, while reducing fraud
5.5 **Information Provision**

5.5.1 Provision of information and the technology which delivers it is a rapidly evolving environment; predicting what will be available in five years, let alone in 10-15 years, is an inexact science. However what is clear is that access to accurate and relevant information is important to our customers, whether it refers to their daily journey, to short or long term disruption, or comment, complaints and feedback mechanisms.

5.5.2 Growth in availability of smart phones means more and more people are regularly accessing information on the move, and expect to be able to quickly and easily access live updates and personalised information. Research by UKGov suggests that 60% of people already have access to a smartphone. As this technology becomes more accessible and sophisticated, the focus for information provision on Metro will evolve, with more emphasis on personalised, integrated, real time information delivered direct to the individual.

**Current Situation**

5.5.3 Nexus has worked to adopt new technology and improve on information provision in recent years. [www.nexus.org.uk](http://www.nexus.org.uk) now exceeds 3m hits per year, and hits on the mobile site, accessed through a smart phone now exceed hits to the website, demonstrating clear trends in how people wish to access their information. The range of tools and types of information which can be accessed in this way is also growing from static information to interactive journey planning. Metro is also now interacting with its customers on Facebook and Twitter, giving customers a new source of information and another forum for complaints, comments and conversation, with users able to have conversations not only with Metro, but also with each other about the service. In 2013 Metro had over 14,000 ‘likes’ on its Facebook page and over 16,000 followers on Twitter. Metro also has a subscriber email service which allows users to receive email alerts about disruption on specific sections of the network and time periods relevant to their journey.

5.5.4 Information provision will cover three elements, journey planning, reassurance, and general information which add value to the product.

5.5.5 One of the key complaints of customers across all aspects of public transport is the provision of information in times of disruption. The provision of information is key to satisfaction with the service when there is a delay, whether planned or otherwise. Passenger Focus found that “information greatly influences the impact that delays and disruption have on passengers, empowering them to make practical decisions about their journey and reduce stress”\(^\text{28}\), a finding relevant to all forms of public transport. Passengers want to know:

- About any disruption that will be or is occurring
- What the change is
- Scale of the disruption
- Alternatives
- Impact on journey time, even if it is an estimate
- Anticipated duration of the problem.

\(^{28}\) Passenger Focus; Bus passengers experience of delay and disruption, Jan 2013
5.5.6 Metro currently provides this information via social media in addition to visual and audio announcements made at stations for the benefit of intending passengers. Passenger Focus found that preferred channels for information were electronic real time information and on board electronic announcements. Internet and social media communications was recognised as a useful source, but must complement other channels and not replace them.

5.5.7 Passenger Focus found that passengers felt local rail services were better at information provision in times of disruption than bus, although the conclusions highlighted above are still relevant to Metro services. It was important to passengers that live updates were provided throughout the operational hours of the services, not just during office hours.\(^2^9\) Satisfaction with information provision on Metro grew from 83% in 2008/09 to 89%, in 2012/13. 

What we will do

Journey Planning

5.5.8 Information provision should enable individual journey planning providing integrated travel information for all modes, aiming to minimise waiting times and interchange penalties. Although this strategy relates to future developments on Metro, it is critical that information provision considers public transport as an integrated network and that journey information links closely to ticketing information to give full information about and reassurance during the journey. Journey planning should also be developed to allow planning to a journey destination; for example an attraction, rather than a transport interchange to allow full door-to-door service planning and allow for added value on destinations and possible revenue streams from advertising to be explored.

5.5.9 Nexus will continue to develop applications for smart phones and other portable devices, allowing individuals to undertake individual/personalised journey planning across Metro and other modes.

5.5.10 A proportion of public transport users will always be unwilling or unable to access information in this way, therefore it will be important to continue to provide accessible formats for information throughout the public transport network. This includes face-to-face information through customer service staff, who are able to provide information to travelling customers, but also advice and reassurance. Staff presence on the Metro network is highly valued by customers, not only for provision of information but also in terms of perceptions of safety and security. Additionally in times of disruption, reliance on apps or similar channels might not always be the best way of communicating with customers. Passenger Focus found that whilst passengers were positive about apps which provided this information, they felt they would need an alert to prompt them to look at this section of the app in the first place.\(^3^0\) Nexus will continue to maximise staff presence on the Metro network, particularly during evenings, and incentivise them to provide high quality customer service and information provision, within available budgets.

5.5.11 For those customers willing to access information via new technology but are unable to through their own devices, provision of interactive information points allows for large amounts of personalised information to be provided in real time and without requiring significant amounts of space. Touch screen information points have been provided on a number of transport networks,

\(^2^9\) Passenger Focus; Bus passengers experience of delay and disruption, Jan 2013  
\(^3^0\) Passenger Focus; Bus passengers experience of delay and disruption, Jan 2013
such as at St Pancras International and by First Transpennine in the UK as the technology becomes more robust. Interactive information has some significant advantages in that it is quick and easy to update, with no ‘waste’ when information is changed and large volumes of information able to be accessed through one small device.

5.5.12 Nexus will implement technologies at major Metro interchanges to allow passengers to access live real time information, journey planning and self-serve facilities.

**Reassurance**

5.5.13 Provision of information is important to provide reassurance to travellers, both during times of disruption and also generally to help improve perceptions of safety and security. Real time information can play a big part in this, giving people reassurance of when the next train is due and also, if provided remotely, allows them to actively plan their journey to minimise waiting times at stations. Increased process automation based on GPS positioning technology will make this more relevant and reliable in future.

5.5.14 Information should also be accessible throughout the full operational hours of Metro and this is particularly important in times of disruption. Therefore Metro will continue to monitor, manage and update real time sources of information via streams such as Facebook, Twitter and yet to be invented outlets throughout the full operational hours of Metro.

5.5.15 Information sources need to be flexible enough to take into consideration periods of planned and unplanned disruption and provide real time information on alternative ways of completing the journey, so passengers can make informed choices. This can be achieved in a variety of ways including staff being present at stations during planned disruption to advise and direct passengers, through to an ability to update online journey planning tools to take disruption into account. The key to successfully achieving this is monitoring satisfaction with information provision during disruption.

5.5.16 Nexus will establish a programme of monitoring satisfaction with information during planned and unplanned disruptions, and develop technological and staffing solutions to improve satisfaction.

**Adding Value**

5.5.17 Digital media and information can give significant opportunities to add value to transport information provided to the travelling public, but also to generate revenue to support investment in Metro. As journey planning develops, such systems should offer genuine multi-modal door-to-door journey planning. This allows the opportunity to also provide destination information to the users and doing this is likely to create revenue generation opportunities through advertising of attractions.

5.5.18 Additional forms of advertising revenue will also be investigated, ensuring a balance between generating additional revenue to support investment in other areas of Metro, whilst not detracting from the purpose of the message – providing accurate public transport information.

5.5.19 Opportunities to ‘push’ information to users, subject to opt-in by passengers, should be investigated, through blue tooth-enabling stations and Wi-Fi on train and at stations.

5.5.20 Nexus will investigate ways of generating revenue through the provision of information channels and use this income to invest in improving customer services on Metro.
5.6 Station Facilities

Current situation

5.6.1 Metro in 2013 has 60 stations, a combination of halt stations, larger interchanges, and substantial city centre stations. These are a mix of ages, styles and designs, depending on when they were built but as part of Metro Reinvigoration Phase 2 significant work was undertaken to ensure that the stations met accessibility requirements, through installation of items such as tactile surfaces and dual hand railing. Additionally all stations have been rebranded with new furniture and where necessary updates to CCTV and public address systems. All stations are also equipped with help points, passenger information systems and ticket machines, which accept payment by card, cash and pay wave as well as top-up facilities for smartcards. 13 of the busiest stations now have gate-lines installed, additional CCTV has been installed at these stations as part of this project. Validators are installed at stations which are not gated.

5.6.2 In addition improvements have been made to signage and onward travel information at the stations and where possible improvements to signage and access around the station have been made in conjunction with local authority partners.

5.6.3 Nexus was successful in achieving funding through the Local Sustainable Travel Fund to install cycle parking at all Metro stations during 2013-14. This included cycle pod storage at all stations with more secure solutions at the busiest, interchange stations including lockers, and hub buildings at University and Heworth.

5.6.4 Significant improvements have been made to lighting at the stations, helping not only to improve the appearance of the station, but also improving safety and security by eliminating dark areas.

5.6.5 Improvements have also been made through schemes such as the Better Bus Fund which enabled investment at Heworth in 2012 to improve the bus facilities and therefore improving the attractiveness of interchange between bus and Metro at this point.

5.6.6 Generally market research suggests that customers are reasonably happy with stations:
5.6.7 Issues most commonly raised relate to provision of toilet facilities and availability of staff, particularly in the evenings. The installation of gate-lines at the 13 busiest stations increases the staffing presence at these stations at key times and also allows for staff previously involved in revenue protection duties at these stations to take a more ‘roaming’ role around the wider network. Arising from this, the aim is that satisfaction with staffing on the network and safety and security will improve from 2014 onwards. It is not currently proposed to staff the full network throughout the full hours of operation as the cost of this would be prohibitive and not provide value for public money. Additionally it is not proposed to fully gate the remaining stations on the network, as again the cost of doing this would not provide an adequate payback against the revenue that this would save through reducing fraudulent travel. It is however proposed that this would be kept under review, and further stations may be gated should a business case and funding stream become available in future years.

What we will do

5.6.8 Nexus is committed to continually improve stations to ensure that passengers perceive stations as safe and welcoming places to wait and encourage use of Metro at all times of day.

5.6.9 A study will be undertaken to assess the possibility of remote monitoring of gate-lines at quieter halt stations to reduce the revenue implications of gating, which could improve the business case at some sites. However the safety case for this would need to be proven. A prioritised list of stations where gating is considered viable will be developed, and from this business cases for gate-lines at individual or groups of stations would be drawn up. It is not anticipated thought that the network will ever be 100% gated. A trial involving the use of roaming staff during evenings is currently under way and the findings will be used to keep network staffing levels under review.

5.6.10 Toilets will not generally be provided at stations due to the on-going costs of maintenance and the potential for anti-social behaviour, impacting on the perceptions of safety and security at the station. Onward travel information at stations will highlight locations of locally available public toilets.

Existing stations

5.6.11 A template for Metro stations has now been established through Metro reinvigoration Phase 2 and further improvements on this specification can be made as and when funding becomes available. The priorities for additional improvements include:

5.6.12 Additional measures to improve safety and security:

- CCTV coverage of help points
- CCTV repeater screens

5.6.13 Integration with bus:

- Improvements to bus waiting facilities at stations, where practical
- Further developments of wayfinding information to bus services from stations
- Further information on station and through online and mobile applications
5.6.14 Accessibility

- Although all stations are provided with step free access, further improvements to accessibility above and beyond the required standards will be made where funding is available and site constraints permit.
- Minor accessibility improvements to stations on the Sunderland extension.

5.6.15 Information

- Real time information will be provided at all stations and at major interchange points passengers will be able to access information terminals to access public transport information.
- Work with the market will be undertaken to provide Wi-Fi on all stations and trains to facilitate access to public transport updates via smart devices. Social media and web sources are an important and growing source of information for customers, particularly in times of disruption.

5.6.16 Integration with cycling

- Work will progress with local authority partners to improve cycling access to Metro stations where possible, further funding will be sought for this.
- Once the 3/4-life refurbishment of the existing fleet is completed, it is proposed that a pilot commences of carriage of full size cycles on Metro.
- Potential carriage of cycles on the new fleet is considered elsewhere in this strategy.

5.6.17 Station condition and cleanliness

- This is currently managed through the performance regime as part of the Concession Agreement with the operator, with standards set by Nexus.

5.6.18 Additional infrastructure works required

- Rewiring of all existing stations and replacement of CCTV, Radio and help point electronics
- List and escalator replacement programme recommences from 2024 until 2037.

5.6.19 Businesses cases will be developed for all these elements to feed into future funding opportunities.

New stations

5.6.20 It is anticipated that new stations on any on-street network extensions will be based on a tram-stop design and are likely to be more like large covered bus stops than the stations that exist on Metro today. This reflects the likelihood of street-based locations having a more constrained footprint; this standard of provision that has been successfully employed on other UK on-street light rail networks. Stations will be designed with bus interchange facilities appropriate to specific locations. New stations on the existing network will be designed to latest standards complementary to recent additions.

5.6.21 New stations, either on the existing Metro network or extensions, will be designed to facilitate clear and simple integration between Metro and other forms of transport, including bus, cycling and
walking. Parking spaces will be provided where space permits, but this should not be at the expense of high quality bus facilities. Stations will be constructed to standards outlined in the DfT publication “Accessible Train Station Design for Disabled People: A Code of Practice Version 03 – Valid from 1st November 2011.” (as may be amended over time) and will have the highest regard to ensure full accessibility and be fully compliant with and where possible exceeding relevant current legislation.

5.6.22 New stations will provide high-quality covered waiting facilities for bus - if appropriate - and Metro with, where possible, level access between the two modes; through providing raised kerbs at bus stands.

5.6.23 All new stations will have cycle parking provision, in line with Nexus policy, with Streetpod facilities at smaller, halt stations and more secure provision at larger stations with higher footfall, and major interchange points.

5.6.24 Signage to safe cycling and walking routes will be clear from the station and within the design phase Nexus will work with the local authorities to investigate opportunities to improve safe walking and cycling routes surrounding stations.

5.6.25 Specific high quality and large scale Park and Ride facilities will be considered at specific points on the network, linked to congestion hot spots and areas where there are large residential areas that would be within the Park and Ride catchment. This is addressed in more detail in section 5.7 below.
5.7 Park and Ride

5.7.1 Large well-planned major interventions, such as new light rail lines and networks, can create significant new economic opportunities, as can complementary smaller schemes like Park and Ride facilities.31

5.7.2 Light rail schemes can often offer a step change in quality, offering journey time reliability that encourages modal shift from car, and Park and Ride facilities are seen as attractive by car users32. Manchester Metrolink, despite replacing a well-used rail service, saw up to a 21% shift from car use with associated Park and Ride on its new routes33, with similar figures for Sheffield Supertram. Park and Ride is considered to be a key factor in the success of the Nottingham project34. To operate efficiently, Park and Ride facilities must be provided at appropriate locations on light rail networks to provide quick and comfortable journeys.35

Current situation

5.7.3 Park and Ride sites can significantly increase the catchment area of a Metro station beyond the 800m walking distance typically associated with Metro; Nexus research carried out in 2012 showed that half of people currently using a Metro Park and Ride site would have used their car for the whole journey, had the site not been available.36 Overall 4% of Metro users arrive at the station by car. The average journey to and from the Park and Ride sites where Nexus surveys have taken place is 11.4km.

5.7.4 38% of Metro Park and Ride users are commuters, particularly into Newcastle city centre where higher parking charges and congestion make Metro a more attractive journey than driving37; this is however a lower rate than that seen elsewhere; for example Merseytravel found that 73% of their Park and Ride users were commuters, with little change in occupancy of car parks after the morning peak38. For Metro, peak occupancy is currently between 1000 and 1400 vehicles. This may be because of the relative permeability of city centre areas for peak-hour driving and parking compared to some other urban centres.

5.7.5 Occupancy at Metro Park and Ride sites varies, with some car parks such as at East Boldon regularly over capacity, whilst others are underutilised. In addition there is a variety of approaches to parking at different stations: some are formal sites, owned and controlled by Nexus, where parking charges apply, whereas others are less formal sites and a small number of sites are owned by other parties such as local authorities.

5.7.6 The chart below show occupancy levels at Nexus-charged car parks in 2011-12 and 2012-13.

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31 Transport Works, the case for investing in the city regions, pteg
32 What can light rail do for cities, a review of the evidence, SDG for pteg February 2005
33 ibid
34 ibid
35 ibid
36 Nexus, Park and Ride Market Research August 2012
37 ibid
38 Merseytravel Park and Ride Market Research 2007
5.7.7 Car parks were charged at £1.60 from 2011 until August 2012, offered free parking from August to November 2012, and at £1 from then onwards.

5.7.8 Research was undertaken at Heworth and Four Lane Ends long-stay car parks in 2012 to determine user profiles at these stations. The table below shows journey purpose and Metro use at each site.

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Heworth</th>
<th>Four Lane Ends</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purpose: Work</td>
<td>25%</td>
<td>38%</td>
</tr>
<tr>
<td>Purpose: Shopping</td>
<td>18%</td>
<td>3%</td>
</tr>
<tr>
<td>Also use Metro</td>
<td>48%</td>
<td>13%</td>
</tr>
<tr>
<td>Regular use</td>
<td>35%</td>
<td>35%</td>
</tr>
</tbody>
</table>

5.7.9 Heworth was used in the traditional Park and Ride sense with almost all users subsequently using Metro while Four Lane Ends users, in contrast, were unlikely to be using Metro due to the facility being used as overflow staff parking for drivers working at a major local employer. While both sites have the same overall level of regular usage, defined as more than once per week, Four Lane Ends had a higher level of those using it daily. Analysis of user origin shows that Heworth has a much larger catchment area with a number of regular users as far away as Middlesbrough – 34 miles away. Four Lane Ends however saw its furthest regular user living only 15 miles away. The map below shows a selection of user home locations.
5.7.10 Ticketing and pricing of Park and Ride facilities is also an important consideration. The price must be attractive enough to encourage commuters to break their journey and not drive into the urban areas, whilst helping to support the costs of providing the facilities. Both users and non-users stated in research that the need to pay twice, once for parking and then again for Metro was inconvenient and there was a strong feeling that the cost of parking should be integrated into a one-ticket price\textsuperscript{39}. Over half of monthly and annual pass holders were interested in a reduced price ticket when renewing their pass.\textsuperscript{40}

5.7.11 Additional sites adjacent to the A1 and A19 truck roads were most sought after by survey respondents. This suggests the potential for Park and Ride facilities to form a major component of future business cases for the following Metro extension corridors:

\textsuperscript{39} Future of Metro, Woodholmes, January 2012
\textsuperscript{40} Nexus Park and Ride Market Research August 2012
<table>
<thead>
<tr>
<th>Corridor</th>
<th>Park and Ride site</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sunderland to Seaham</td>
<td>Ryhope</td>
</tr>
<tr>
<td>South Shields to Doxford International</td>
<td>Doxford Park; Fulwell Quarry</td>
</tr>
<tr>
<td>South Hylton-Washington-Pelaw</td>
<td>Washington; Follingsby</td>
</tr>
<tr>
<td>West Newcastle</td>
<td>A69/A1 junction vicinity</td>
</tr>
<tr>
<td>Team Valley to Gateshead</td>
<td>Tyne Yard Lamesley; Team Valley</td>
</tr>
<tr>
<td>Metrocentre to Gateshead</td>
<td>Metrocentre (by agreement)</td>
</tr>
<tr>
<td>Howdon to Northumberland Park</td>
<td>Northumberland Park; Cobalt</td>
</tr>
</tbody>
</table>

5.7.12 Currently there is a mixed offering in respect of Park and Ride at Metro stations, with different ownerships, charging regimes and quality of facilities offered. It is proposed that in the future there will be greater consistency of offering at all sites, with enhanced levels of safety and security to enable blanket achievement of Parkmark safety accreditation or similar. All sites will be equipped with correctly marked, adequately provisioned disabled parking, drop-off points, electric vehicle charge points and cycle parking.

5.7.13 New facilities will be developed along new corridors, aligned to relieving pockets of congestion on the highway network. These will be high quality facilities, which as well as allowing Park and Ride, will provide bus facilities where possible to assist with integration between modes. This should include off-highway facilities, covered waiting areas and options for off-bus ticketing and located conveniently for the entrance to the Metro station.

5.7.14 Working with local authorities and where site conditions allow, Nexus will look to expand existing sites or offer alternative sites where capacity is limited. We will also work with local authorities on local travel planning and development of safe walking and cycling routes at stations to encourage travel to stations by means other than car, where parking capacity is constrained or unavailable.
5.8 Conclusions and Recommendations

5.8.1 Customer requirements are central to all aspects of this strategy. An organisation which alienates its customers, or which fails to respond to changing needs over time will lose ground and offer only a distress purchase rather than a product of choice. Keeping in close touch with Metro customers, understanding their travel requirements and preferences and continually reshaping the product offer at all levels, incremental and fundamental, will be essential if the network is to continue to thrive in a competitive market-place. Renewals, such as the ongoing phase of Metro re-invigoration including refurbished trains and stations, are positive in this regard; new trains and stations will have an even more powerful impact on passengers’ perceptions. But not all improvements for customers need be expensive. Responsiveness, flexibility and attention to detail are all essential attributes for maintaining and enhancing customer loyalty. Establishing contact with non-users and understanding their needs will also be important, as a proportion of mode shift will be essential if the demanding network patronage targets outlined earlier are to be achieved.

5.8.2 High-level recommendations for customer requirements can be summarised as follows:

- Develop and maintain close contact with Metro users and non-users to establish a deep understanding of customer preferences.
- Incorporate customer requirements into the design of new rolling stock as far as practicable.
- Ensure that Metro fares and ticketing products are simple to understand and relate to users’ needs.
- Continue to provide accurate and timely proactive and reactive service information in formats that customers want, taking account of wider accessibility needs.
- Design new and refurbished stations that are modern, safe and welcoming.
- Promote Park and Ride facilities where feasible and justified by demand.

Above: ‘Streetpod’ cycle parking of an innovative secure design is being installed at every Metro station
Section 6: FUTURE OPERATING STRUCTURES

6.1 Context

6.1.1 A key element of the strategy is to assess a range of options for the way in which Metro is operated in future, and to identify a preferred option for the future operational framework of Metro covering the existing network and any network extensions. This section summarises the types of arrangements that are in place at other UK light rail networks, and outlines a range of options potentially available to Nexus, focusing on the various mechanisms that could deliver infrastructure and fleet procurement and maintenance capabilities.

6.1.2 At present Nexus maintains ownership of all Metro assets. The maintenance and renewal of tracks and stations is undertaken in-house, with the maintenance and operation of Metro services outsourced via a concession agreement to DB Regio Tyne & Wear from April 2010 for a minimum of seven and a maximum of nine years. The concession operates on the basis that Nexus takes revenue risk, i.e. that it sets the fares and retains revenues, with the concessionaire responsible for the operation of the service according to contractually agreed targets. With the concession due to end in 2017 or 2019, planning needs to start soon to ensure that future arrangements take account of fleet renewal and network extension proposals, as appropriate.

6.1.3 In this context a case could be made to allow an arm’s length subsidiary or ‘not for profit’ company to operate the next concession, as this would allow the transfer of manageable risks to the operator, but retain the larger risks with Nexus.

Renewal timelines

6.1.4 It is likely to take around 36 months to complete the process of re-letting a concession, depending upon the format chosen, and based upon the timescales from when the current concession was originally let which were at the minimum of what would be required to complete the process and did not allow for any challenge to the award. Taking account of these factors, the possibility of an appeal and the desirability of a timely approach to the process, it is recommended that 48 months are allowed for to execute the full process of business case validation, DfT acceptance and funding and concession renewal. As fleet renewal and possibly network extension elements are likely to be an integral part of the concession - or as a minimum as costed options - then a longer period than previously will be a necessity. This gives rise to the following suggested simplified concession timeline:

<table>
<thead>
<tr>
<th>Timeframe</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early-2014</td>
<td>Initial high-level discussions with DfT and political parties</td>
</tr>
<tr>
<td>2014</td>
<td>Business case definition and scoping</td>
</tr>
<tr>
<td>Spring 2015</td>
<td>Definition of concession scope and extent and market testing</td>
</tr>
<tr>
<td>Autumn 2016</td>
<td>Commencement of re-letting process with issue of Prior Indicative Notice</td>
</tr>
<tr>
<td>April 2019</td>
<td>Current concession ends and new concession commences</td>
</tr>
</tbody>
</table>
6.2 **Potential future options**

**Franchising**

6.2.1. It would not be feasible to let a concession on the same legal basis of a franchise, given that only the DfT can let franchises under existing legislation. There are few differences between a DfT franchise which is subsidy-dependent, and a concession, whereas a commercial franchise such as the Intercity East Coast or West Coast has fundamentally different objectives. The main areas of difference between a commercially driven franchise and a concession are as follows:

Franchise:
- more commercial risk rests with franchisee, sometimes much more;
- a profile of premium or subsidy payments is defined at the outset;
- ‘cap and collar’ clauses covering divergences in agreed profits/losses;
- franchisee has some commercial freedom in areas such as fares and marketing, consistent with levels of risk adopted.

Concession:
- more rigid terms than a franchise;
- less commercial risk to the franchisee;
- agreed payment structure in return for tightly-specified service delivery;
- little or no branding or fare-setting autonomy;
- concessionaire is able to calculate returns with a fair degree of certainty;
- approach favoured by Transport for London;
- standard practice for light rail network,
- one heavy rail operating concession exists (Merseyrail).

6.2.2 Rail franchising policies are likely to be subject to change with successive governments and are currently being revised following the government’s acceptance of the majority of the Brown Review’s recommendations. The key findings of the Brown Review are as follows:

- Continue with franchising but with some changes
- Incentivisation delivers greater customer service
- Importance of relationship being seen as a partnership
- End the practice of leaving the private sector to forecast implications of economic growth
- Support for devolution to sensibly-sized operating units subject to sufficient dowry
- Tailoring the length of each franchise to its own specific circumstances
- More explicit scoring of bids in a way which reflects passenger benefits more closely

6.2.3. The main implications of these policy shifts in the context of the Metro concession are heightened priority given to the value of passenger benefits, and reduced requirements upon potential franchisees to make assumptions about the future trajectory of national and regional economic growth. This is likely to result in more potential applicants entering the field with an expectation of greater certainty of returns commensurate with lower risk and upside potential. In addition there are several areas where recent policy developments will impact the shape of a new concession:
• Arising from the Laidlaw report into the lessons of the letting of the West Coast franchise, the need to allow sufficient time to let a concession including allowing for legal challenge.
• Adjustment of the amount needed to be provided as a bond should the concession fail.
• The drive to reduce costs which could impact on staffing, service levels, type of oversight of the concession, format of Committed Obligations and performance regimes.
• Northern franchise letting: if a separate North East business unit were agreed, it could allow for subsequent merger and letting of a combined heavy/light rail contract for the area.

6.2.4 The above analysis suggest that both variants of both concessions and franchises are possible options given the shift in government policy following the Brown Review and within the context of on-going developments in the devolution of local rail services.

6.2.5 The concession arrangements currently in place on other UK light rail networks are summarised in the table below. Of interest is the fact that networks such as Metrolink have acquired different concession arrangements relating to the opening of subsequent network extensions.

<table>
<thead>
<tr>
<th>Network</th>
<th>Concession Type</th>
<th>Scope</th>
<th>Duration</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tyne and Wear Metro</td>
<td>Revenue risk with network owner</td>
<td>Operations and train maintenance</td>
<td>7 years plus 2-year option expiring 2017/19</td>
<td>Operator DB Regio Tyne &amp; Wear</td>
</tr>
<tr>
<td>Sheffield Supertram</td>
<td>Revenue risk with operator</td>
<td>Operations and maintenance</td>
<td>17 years expiring 2024</td>
<td>Stagecoach plc.</td>
</tr>
<tr>
<td>Nottingham Express Transit</td>
<td>Revenue risk with operator (PPP)</td>
<td>Operations and maintenance</td>
<td>23 years to 2034</td>
<td>Tramlink Nottingham</td>
</tr>
<tr>
<td>Croydon Tramlink</td>
<td>TfL contract (not a concession), London Tramlink operator</td>
<td>Operations and maintenance</td>
<td>Not applicable</td>
<td>London Tramlink is a division of TfL</td>
</tr>
<tr>
<td>Midlands Metro</td>
<td>Revenue risk with network owner Centro</td>
<td>Operations and maintenance</td>
<td>23 years to 2018</td>
<td>National Express Midland Metro</td>
</tr>
<tr>
<td>Manchester Metrolink</td>
<td>DBFO risk-sharing with RATP Group, M-Pact Thales to construct Phase 3b routes</td>
<td>Operations and maintenance</td>
<td>Varies according to Phase</td>
<td>M-Pact Thales</td>
</tr>
<tr>
<td>Docklands Light Railway</td>
<td>Revenue-share plus different arrangements for Lewisham</td>
<td>Operations and maintenance</td>
<td>8 years to 2014</td>
<td>Current operator Serco, concession out to market</td>
</tr>
</tbody>
</table>
6.3 Types of concession

6.3.1 This section reviews the different types of concession framework which could be employed, and summarises the potential strengths and weaknesses of each approach and its relevance to Metro.

(1) No operating concession

6.3.2 This option would effectively take operation of Metro back in-house, either as was the case prior to the existing concession, or as an arm’s-length company. There could be potential cost-savings associated with this model in the light of experience gained through the existing concession. Although there are no legal restrictions in doing this, it would run counter to the operational models favoured by the DfT and successive governments which involve some measure of client/contractor split. It would also require the re-creation of Nexus management and delivery functions transferred in 2010. It is unlikely that this option will gain national government support.

6.3.3 Recent developments with respect to the European Commission’s Fourth Railway Package could potentially also make this a less likely outcome. The preferred option of the Commission remains that of separation of maintenance and operations, however the Commission has stated that it will accept a vertically integrated structure or ‘holding structure’ that could deliver the necessary independence, with strict ‘Chinese walls’ to ensure the necessary legal, financial and operational separation, as is the case with London Underground Limited.

(2) Short term operating concession along existing lines

6.3.4 In effect similar to a continuation of the existing concession but let as a new entity, a short-term concession would enable current arrangements to be largely maintained. This could provide scope to introduce more fundamental structural change in the longer-term, potentially allowing greater alignment with fleet renewal timescales and/or the re-letting of a locally specified non-Intercity rail franchise. The weaknesses of such an approach include the potential lack of any real improvements to the customer offer, and most importantly the lack of anticipated interest in such a proposal from the market due to the proportion of expenditure that would have to be devoted by applicants towards set-up and transfer costs.

(3) Extension of current concession

6.3.5 Legal advice is that extension of the current concession beyond the 28-week period allowed-for in the existing agreement could be the subject of challenge, although precedents do exist such as the 18-month extension of Serco’s contract to operate the Docklands Light Railway. This would allow greater time to complete negotiations with potential funders and to mobilise towards a more fundamental restructuring of existing arrangements. Securing the agreement of the current concessionaire along mutually acceptable terms to continue the current contract on this basis would be fundamental to the success of this option.

(4) Single Tender Action (STA)

6.3.6 A recent development in national rail franchising, brought about largely due to the recent hiatus occasioned by events following the legal challenge to the West Coast franchise competition, is the use of a single tender action process to ensure the continuation of local rail service provision. The
DfT has recently contracted with a number of existing rail franchisees including Northern Rail via an STA to achieve continuation of services beyond the expiry of an existing franchise, to allow the re-launched franchise process to be handled in a timely way.

6.3.7 An STA, also known as a non-competitive action, (NCA) is required when purchases of any kind that need to be made cannot be obtained through normal procurement procedures. EU procurement rules in relation to NCAs continue to apply and need to be taken into account once such a course of action is being considered. There remains a requirement to achieve best value for money and to demonstrate the fair and equal treatment of suppliers. The most normal situations for an NCA/STA include where the proposed supplier has by recent experience proven to offer best value for money as the result of a fully compliant, competitive procurement exercise and where further competition would be highly likely to produce the same outcome, or where the proposed supplier is the only one known to provide the goods and services and there are no satisfactory alternatives.

6.3.8 The DfT’s use of the STA process has added legitimacy to the process and this course of action could be considered for Metro under certain circumstances if it delivered timing benefits, although use of the process is expected to remain open to challenge as representing a restriction of potential competition.

(5) Combined Infrastructure and Operations Concession

6.3.9. This was the original format proposed during the early stages of planning for the existing operating concession. This was subsequently not proceeded with on DfT guidance on the grounds of insufficient knowledge of the asset base that would have been likely to have led to a substantial bidder’s premium in order to take on the risk.

6.3.10. This option is common in the light rail sector but is unusual in heavy rail. It would be appropriate to revisit this option if, given the greater asset knowledge which now exists, there are potential cost savings from this approach. It would also be the preferred option if the active investment of a future concessionaire is sought in fleet renewal, network extensions or station and equipment upgrades. It would mark a radical departure from the current concession framework, requiring major changes to the status of the existing Nexus infrastructure function.

Strengths

- Economies of scale.
- Ability to attract investment in infrastructure.
- Nexus asset knowledge greater than previously.

Weaknesses

- Would prevent the creation of a combined Metro/Northern area franchise.
- Increased re-letting costs as contract documentation and data room requirements would be greater.
- Longer process.
- Greater levels of concession management.
6.3.11. It may be an appropriate model for a separate on-street operation, such as has been mooted for Sunderland to South Shields or West Newcastle/Team Valley/Metrocentre.

6.3.12. Most UK light rail networks use this type of concession in some form, primarily as a means of accessing additional private sector investment to fund infrastructure improvements and rolling stock. It would be more difficult to achieve closer integration with a future local rail franchise under this scenario, as the heavy rail network is structured as an infrastructure provider/operator split (i.e. Network Rail and franchised or open access train operating companies).

(6) Separate Infrastructure and Operator Concessions

6.3.13. This model is used by UK networks such as Manchester Metrolink where both the provision and maintenance of infrastructure and service delivery are the subject of separate concession agreements, retaining the wheel/rail interface separation. The specifying authority then takes the role of setting standards, reviewing the performance of each concession and maintaining tripartite dialogue. The strengths of this approach include the ability to appoint infrastructure and operations specialists for each delivery element, and to achieve more competitive pricing than a combined infrastructure and operations might offer. On the debit side this framework can increase the level of contractual complexity and the extent of compliance monitoring. The risk (or opportunity) also exists that the same contractor may be successful in winning both concessions, as has occurred on sections of Metrolink.

6.3.14. The decision to proceed on a separate infrastructure concession is in effect separate from the decision on the new concession and would be subject to separate evaluation. It is worth noting that the current suite of Metro concession transaction documents has been written to allow for such a possibility and could be implemented at any time and not necessarily cotermiously with the timescales associated with the current concession.

Strengths

- Opportunities to market-test existing infrastructure costs
- Investment from companies with infrastructure maintenance experience

Weaknesses

- Risk of single entity winning both infrastructure and operations concessions with consequent financial/performance implications
- Larger concession management function required
- Complex arrangements between all parties

(7) Integration with North East Business Unit in Northern franchise

6.3.15. The most radical of the options considered here is some form of merger with the heavy rail network, where Network Rail and/or the holder of the Northern rail franchise are invited to take over responsibility for Metro infrastructure and operation respectively (or alternatively where Nexus retains responsibility for infrastructure, and the local rail franchisee operates the network). Alternatively, in the long term the Metro operator of the time could expand the extent of the Metro network by operating local rail services over routes currently delivered by the local rail franchise e.g.
Tyne Valley, Durham Coast and possibly in the future Ashington Blyth and Tyne (subject to the necessary infrastructure changes). These options are included here for completeness, however it is not evident how such potential operational frameworks would cover fleet renewal and any network extension proposals, given that both the rail franchising programme and Network Rail’s activities are funded through the DfT’s High Level Output Statement (HLOS) and the Office of Rail Regulation (ORR) Control Period programme respectively which are not earmarked for light rail expenditure.

6.3.16. The change to current funding arrangements which could render this option potentially viable would be a major shift in the specification and operation of local rail services resulting from the ongoing ‘rail devolution’ process. The conditions that would make this most likely would be the greatest extent of devolution possible within the functions of a North East business unit with substantial financial and operational autonomy. The most likely time for such a scenario would be post-2023, but there is a large degree of uncertainty over the extent of rail devolution during the intervening period, and any potential involvement of a heavy rail franchisee and/or Network Rail can only be seen as speculative at this time.

(8) Alliancing

6.3.17. The concept of alliancing is not a type of concession or franchise as such but a means of achieving closer liaison between infrastructure and operations providers with the aim of achieving mutually positive outcomes. It is currently practised between Network Rail and two train operating companies in separate areas – South West Trains and ScotRail. Alliancing is one of the recommendations of the McNulty Study into rail value for money; it is defined as

‘a legally binding commercial agreement between two or more companies for a specific purpose, and defining how risks, profits and losses are shared’.

6.3.18. Alliancing is essentially a means of attempting to drive down costs and increase efficiency through a shared understanding of and attitude towards risk. On the routes used by South West Trains, a joint alliance launched in 2012 has resulted in the creation of a single senior joint management team, with responsibility for both trains and track on the route operating out of London Waterloo. This alliance is being used to reopen the disused former Eurostar platforms at Waterloo International for domestic use.

6.3.19. Alliancing could have a role to play in a future relationship between the infrastructure arm of Nexus and a concessionaire, or between external infrastructure and operating concession holders. If built into the relevant contractual relationships at the outset, the principles of alliancing could result in substantial operational synergies.

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6.4 Considerations in deciding types of concession

6.4.1. Before Nexus is in a position to let a future concession for the provision of Metro services there needs to be clarity as to what the desired outcomes of the process are. If overall cost is the most important criterion and contractors willing to adopt a higher risk profile can be attracted to the bidding process, then revenue-sharing or the transfer of risk to the contractor should be considered, although this comes with a loss of control over the outcomes described above, to varying degrees.

6.4.2. In many local rail concessions and franchises, risk lies with the client or is shared with the concessionaire. The only current example of the operator taking revenue risk on the heavy rail urban network is the Merseyrail franchise where as part of the 2002 Concession Agreement, Merseyrail has responsibility for revenue risk for journeys on the Northern and Wirral Line rail services and as such has responsibility for setting the fare levels on these services. This was common in PTE areas in the first round of rail franchises; only Greater Manchester transferred revenue risk to the operator.

6.4.3 It is more common for operators to take responsibility for revenue risk in the case of heavy rail franchises, and some light rail concessions were also let on this basis (e.g. Sheffield Supertram). Revenue risk with the operator could potentially reduce the overall costs of a concession to Nexus if passenger numbers were below expectations, with conversely potential additional revenue foregone if patronage exceeds expectations. Another issue related to revenue risk is that bidders may assume unrealistic levels of growth which, coupled with the need to de-risk the impact of the economy on the concessionaire’s finances, may see considerably less transfer of risk to the private sector than anticipated. This becomes more acute if a long concession length is envisaged, given the difficulty in long-term economic forecasting. This is apparent in the variability of the scenarios generated by the regional economic forecast commissioned by Nexus as background context for this strategy.\(^\text{42}\)

6.4.4 Transfer of revenue risk to the operator would reduce the ability of Nexus to maintain an overview of the impact of any pricing changes on the overall provision of transport within the area, and could be at odds with wider transport or social policy objectives, and particularly given the forthcoming introduction of smart ticketing with stored travel rights. Also, the Brown Review of franchising for the national rail network suggested that it is not appropriate to transfer risk in future franchises as currently envisaged, with more of the risk being retained by the public sector.

6.4.5 Where an extension to existing light rail network has taken place under a public private partnership or private finance initiative arrangements then the propensity of the concessionaire to shoulder or share revenue risk is enhanced, as there are other guaranteed revenue streams in respect of operations and maintenance that can be used to smooth overall income streams. In the end a judgement on the feasibility of full revenue risk transfer to the operator is likely to rest on the forecast future profitability of the Metro network. Whilst the network demand study and high level transport policies both indicate higher future levels of demand for Metro, the population density of the Tyne and Wear area alone suggests that some degree of on-going revenue support may be required, which would indicate that Nexus ownership of revenue risk or some risk-sharing formula with the concessionaire may be a likely outcome. If the performance of the regional economy remains at existing subdued levels closer to the time of concession renewal, it may also be difficult to market the concept of revenue risk transfer to the operating organisation.

\(^{42}\) Regional Economic Forecast for Nexus. Arup & Oxford Economics 2012
Retention of revenue risk

6.4.6. The retention of revenue risk by Nexus in a future concession would be a continuation of the current position. The advantages of this approach include the ability to set fares and promote integrated transport journeys as part of a wider set of policy objectives. Operating companies are often attracted to this type of concession by the prospect of dependable profit margins, even if potentially lower than those achievable by taking on revenue risk. In these situations it is normal for the specifying authority to retain responsibility for levers such as marketing and promotion which enables them to maximise revenue. Nexus taking responsibility for Metro marketing at the commencement of the next concession, in the event that revenue risk continues to lie with Nexus, should be seriously considered.

Revenue share

6.4.7. Revenue share between the owner and operator of the concession is a halfway-house between the ‘all or nothing’ models described above. The division of revenue share could be anywhere between the two extremes but is commonly based upon the sharing of revenues achieved in excess of a mutually agreed threshold at the outset of the concession agreement. An alternative arrangement would be an agreed share of the percentage of total fares revenue.

6.4.8. Successful revenue-share activities depend on good visibility of forward income streams that enable potential concession holders to factor-in an appropriate risk premium that is acceptable to both parties. In the case of the existing concession agreement, the impact of the on-going level of engineering possessions and the forthcoming introduction of smart ticketing meant that the risk premium sought by the concessionaire was not acceptable. A more manageable, stable and predictable level of possessions going forward alongside a revised fares structure would provide the opportunity to reconsider this option as it would reduce upfront concession costs in exchange for a share of the revenue and see a greater transfer of risk to the private sector. For example, small incremental timetable enhancements for special events would be funded by the operator rather than as an additional cost, and would further incentivise delivery of the service, particularly in terms of areas such as fares collection within organisations that practise revenue-share such as London Overground (LOROL) and Merseytravel.

6.4.9. In this scenario, it would also be appropriate for marketing activity to continue to be undertaken by the concessionaire.

Concession Length

6.4.10. The average length of an operating concession at around 7-10 years represents a compromise between being long enough to make it worth the concessionaire’s while in terms of investment and subsequent returns, and short enough to take account of changing market circumstances. Where Design, Build, Maintain and Operate (DBOM) arrangements are in place the duration of concessions is often considerably longer to allow for an adequate return on initial investment by the concessionaire. Legally, the maximum period over which a concession can currently be let is 22 years.

6.4.11. Given the costs of bidding, unless there is a fundamental change to services / routes or structures, such as combining with the North East business unit of the Northern Rail franchise, it is not normally
appropriate to let a concession for a very short period of time. In the parallel process of rail franchising, of the three let for 15 years as part of the first round of franchising, only one (Essex commuter route c2c) lasted the full term. Merseyrail was something of an exception, let for an initial 25-year period in 2003 to the Serco-Nedrail (now Abellio) consortium on the basis of little investment by the franchisee. The Chiltern rail franchise was let for ten years extendable for up to 20 further years, dependent on the government agreeing future investment by the operator. As discussed above, the Brown Review cautions against excessive franchise length on the basis that for most businesses, seven to ten years would be a more than adequate period to recoup the benefits of cost reduction initiatives and that the major drawback of longer franchises is that they greatly increase risk. It states that uncertainties of forecasting, particularly of revenues, compound exponentially over time, reducing the confidence that can be placed in longer term forecasts, and driving both bidders and franchising authorities to take extra measures to compensate for risk.

6.4.12. Despite this being contextually useful, there are clear differences between the risk allocation of franchises and concessions, which can be subdivided further according to revenue risk arrangements. Generally, light rail concessions are specified for longer periods than heavy rail franchises because risks are lower and income streams comparatively more dependable. From the evidence available from other light rail networks, it is likely that the optimum concession duration for Metro will be that which:

(i) aligns with Department for Transport advice regarding preferred funding methods,

(ii) ensures the replacement of the existing fleet and the construction of any network extensions as applicable, and

(ii) offers a concessionaire a realistic timeline during which to make an acceptable return on their investment into the concession, as applicable.

Investment

6.4.13. One of the main factors likely to determine the approach to be taken by Nexus will be the agreed content of the third phase of Metro reinvigoration funding which will commence, assuming the current concession runs its full course, around two years into the start of the new concession. The main investment will be the replacement of the current fleet which is programmed for replacement around 2025, expected to be within the currency of the next concession. Other key tasks will include the third phase of investment in the network including treatment of mine workings, flood prevention, upgrade of substations and the new signalling network together with any extensions to the current network. It is also worth noting that there will need to be significant investment in bridges, earthworks and permanent way renewal under Phase 2 of Metro reinvigoration which will affect the first two years of the new concession in terms of network availability.

6.4.14. It is normal within heavy rail franchises to ask the franchisee to undertake the procurement of rolling stock, with the franchisee taking the risk in terms of cost overrun and performance if delivery is delayed. Group expertise in this area is also viewed as helpful in ensuring product delivery within specified timescales. The alternative would be procurement by Nexus.

6.4.15. If a combined infrastructure and operating concession were to be let it may be appropriate to ask the concessionaire to undertake the investment in upgrading specified equipment as well. This could
include track, signalling and power refurbishment, upgrade or replacement, new stations and improvements at others, new depot and fleet. In this situation it may be appropriate for the concessionaire to sub-contract to a suitable body to oversee project delivery. DfT are currently seeking to encourage firms with infrastructure experience into taking on train operating company roles, as well as existing train operating groups; this is an option that should be investigated at the beginning of the procurement scoping process.

6.4.16. The option of a combined infrastructure and operating concession may be sensible to pursue for any stand-alone on-street route extensions.

Concession Management

6.4.17. The current approach is for a significant level of compliance checking to ensure delivery by the operator of its obligations; this model is common for a concession where subsidy is required as there is little incentive on the operator to deliver. An alternative approach would be to shift more responsibility to the operator to self-declare and to increase the penalties for wrong declaration. A ‘light touch’ approach would reduce the cost of management for both organisations but would depend upon sufficient resources being available to undertake periodic compliance checks on any areas of concern. A combined concession would require additional Nexus resources.

Above: commuters at the refurbished Haymarket station
6.5 Procurement and ownership of rolling stock

6.5.1. The following procurement and ownership models are amongst those currently available.

**Outright Purchase**

6.5.2. Ownership of a fleet of new trains has advantages in terms of low on-going asset costs and freedom to operate and maintain without any constraints imposed by the leasing company. This would allow the operating concessionaire to maintain the fleet - with the consent of the asset owner (Nexus), and in line with the warranties that may apply.

6.5.3. Upfront costs represent the most obvious drawback to this option. With fleet renewal costs conservatively estimated at £200 million this magnitude of finance may be difficult to acquire at the outset. It would also rule out a number of combined framework options including design, build, operate and maintain (DBOM) arrangements which often offer greater procurement flexibility and lower lifetime costs than would be available via the outright purchase route. DBOM frameworks also potentially greater economies of scale and a wider variety of funding and finance options which are available to potential concessionaires.

**Leasing outwith the operating concession**

6.5.4. This option has not been exercised recently by UK light rail networks; however it would be feasible to procure rolling stock separately from the letting of a future operating concession. Leasing companies (known in the rail industry as ROSCOs) such as Angel Trains, Porterbrook and Eversholt Rail Group are responsible for providing the vast majority of British trains, although other organisations are also known to be keen to enter the market. These companies are owned by consortia of private companies and are the subject of some controversy due to the perceived high rates they levy for the use of fully depreciated assets e.g. Class 142 units.

6.5.5. Procurement of new Metro stock via this route would be feasible and should be considered as part of a range of options at the appropriate time. Leasing would offer cash-flow advantages over outright purchase and procurement outside of the operating concession would allow maintenance to be undertaken by specialist contractors, potentially as a joint maintenance contract including infrastructure maintenance. The potential disadvantage of such an approach is that it would preclude the ability to achieve economies of scale that could be offered by a DBOM framework where the complete operations and maintenance package is provided by a single organisation or consortium. This option would require DfT support in revenue terms.

**Leasing by concessionaire**

6.5.6. Alternatively it would be possible to make a concessionaire responsible for the leasing of rolling stock, thus removing Nexus from any direct involvement in its procurement. This is effectively the relationship between national rail franchisees and the leasing companies listed above. This approach would transfer responsibility for rolling stock procurement from Nexus to the concessionaire - subject to agreement on details of vehicle specification and cost. Risks of this approach include:
• restrictions on optimum concession length,
• the need for adequate fall-back arrangements in the event of financial failure of the concessionaire
• a potential lack of transparency and control in the event of large-scale fleet reliability problems, and
• the need for Nexus to underwrite the agreement beyond the length of the concession.

6.5.7. As with other options, this method should be considered along with others, depending on market conditions at the time of fleet renewal. To a degree it could depend on the extent to which Nexus seeks to be an active or passive client in terms of long-term Metro service delivery.

Leasing through ROSCO

6.5.8 The rolling stock operating companies (ROSCOs) listed above or new entrants to the market could be interested in leasing new Metro vehicles to Nexus on mutually acceptable terms. As an example, QW Rail Leasing, formed as a joint venture between National Australia Bank and SMBC Leasing and Finance43 to lease rail vehicles in the UK has recently concluded its first major deal with Transport for London (TfL) to fund the £300 million purchase of 54 Class 378 trains for London Overground. TfL claims similarity between purchase and leasing costs but with the advantage that TfL will not bear the cost of the depreciating value of the fleet and the risk of a loss if selling second-hand stock.

6.5.9. The contract gives TfL use of the trains until at least 2027, differing from the usual UK rolling stock lease arrangements which expire with the train operator’s franchise. In 2027 when the trains reach half-way through their economic life TfL will have the option of a second lease or entering into a new agreement with another party for new trains. The European Investment Bank also provided funding.

6.5.10. This transaction allowed a number of TfL’s financial risks to be transferred. Late delivery of the trains would have resulted in penalties being payable by the manufacturer, and the London Operator LOROL45 can be penalised if rolling stock presentation falls below the standard agreed by TfL.

6.5.11. The option appears to offer some potential advantages, however ROSCOs do not currently offer the kind of DBOM packages that have proven popular with similar light rail networks in the recent past. A ROSCO-sourced solution may be more appropriate to the circumstances of the existing Metro network than to the proposed extension corridors, where a DBOM-type solution appears to offer a number of advantages.

Deferred purchase paid-for by passenger revenues

6.5.12. It may be possible to acquire new rolling stock through a deferred purchase mechanism, effectively a hire purchase agreement where the supplier retains title of the assets until the purchaser pays off the balance of the cost, in addition to interim interest payments. This approach would benefit Nexus by removing the need to pay up-front for assets that could be afforded downstream through ring-fenced passenger revenues, whilst conferring eventual outright ownership.

6.5.13. The major risk to this proposition surrounds the level of certainty of future revenue streams. As evidenced by events in recent years, there can be many controllable and non-controllable influences

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43 A division of Sumitomo Mitsui Financial Group
44 Transport for London signs new train leasing contract. TFL press release 20/2/08.
45 London Overground Rail Operations Ltd, a 50/50 joint venture between MTR Corporation and Deutsche Bahn
upon patronage that cannot be precisely defined at the outset. It may be difficult to agree deferred purchase terms commensurate with that level of future income variability, with the additional risk to Nexus that failure to meet the deferred purchase terms could result in Nexus continuing to pay interest on assets of reducing value, without gaining ownership, for an indefinite period.

‘Bulk-buying’/joint ownership with other transport authorities

6.5.14. There is no recent precedent to this model in the UK, but it offers a number of potential possibilities. The first is that established and evolving light rail networks may be able to club together to achieve meaningful economies of scale through bulk ordering of a common product from a single source. The second is that a ‘PTE ROSCO’ could be developed to supply light rail and heavy rail rolling stock to participating organisations, possibly in conjunction with a Rail in the North Executive framework. This would be set-up with the aim of achieving lower leasing costs than the market to a specific group of public sector organisations.

6.5.15. Progress towards this objective is likely to be bound up with the future range and influence of PTEs, progress towards devolution of local rail service specification, the ability of partners to bulk-buy during similar timescales and, in particular, the likelihood that the Tyne and Wear Metro will continue to operate 1500V trains rather than the more common 750V power supply. Although minor changes of specification can be accommodated as part of a bulk purchase the greater the variation from a standard product, the less likely it is that meaningful savings can be made. However given the potential pace and scale of change in local and central government transport specification and provision, this may prove to be a positive option depending on prevailing circumstances.

Wet Lease and Dry Lease options

6.5.16. The leasing options described above can be further subdivided into ‘wet lease’ and ‘dry lease’ options. These terms originate from aircraft leasing, are extensively used in train operating company leasing arrangements, and define the relative involvement of lessor and lessee in rolling stock maintenance and overhaul arrangements.

6.5.17. A wet lease (also variously described as ‘damp lease’ or ‘soggy lease’) defines an arrangement where the ROSCO or other leasing company carries out all or a specified proportion of fleet maintenance – a wet lease usually refers to all maintenance being carried out, with variants reflecting differing levels of intervention, perhaps with the operator responsible for light maintenance and the ROSCO for all other work. Where a dry lease is in place, the operator is responsible for all maintenance (and for returning the asset to the ROSCO in an agreed condition at the end of the lease, if appropriate).

6.5.18. The national rail network operates with both wet and dry leasing arrangements and both can be effective so long as the lines of accountability are clearly drawn. In terms of which option could be most appropriate to Metro in the future, the availability of funding will is likely to influence which if any format of leasing arrangement should be pursued. If upfront funding is limited then wet lease arrangements may prove attractive – although the formulation of a successful business case for funding will be critical. The enthusiasm of suppliers to use them suggests that the whole-life costs may be greater than in the case of dry lease or outright purchase arrangements. However it may be possible to reduce on-going lease charges by, for instance, paying upfront for future heavy maintenance costs.
6.6 Conclusions and Recommendations

6.6.1 Operational models for light rail networks are constantly evolving. Prior to the expiry of the current Metro operating concession, the task for Nexus is to identify and implement the solution that best delivers the key aims and objectives of this strategy. The nature and extent of the processes involved demand that this work needs to begin now.

6.6.2 The key recommendation is to remain open-minded as to the exact definition of a future concession framework, as it is likely to be shaped by several key factors including:

- Customer requirements.
- Availability of finance and loan guarantees.
- Progress towards the identification of viable network extensions.
- Design, Build, Operate and Maintain options.
- Assessment of strengths and weaknesses of the existing concession arrangements.
- Opportunities to achieve economies of scale.

6.6.3 It is also recommended that the concession renewal process should, if possible, be based around a three-package approach with the option retained to combine or separate as governed by financial and market factors and constraints. Although this may need to be amended or combined as circumstances change, these are suggested as a starting point for further consideration. The three packages are:

   (i) The existing Metro network
   (ii) Network extensions physically connected to the existing network
   (iii) Network extensions physically separated from the existing network

6.6.4 It is also recommended that high-level discussions take place with the Department for Transport prior to the process outlined above getting under way, to gauge expectations in terms of governance, value for money and passenger benefits anticipated from future concession arrangements.
Section 7: NETWORK EXTENSIONS

7.1. Potential Extension Corridors

7.1.1 Introduction

7.1.1.1 This section describes the technical and demand factors that apply to each of the corridors identified by the ITA and Nexus as being potentially suitable extensions to the Metro network. It sets out the features of each corridor, the constraints and opportunities to development that exist, projected levels of demand and the potential for integration with the rest of the Metro and public transport network. In conclusion it provides an outline indication of construction costs and rolling stock requirements, both of which would need to be scoped-out in greater detail during business case development.

7.1.1.2 Where there is an inter-relationship between two or more corridors this is analysed, although for the purposes of this analysis each one is described separately. Direct and indirect impacts on the existing Metro network are also assessed.

7.1.1.3 There is no attempt to rank the corridors at this stage; they are ordered randomly, although the ‘on-street’ corridors are described separately after those options that are being assessed on the basis of segregated technology.

7.1.1.4 Network extension proposals are an important element of this strategy as they provide a focus for further debate and assessment of Metro’s role and functions over the decades to come. The seven corridors discussed in detail are not necessarily the only options for the future, but they do represent those with the greatest outline potential based on predicted demand and technical feasibility. As discussions over the future of Metro evolve, they will be updated and revised as opportunities and circumstances change.

7.1.1.5 The primary motivation for progressing any network extension proposal is proven demand, and whilst they form an integral element of the long-term strategy, the over-riding priority remains the renewal of the train fleet that operates over the existing network.

7.1.1.6 Each of the network extension proposals that follow has different capabilities and requirements, and would be planned and introduced according to their specific circumstances. Whilst the ‘on-street’ and ‘off-street’ proposals would have maximum commonality of equipment to drive down costs and maximise economies of scale, they would have detailed differences whilst remaining under the umbrella of the corporate Metro brand. In each case, the technology proposed best meets the opportunities and constraints which present themselves.

7.1.1.7 In essence, the proposals fall into two sub-categories. The routes to Seaham, Washington and Cobalt would represent an evolution of the existing Metro network and would be served by the same trains that are in use on the existing network, potentially by extending or altering existing route patterns. The second sub-category, the routes to Metrocentre, Team Valley, west Newcastle and between Doxford Park, Sunderland and South Shields would operate on-street as is the case in central Manchester, Sheffield and Nottingham, but is completely new to the Tyne and Wear area.
7.1.1.8 Cost estimates are indicative and intended purely for comparison and benchmarking. Subsequent business case preparation will involve detailed work on cost and feasibility. Routes and station locations are also indicative in many cases.

7.1.2 Sunderland to Seaham

7.1.2.1 The proposal is to extend the reach of Metro from Sunderland station southwards to Seaham in County Durham, using the Network Rail ‘Durham Coast Line’ and terminating at the existing Seaham station, or potentially at a town centre site east of the existing railway.

7.1.2.2 The technology used and joint running protocols would be based on those used between Pelaw and Sunderland. It is envisaged at this stage that the route could either function as Seaham to Pelaw and beyond with connecting services to and from South Hylton, or with an equal proportion of trains running directly from Seaham and South Hylton to Pelaw, or trains from Seaham connecting at Sunderland with direct South Hylton - Pelaw trains.

7.1.2.3 The main issues (other than cost and demand) that would need to be addressed include:

- Track capacity – the Durham Coast route is being examined by Network Rail as an alternative route to the East Coast main line for long-distance freight traffic; the ports of Tyne and Seaham are also generating increased flows locally. Northern Rail and Grand Central also operate over this route.
- Electrification issues – future Metro fleet dual-voltage 1500V DC / 25kV AC capability (as described in Section 4.2) would allow continued operation over Network Rail infrastructure between Pelaw and South Hylton, in the event this route were electrified at 25kV AC.
- Rail devolution proposals – dependent on the future progress of rail devolution proposals, the introduction of Metro services over the route may need to be considered in the context of part of a range of potential solutions for local rail services along the length of the Durham Coast route. For instance, there are known aspirations to increase the frequency of heavy rail services between Middlesbrough, Sunderland and Newcastle.

7.1.2.4 Potential Metro station sites have been identified at Villette Road, Grangetown and at Ryhope as well as a new station at Seaham, either at the existing site or at an alternative town centre site off the Durham Coast line, which appears to be potentially feasible. Ryhope has previously been identified as being suitable for a major Park and Ride facility for the south Sunderland area.

Demand

7.1.2.5 In terms of demand along the corridor, the following factors apply:

- The line benefits from a significant catchment area around Seaham, and an existing rail market transfer to Metro (assuming substitution).
- Through running (assumed by the demand study) to central Tyneside and Newcastle International Airport increases demand and revenue forecasts relative to other corridors where interchange is required.
- Stations at Villette Road and Grangetown have smaller catchments due to competition with each other, and from bus which is likely to be a significant competitor along this corridor.
• The corridor will be a net originator of Metro trips, with the number of return trips originating between Sunderland and Seaham outweighing the number of trips originating elsewhere.

7.1.2.6 The year 2030 demand forecast from new stations only is estimated at 5.011 million, with total extra demand, including that from existing network stations, estimated at 12.550 million passengers per annum. It should be noted that the latter figure would vary depending on the quantum of network extensions added to the core network. The figures above refer only to the extra demand created by the addition to the network of the Seaham corridor; were further corridors added to the network e.g. South Shields to Doxford Park, then that would further increase the aggregate level of demand.

Costs

7.1.2.7 Indicative costs are in the region of £41 million for a scheme subdivided as follows:

- Electrification £13 million based on a route length of approx. 10km
- Stations £20 million (based on £5 million per station on Network Rail)
- Additional trains £8 million (based on £2 million per train)

TOTAL £41 million

Risks

7.1.2.8 The main risks specific to the corridor surround compatibility with Network Rail infrastructure and the adequacy of train paths in the Sunderland area. These would need to be fully evaluated in partnership with Network Rail at an early stage.
### 7.1.3 Washington extension from Pelaw/South Hylton

7.1.3.1 The proposal is to continue south from Pelaw, initially along the route of the disused Leamside line, before heading south-west on a new alignment towards Washington town centre using a mixture of on-street and segregated running. Between Washington and South Hylton the preferred route would be to regain the Leamside corridor north of the viaduct over the River Wear then head east to join the alignment of a former rail corridor between Penshaw and South Hylton, there connecting with the existing Network Rail route along which Metro is the sole operator. Construction could also begin from the South Hylton direction.

7.1.3.2 Initially the proposal was to utilise the Leamside alignment between Pelaw and Penshaw throughout. However as this corridor skirts the eastern edge of Washington it would not provide the essential town centre penetration that is required at this location. Much of the existing road network has wide verges originally provided with future road-widening schemes in mind; in the majority of locations there appears to be sufficient space to accommodate Metro tracks. It is predicted that patronage levels along this corridor would be 70% higher via the town centre route than via the Leamside route to the east.\(^\text{46}\)

7.1.3.3 A number of issues surround the viability of this proposal, including:

- The requirement to tie-in to Network Rail infrastructure at both ends of the route. At South Hylton this should be a straightforward end-on connection with the existing terminus; at Pelaw a greater amount of new alignment would be required.
- The future status of the Leamside corridor could affect operating arrangements. At present the corridor is without tracks and disused, but retains the legal status of a railway. Various proposals exist at a regional and national level for the re-use of all or part of the route for passenger and / or freight traffic; were these to be progressed then it is likely that joint running protocols similar to those in force on the East Boldon corridor would be required.
- The condition and capacity of Victoria Viaduct over the River Wear: in the latter years of British Rail operations the viaduct carried only a single track, understood to be due to clearance issues (the route was originally double-tracked throughout). If double-track operation cannot be restored, it causes a potential constraint over the operation of the route as a Metro corridor, although this may not be an issue unless the Leamside was also being used for other heavy rail purposes. Whatever the outcome of these proposals, the Leamside corridor is likely to remain in Network Rail’s ownership.

7.1.3.4 Indicative Metro station sites have been identified at Washington South, The Galleries, Washington North and at Lingey Lane in Wardley. A further site for potential consideration is Penshaw North just south of the Wear crossing, an area of new housing growth.

7.1.3.5 A potential alternative option to link Washington and Sunderland, not examined in any detail in the studies supporting this strategy, would be to run on-street from Sunderland city centre and cross the Wear on the upper deck of the A1231 Queen Alexandra Bridge, disused since 1921. The route would run through North Hylton before serving Nissan and running into Washington. Demand for this route could be higher as it does not overlap in terms of catchment with the existing Metro line to South

Hylton or the proposed route to Doxford Park, but there would be a number of engineering issues to be addressed before it could be considered further.

**Demand**

7.1.3.6 Only routes which serve Washington town centre are likely to deliver reasonably high levels of demand. The community has strong travel links with both Sunderland and Newcastle city centres and the highest demand would result from provision of a through route to the north and south. If the route were to be constructed on a staged basis, then building southwards from the Pelaw direction would be likely to generate the greatest initial demand. There has been evidence of public support for the introduction of Metro services linking Washington with Sunderland and Newcastle for many years. Washington has a population of 54,000 and is one of the major conurbations lacking access to Metro.

7.1.3.7 The 2030 demand forecast from new stations along the route only is 3.954 million passengers per year. The total additional demand from the existing network, including the above, is 7.737 million passengers per year (assuming no other network extensions opened, see 7.1.2.6.).

**Costs**

7.1.3.8 Indicative costs are currently estimated at around £253 million subdivided below. There is a large range of uncertainty linked to existing asset condition and the practicability of constructing a new route into Washington town centre. Costs based on a 17km route.

- Construction costs £230 million
- Station costs £15 million
- Additional trains £8 million

**TOTAL** £253 million

**Risks**

7.1.3.9 The main risks can be summarised as the lack of detailed knowledge of the construction issues surrounding a new route into Washington, potential use of the Leamside rail corridor by other passenger or freight users, and the condition of the Victoria Viaduct.

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47 Derived on the basis of twin-track electrified at £12.5m/km off-street, £18.5m/km on-street – routes based on recent average construction costs of UK light rail and heavy rail schemes. Excludes optimism bias as required by current DfT appraisal.
7.1.4 Howdon to Northumberland Park

7.1.4.1 This network extension would connect to Metro the A19 growth corridor in North Tyneside, between the existing north and south arms of Metro’s Coast loop. Silverlink and Cobalt are large retail and employment sites that have been developed over the period since the original 1980s Metro construction, and Tyne Tunnel Trading Estate continues to grow. The corridor would also act as a focus for sustainable development proposals across this area of North Tyneside. By using an existing former freight rail alignment, some of whose track is still in existence and in (very) occasional use by a Steam Railway, the opportunity exists to connect the two Coast loop lines by diverging from the existing line east of Howdon, and east of Northumberland Park, using east-facing junctions in both cases. This would create an ‘inner circle’ within the Coast loop that would increase network flexibility, as well as serving the Cobalt and Silverlink areas.

7.1.4.2 Significant planned development for the area is known, and construction of a Metro corridor would act as a catalyst for such growth as well as alleviating highway capacity constraints on the A19 and A1058 road corridors. It is proposed that the extension, if built, would operate along existing Metro principles as a segregated off-street alignment.

7.1.4.3 There is also a potential to connect with the Ashington, Blyth and Tyne line which diverges from the Coast loop east of Northumberland Park. Northumberland County Council sees the restoration of passenger rail services over the route as a strategic connectivity objective. The technology used to deliver this objective has yet to be finalised and could either utilise heavy rail diesel or light rail electric infrastructure; were the latter to be the chosen option, the opportunity to operate Metro from St James to south east Northumberland via Wallsend and Cobalt Business Park would open up a number of connectivity improvements and utilise spare route capacity on the Wallsend route.

7.1.4.4 Issues to be addressed along this corridor include:

- Constancy of demand across the operating week: evenings and weekends are likely to have lower demand levels based upon existing land uses.
- Feasibility of linking to the existing Metro lines near Howdon, and particularly Northumberland Park.
- Impact on the North Tyneside Steam Railway’s operations, which would have to be curtailed.
- Level crossings would be required at Middle Engine Lane, Silver Fox Lane and Earsdon Road.

Demand

7.1.4.5 This route would anticipate future demand as well as serving existing traffic generators, as it would help to unlock significant housing sites in the West Chirton area. It would also have an indirect impact upon demand on areas of the existing network between Northumberland Park and central Newcastle and between Howdon and the city centre, which would experience an increased frequency of service as a result.

7.1.4.6 The 2030 demand forecast from new stations along the route only is 1.214 million passengers per year. The total additional demand from the existing network, including the above, is 4.062 million passengers per year (assuming no other network extensions opened, see 7.1.2.6.). This suggests that the corridor would generate substantially more indirect demand than direct demand. Costs are based on a 6km route length.
Costs

7.1.4.7 Indicative costs are shown below. It is possible that these are an over-estimate given that Nexus owns the infrastructure at either end of the corridor, and that part of the route has an existing standard-gauge track used as a tourist railway on an occasional basis. Savings on construction costs could also be realised by installing single track with a central passing loop at Silverlink.

- Construction costs including electrification £75 million
- Station costs – assumes no railway possessions required £9 million
- Additional trains/fleet improvement package £6 million

**TOTAL indicative costs** £90 million

7.1.4.8 The main risks identified at this stage relate to the feasibility of achieving physical connections with the existing Metro network at each end of the route corridor, the eventual level of demand once development has been completed, and the implications in capacity and performance terms across the existing network. It is anticipated that private sector contributions would form part of any funding agreement in respect of this route.
7.1.5. **South Shields – Sunderland city centre – Doxford Park**

7.1.5.1 This is one of a number of on-street extensions that have been identified as potential extensions to the Metro network, enabling the network to reach a substantially higher proportion of the Tyne and Wear population than is presently possible. Although not physically connected to the existing network, any extensions operated on-street will have a similar branding style and feel to the existing network, although tram stops will be to a different scale and function which recognises their on-street environment.

7.1.5.2 The corridor between South Shields and Doxford Park serves a number of different markets. The section north of Sunderland is based on the A1018 road corridor and would allow Metro to serve a number of communities that are not currently accessible. In the Stadium of Light/St Peter’s area there would be scope for a direct connection between the on-street and Network Rail corridors. In central Sunderland Metro would perform the function of an inner-city tram network with a higher ratio of on-street halts, and between the city centre and Doxford Park it is proposed that the route will achieve higher speeds along a partially segregated alignment utilising sections of former colliery wagonways. At the southern end of the route, both the residential and business areas of Doxford Park could be served. The Business Park experiences parking problems and congested access to and from the A19 trunk road which Metro would significantly alleviate. Businesses located on the site employ over 8000 people.

7.1.5.3 Alternative routes considered but not recommended include a new alignment extending westwards from the existing South Hylton terminus before running south parallel to the A19 to Doxford International Business Park, and an alignment connecting Ryhope and Doxford after using the Durham Coast route southwards out of Sunderland.

7.1.5.4 Although it would be possible to develop either the South Shields or Doxford Park corridors in isolation, there are strong benefits to be derived from the operation of a cross-city route directly connecting Doxford Park with north Sunderland and areas of South Tyneside. If successfully implemented, on-street Metro has the potential to transform sustainable transport movements along the corridor although the substantial risks to implementation remain.

7.1.5.5 On-street operation on this route, as elsewhere, raises a number of uncertainties that will need to be addressed. Sharing of street space with other vehicles and public utilities has caused well-documented issues elsewhere and whilst these interfaces can be effectively managed, they can never be entirely eliminated as with a wholly segregated network. There are also issues of potential bus competition and traffic congestion to take account of, and there is likely to be abstraction by and from existing Metro services between Seaburn and University stations.

**Demand**

7.1.5.6 Forecast demand along the route from new stations only is 5.444 million passengers per year in 2030, subdivided into 4.233 million between Sunderland and Doxford Park and 1.211 million between South Shields and Sunderland city centre. The latter figure is low due mainly to population densities and the parallel bus and Metro competing services referred to above. The 2030 patronage forecast for demand from new stations and the existing network – again, excluding the impact of any other network extensions – is 6.358 million passengers per year.
Costs

7.1.5.7 Accurate estimation of on-street corridor construction costs is particularly difficult because of the lack of direct experience and the wide variances reported from the small number of comparable UK schemes. The comparator scheme used to gauge a rough estimate is Manchester Metrolink which shares some attributes with Tyne and Wear Metro reinvigoration phase 3; at this stage any further refinement of cost is not possible until a much clearer understanding of the route’s specific characteristics can be developed. The quoted on-street costs are therefore more relevant as comparators than absolutes at this stage, on the basis that the four on-street candidate corridors have been assessed using the same methodology.

- Construction and electrification costs £388 million
- Rolling stock costs £32 million
  TOTAL £420 million

Risks

7.1.5.8 Initial high level risks include the factors surrounding competition and cost uncertainty as cited above. Bus movements along most of the corridor are frequent, and solid partnership or regulation arrangements would need to be in place to ensure the efficient operation of on-street Metro, including appropriate traffic management priority at key junctions.
7.1.6 **Newcastle city centre- West Newcastle**

7.1.6.1 Metro serves much of east and north Newcastle comprehensively but has never penetrated the densely-populated western suburbs of Newcastle. With a westward tunneled extension from St James ruled out by subsequent above-ground construction, other opportunities have been scoped and the most effective proposition appears to be a street-running network running westwards from the city centre, with the favoured option centred upon the A186 West Road corridor. This option could be potentially combined with new Metro links connecting Newcastle and Gateshead town centres with Team Valley and the Metrocentre (described in sections 7.1.7 and 7.1.8 below).

7.1.6.2 Many of the key issues surrounding the introduction of the Metro to the west end of Newcastle are similar to those described for similar proposals in Sunderland: unrestrained bus competition, unrestricted highway congestion and uncertainties over the impact of public utility diversions. However the opportunities are also considerable: there is a high concentration of population along the preferred corridor alongside low car ownership rates, and forecast demand levels consequently hold up well by comparison with some other potential corridors. There are also potential strategic Park and Ride opportunities around the area of the A1/A69 junction.

7.1.6.3 The preferred route follows the A186 West Road corridor out of Newcastle towards a terminus in the West Denton area (exact location to be identified). Alternative routes have been identified via the B1311 Elswick Road and the A695 Scotswood Road, however these routes serve a smaller residential catchment and in the case of Elswick Road would be no easier to implement. The preferred route serves several important intermediate destinations such as the General Hospital healthcare site, now being redeveloped, and the developing Science City campus adjacent to St James Boulevard.

7.1.6.4 There is also the potential to include a new cross-river link from the Scotswood Road area to the Metrocentre in the Paradise Bridge area, as described above; this option has not yet been assessed in demand or cost terms.

7.1.6.5 The topography of the preferred route includes an 8% gradient, and highway widths would dictate careful use of available space at several points along the route, meaning that the rolling stock specification outlined in Section 3 of the strategy would require the ability to cope with gradients of this magnitude. (For comparison, the maximum Metrolink gradient is 6.5%, on the Sheffield Supertram network it is 10%). This represents a potential constraining factor to the use of this corridor for network extension purposes.

**Issues**

7.1.6.6 This corridor is being assessed as part of a discrete Tyneside street-running network with similar characteristics to the South Shields – Doxford Park proposals described above. It could best be implemented in conjunction with the Team Valley and Metrocentre corridors described below – this is not an imperative but is seen as the most scalable way to bring Metro to adjacent areas of Newcastle and Gateshead where it would be technically impracticable to physically connect to the current network. The preferred route presents certain technical challenges, but in view of its reasonable patronage forecasts, it is recommended that any detailed assessment of the potential to extend Metro in this area of Newcastle examines and discounts this route first.
Demand

7.1.6.7 Forecast demand in 2030 along the preferred corridor from new stations only is 13,600 million passengers per year – the best performing of the identified network extensions. The 2030 patronage forecast for demand from new stations and the existing network – again, excluding the impact of any other network extensions – is 10,925 million passengers per year.

Costs

7.1.6.8 Taking account of the caveats previously expressed in relation to the accuracy of on-street construction costs at this stage, these are outlined below. They assume the construction of stations/halts at 1km intervals to reflect the densely populated nature of the route.

- Construction and electrification costs £148 million
- Rolling stock costs £14 million

**TOTAL £162 million**

Risks

7.1.6.9 The main risks attached to scheme implementation can be summarised as follows:

- The preferred route presents more technical difficulties than alternatives.
- Bus competition represents a potential threat to the viability of the route.
- If implemented on a stand-alone basis not as a part of an on-street sub-network there would be fleet stabling and maintenance issues to address.
7.1.7 Metrocentre to Gateshead / Newcastle

7.1.7.1 The Metrocentre is one of the most important ‘attraction’ destinations in the region, and the largest not served by Metro at present. 9000 full-time and part-time employees travel to the area daily, along with 23 million footfall visits per year48. It is well-served by local buses at a purpose-built transport interchange which includes a station on the Newcastle to Carlisle railway, however the absence of a Metro service has long been viewed as an important missing link in the strategic public transport network which this strategy seeks to address.

7.1.7.2 A physical connection to the existing Metro network from the Metrocentre appears difficult if not impossible to achieve, given the geology and levels around the Gateshead station area that suggest it would be expensive and difficult to construct. The route capacity of the Newcastle – Gateshead Metro corridor could also constrain the optimum frequency to and from this key destination.

7.1.7.3 The preferred option at this stage is to apply an on-street solution that connects Gateshead town centre to the existing Metrocentre public transport interchange. This would be built as part of a sub-network that includes west Newcastle and the Team Valley within its scope, of a scale that would revolutionise connectivity in this part of Tyneside and support stand-alone stabling and maintenance facilities. The proposal is being investigated in early 2014 at a more detailed level, with the support of Intu Properties plc., UK Land Estates and Gateshead Council. An on-street route which connects western Newcastle, central Gateshead and the Metrocentre area is envisaged as the most likely option beginning at Gateshead Interchange.

7.1.7.4 As noted above, the potential exists to link the Metrocentre area with west Newcastle by means of a low-level bridge over the River Tyne which could connect with north-south routes in the Scotswood, Benwell and Denton areas. Whilst these options have not been discounted at this stage, they have not been subject to initial technical and demand evaluation and remain as future connectivity options and in the context of how feasible it would be to run Metro on-street using one of the existing Newcastle - Gateshead road bridges.

7.1.7.5 Routes being examined include the Centrelink bus-only route from central Gateshead via Staiths South Bank and then on-street to the Metrocentre, or an on-street corridor using Bensham Bank. An alternative proposition would be to operate on a joint-running basis over part of the Newcastle to Carlisle Network Rail line eastwards from Metrocentre either to Newcastle Central station (mainline) or to a point where on-street access could be gained to central Gateshead. Route capacity would be an issue with this option. There are already four Northern Rail services in each direction plus freight services over the route, and there are aspirations linked with franchise devolution to enhance these frequencies in the future. The proposed Metro service to and from the Metrocentre would be high-frequency to cater for levels of demand, so in this case joint running arrangements are seen as an unsuitable solution.

7.1.7.6 Future development in the Metrocentre area is likely to increase future levels of demand. A number of sites east, north and west of the Metrocentre are included within the Metrogreen Strategic Growth Area which forms a key component of the NewcastleGateshead One Core Strategy

Additionally, existing and future pressures on the A1 trunk road corridor will highlight a requirement for more sustainable transport alternatives which Metro would be well-suited to fulfil.

7.1.7.7 The width of the A1114 Colliery Road between Teams and St Omer’s Road is a potential issue as it would be spatially constrained as a double-track route.

Demand

7.1.7.8 Forecast demand in 2030 along the Centrelink corridor from new stations only is 11.276 million passengers per year. The 2030 patronage forecast for demand from new stations and the existing network - excluding the impact of any other network extensions – is 16.078 million passengers per year.

Costs

7.1.7.9 On the same basis as estimates have been derived for the west Newcastle corridor, indicative costs are summarised below based upon stations at Gateshead and Metrocentre only:

- Construction and electrification costs £111 million
- Rolling stock costs £20 million

**TOTAL £131 million**

7.1.7.10 These will be calibrated more precisely once more detailed design work under way along this route has been completed.

Risks

7.1.7.11 The main risks to implementation are uncertainty as to the practicability of a cross-river on-street solution at this stage, the width of Colliery Road as described above, and the ease of access to the Gateshead Interchange area. In general however development of this corridor appears to have fewer risks than some others due to the low level of adjacent development along most of the preferred route. The condition of the High Level Bridge represents a major potential constraint to the operation of the route to and from Newcastle recommended by the consultants’ study\(^{50}\). The bridge’s Grade I listed status and the construction details of the lower deck appear to preclude any potential use of this structure.
7.1.8 Team Valley to Gateshead /Newcastle

7.1.8.1 Development of a Metro network extension to serve the Team Valley area could be implemented on a stand-alone basis, or using part of the infrastructure required to access the Metrocentre area.

7.1.8.2 The rationale behind the proposal to extend the network to the Team Valley area is based around the comparative lack of sustainable transport links from other areas of Tyne and Wear. Home to around 20,000 jobs and with a substantial and growing retail presence in the Retail World and Maingate areas, Team Valley is also constrained by the pressures on development exerted by the congested A1 trunk road. UK Land Estates administers the bulk of the estate, and the width of the highway network is favourable towards the construction of an on-street Metro corridor.

7.1.8.3 Potential routes between Team Valley and Gateshead town centre include one diverging from the Centrelink corridor, which would be easier and less costly to construct with faster journey times, but would attract less in the way of intermediate traffic. A further option via Bensham Bank has significant gradients.

7.1.8.4 The initial technical survey suggested two station locations on Team Valley (North and South), however it is proposed that at least three would be provided, with access via the central route of Kingsway where there is sufficient space to operate down the central reservation once provision is made for the River Team culvert over part of the route. A terminating location has yet to be formalised, however there could be strategic advantages in extending towards the Tyne Yard area (Lamesley) to serve strategic Park and Ride or development opportunities, although these should be viewed as speculative at this time.

Demand

7.1.8.5 Forecast demand in 2030 from new stations only is 4.220 million passengers per year. The 2030 patronage forecast for demand from new stations and the existing network – excluding the impact of any other network extensions – is 4.572 million passengers per year. These forecasts assume a route branching off from Centrelink.

Costs

7.1.8.6 On the same basis as estimates have been derived for other on-street corridors, costs are summarised below based upon stations located at roughly 1km intervals.

- Construction and electrification costs £148 million
- Rolling stock costs £14 million

**TOTAL** £162 million

Risks

7.1.8.7 The risks with the greatest potential impact are similar to those described in the section describing the Metrocentre corridor, namely how to secure an on-street route into the centres of Newcastle and Gateshead that is viable in engineering and cost / benefit terms. The uneven nature of demand over the operating day that applies to large employment sites may also represent a risk to the economics of the proposal.
### 7.1.9 Summary of predicted demand and initial estimate of costs of network extensions

<table>
<thead>
<tr>
<th>Corridor</th>
<th>Demand from new stations (mppa)</th>
<th>Demand from new stations and existing network (mppa)</th>
<th>Estimated costs</th>
<th>Format</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sunderland – Seaham</td>
<td>5.011</td>
<td>12.550</td>
<td>£41m</td>
<td>Off-street</td>
</tr>
<tr>
<td>Pelaw – South Hylton</td>
<td>3.954</td>
<td>7.737</td>
<td>£253m</td>
<td>Off-street</td>
</tr>
<tr>
<td>Howdon-Northumberland Park</td>
<td>1.214</td>
<td>4.062</td>
<td>£90m</td>
<td>Off-street</td>
</tr>
<tr>
<td>South Shields – Sunderland-Doxford Park</td>
<td>5.444</td>
<td>6.358</td>
<td>£420m</td>
<td>On-street</td>
</tr>
<tr>
<td>West Newcastle</td>
<td>13.600</td>
<td>10.925</td>
<td>£162m</td>
<td>On-street</td>
</tr>
<tr>
<td>Metrocentre- Gateshead - Newcastle</td>
<td>11.276</td>
<td>16.078</td>
<td>£131m</td>
<td>On-street</td>
</tr>
<tr>
<td>Team Valley</td>
<td>4.220</td>
<td>4.572</td>
<td>£162m</td>
<td>On-street</td>
</tr>
</tbody>
</table>

### 7.1.10 Other corridors examined as potential Metro network extensions

#### 7.1.10.1 In addition to the network extension corridors outlined in the previous section, a number of other potential routes have been examined at a baseline technical level. At this time it is recommended that they are not progressed towards detailed business case stage for the reasons described, but that they should continue to be kept under review should circumstances change in the future.

**Four Lane Ends to Killingworth**

#### 7.1.10.2 An extension corridor linking Killingworth to the Metro network by means of a route parallel to the A188 road was examined at a preliminary level, however as a corridor characterised by low density, dispersed residential areas and employment locations demand appears weak, and there are no major time advantages over bus feeders to the existing Four Lane Ends interchange and desired destinations such as Newcastle city centre.

**Byker or Chillingham Road to Walker**

#### 7.1.10.3 The concept of a loop line centred on the A186 Walker Road corridor was examined, on the basis that the route could diverge from the existing Metro line in the Chillingham Road area and head south through Byker into the Walker riverside district, then east via Welbeck Road and the Fossway to re-join Metro in the Walkergate station area.
7.1.10.4 Parts of this route already fall within the catchment area of the existing network, and an extension of the Metro within this area is unlikely to represent major journey time advantages over those achievable by bus. The extension of the existing Quaylink route to the Walker area, with appropriate bus priority measures, appears to represent a more viable alternative.

**Extension of Metro network via the Durham Coast route beyond Seaham**

7.1.10.5 The engineering principles which underlie the suggested extension of Metro services as far south as Seaham could apply equally to the expansion of Metro further down the Durham Coast route towards Teesside. In demand terms however there is little to commend the proposal. Adjacent population catchment densities fall off sharply south of Seaham, notwithstanding the possibility of the forthcoming station at Horden Sea View. The relative performance of Metro-type stock and heavy rail units also point towards a heavy rail solution as a more feasible option. Overall route capacity limitations also point towards a local rail service with fewer stops than would be provided by Metro.

**Ashington Blyth and Tyne line**

7.1.10.6 Reference is made to this route in section 7.1.4 in the context of the Cobalt Metro extension corridor. The restoration of rail services to the Blyth, Bedlington and Ashington areas is viewed as a key strategic priority by Northumberland County Council and regional partners. The route is currently in the ownership of Network Rail and is a lightly-used freight corridor.

7.1.10.7 Discussions have taken place over several years as to how services might be provided if funding were to become available. Extension of the Tyne and Wear Metro network to include these locations is one a range of options that the County Council has raised in its feasibility discussions with Network Rail and others. Taking account of route electrification costs and the sparsity of intermediate traffic between Blyth and Northumberland Park, it is suggested that a diesel multiple unit heavy rail service may be more appropriate to the characteristics of the corridor and could be provided a lower cost. However the situation will be kept under review, and more radical options such as a hybrid diesel/electric tram train could also be suitable. It would be technically relatively straightforward to connect the Ashington Blyth and Tyne route into the Metro network, either at Northumberland Park station or by means of the Cobalt corridor, or both. If there is no direct connection, then an interchange at Northumberland Park is highly desirable.

7.1.10.8 Development of the Network Rail GRIP business case beyond Stage 3 will define the preferred option for the re-opening of the route to passenger rail services. It is at this stage that the concept of inclusion within the Metro network can then be further developed or dismissed.

**Leamside line**

7.1.10.9 The Leamside corridor stretches 29 km from Tursdale near Ferryhill to Pelaw, via Durham Belmont and the eastern suburbs of Washington. The proposals for part-use of the corridor in two discrete sections to allow Metro to operate between Pelaw and South Hylton are set out in section 7.1.3 above.
7.1.10.10 The Leamside corridor is viewed as of strategic long-term importance by North East transport authorities and the region’s two Local Economic Partnerships, with its potential to provide additional capacity for long-distance freight services as well as the East Coast Main Line and Durham Coast routes. It could also facilitate operation of intra-regional semi-fast and local passenger rail services serving areas including Durham Belmont A690 Park and Ride, Fence Houses, Penshaw and a station for Washington remote from the town centre in the vicinity of the A1231 Sunderland Highway.

7.1.10.11 Although Metro could feasibly be used as a means of serving communities as far south as Durham Belmont, the characteristics of the route and the variety of services that could use it were it to be re-opened in the future suggest that, as with the Durham Coast and Ashington Blyth and Tyne corridor, a heavy rail-based solution is likely to be the most appropriate intervention, although this will be kept under review as the progress of the Pelaw to South Hylton proposals and the future of the Leamside itself evolve. Decisions as to the best ways forward for these transport corridors are likely to be early priorities for the Combined Authority.

Extension to Ponteland

7.1.10.12 A dismantled railway alignment to Ponteland and Darras Hall in Northumberland suggests the long-term possibility for extension of the existing Metro network beyond its existing terminus at Newcastle Airport. A route diverging from the existing Metro line just short of the Airport station and proceeding across the A696 Trunk Road (probably on a viaduct) could then revert to the former alignment to reach to a new station site in the Callerton Lane area of Ponteland.

7.1.10.14 The costs of crossing the A696 and the fact that Ponteland lies outside Tyne and Wear’s boundary have militated against further development of the concept to date. Levels of demand would also need to be clearly established. Should further developments be proposed in Ponteland then Metro could be viewed as a means of sustainable transport access to a settlement with an existing population of 12000 people, subject to appropriate developer contributions. Therefore whilst there are no current plans for further analysis on this corridor, the option exists to do so in future.

Above: a section of the remaining single-track corridor on the potential Cobalt network extension
7.2 Demand Appraisal of Potential Extension Corridors

7.2.1 Methodology

7.2.1.1 This section of the strategy analyses the conclusions and recommendations of the 2012 Metro Demand Study\textsuperscript{52} commissioned by Nexus. It explains the assumptions and methodology used in the study, and interprets its conclusions in the context of external factors and local knowledge of the corridors under review. It concludes by recommending which of the corridors identified should be considered for further, more detailed appraisal work.

7.2.2 Metro Demand Study

7.2.2.1 The study provided the following information:

- a summary of the demand forecasting approach adopted;
- a discussion of the main drivers of demand for Metro and expected trends to 2030;
- demand and revenue forecasts for the existing network and potential extensions and risks to those forecasts, and
- MVA’s recommendations as to the corridors deemed worthy of earliest further investigation.

7.2.2.2 The forecasting approach employed was that of a direct demand, elasticity-based model which uses observed (historical) relationships between demand and explanatory variables from historic data on the existing network, combined with additional evidence from comparable urban networks across the UK, to estimate future year demand. Use of data from the existing network is seen as a valid proxy for the extension corridors, because although their individual characteristics may differ, the network is sufficiently varied to include attributes characteristic of each extension.

7.2.2.3 Data sources used as inputs to the model included the following:

- Internal – ticket sales and revenue, passenger survey data, fares, generalised journey times, punctuality and station and vehicle quality
- External – population, employment, regional GVA, retail sales, airport users and student numbers
- Competing modes – fuel costs, car ownership, car times, bus fares, bus times and bus headways

7.2.2.4 Each market segment was then tested to identify statistically significant drivers of Metro demand to ensure that the model outputs were relevant to the area and did not import behavioural elements from elsewhere. Three separate scenarios were then created to represent the respective impacts of:

- faster economic growth
- a policy-neutral environment
- employment and population levels remaining at 2011 levels.

\textsuperscript{52} Tyne and Wear Metro Demand Forecasting Study, MVA Consultancy 2012
7.2.2.5 Recognising that the proximity of some of the identified extension corridors to each other is such that multiplier effects could occur if several opened at once, the model assessed a number of scenarios whereby one or more than one extension corridor within a geographical area was opened to passengers. The growth scenarios were benchmarked against an independent regional economic forecast\(^5\) which set out the anticipated changes to GVA predicated upon a number of possible economic and demographic scenarios.

**Assumed technologies**

7.2.2.6 The demand study made some informed assumptions as to the technology most likely to be used on each extension corridor, as this can affect journey times, service patterns and timetables. These assumptions were as follows:

<table>
<thead>
<tr>
<th>Corridor</th>
<th>Technology</th>
<th>Daytime Timetables</th>
<th>Variants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seaham – Sunderland</td>
<td>Metro on Network Rail infrastructure</td>
<td>Extension of Airport service at 12-minute headway</td>
<td>Tram train for alternate through-running possibilities</td>
</tr>
<tr>
<td>South Shields – Sunderland –Doxford Park</td>
<td>On and off-street light rail</td>
<td>6-minute headway</td>
<td>Tram train for through-running possibilities</td>
</tr>
<tr>
<td>Denton – Newcastle city centre</td>
<td>On-street light rail</td>
<td>6-minute headway</td>
<td>Can be integrated with Team Valley, Metrocentre routes</td>
</tr>
<tr>
<td>Newcastle to Team Valley</td>
<td>On-street light rail; river crossing to be determined</td>
<td>6-minute headway</td>
<td>Tram train for through-running possibilities</td>
</tr>
<tr>
<td>Gateshead Metrocentre</td>
<td>On-street light rail</td>
<td>6-minute headway</td>
<td>Tram-train, integration with Team Valley/W Newcastle corridors</td>
</tr>
<tr>
<td>Pelaw - Washington</td>
<td>On and off-street light rail</td>
<td>Up to 6-minute headway</td>
<td>Tram train possibilities</td>
</tr>
<tr>
<td>Northumberland Park – Cobalt -Howdon/Percy Main</td>
<td>Metro on Nexus infrastructure</td>
<td>Every 12 minutes between Longbenton and St James via Wallsend</td>
<td>N/A</td>
</tr>
</tbody>
</table>

\(^5\) Regional Economic Forecast. Arup 2012.
7.3 Links to Land-use Planning

7.3.1 There are residential and/or industrial developments planned along all of these extension corridors, but those locations where major land-use interventions are planned include the following:

- MetroGreen – the future expansion of the area surrounding the Metrocentre involves substantial retail, office, residential and leisure developments. As the adjacent A1 trunk road is heavily congested the local planning is clear that a large proportion of trips generated by the proposed development must be made by non-car modes.
- Team Valley – the area is similarly affected by the impact of A1 road congestion and provision of Metro services would help to facilitate any major proposed changes to the area’s industrial land allocations.
- Washington area – extension of existing activities at the Follingsby Business Park and within the Swan and Pattinson industrial areas of Washington will be aided by provision of a Metro extension serving this area.
- West Newcastle – depending upon the alignment selected, an on-street Metro corridor could help provide sustainable access to the large areas of economic regeneration in the Scotswood and Benwell areas.
- Cobalt Business Park – extensions to the existing footprint of the business park alongside further adjacent residential development are proposed in the local authority core strategy.
7.4 Integration

7.4.1 Metro came into being as an integrated transport network, and its future will be best-served if the existing network and any extension corridors are fully integrated with all complementary modes of travel. Demand forecasting techniques assume an 800 metre ‘walk-in’ distance for new Metro stations however this may be at the upper end of acceptability for some customers, particularly those who are less mobile. Effective integration can also extend the influence of the Metro network to journeys that begin and end long distances away e.g. the existing use of Heworth Park and Ride by customers with Teesside home postcodes, as evidenced by recent market research.

7.4.2 The following integration opportunities have been identified at this stage relating to the extension corridors that are featured in the strategy:

- Sunderland to Seaham – Ryhope Park & Ride
  - Sunderland city centre
- South Shields to Doxford International – South Shields town centre
  - Sunderland city centre
  - A19 Doxford Park & Ride
- Pelaw to South Hylton – Follingsby Park & Ride
  - Washington town centre
- Gateshead to Metrocentre – Gateshead Interchange
  - Metrocentre Interchange
- Gateshead to Team Valley – Gateshead Interchange
  - A1 Lamesley Park & Ride
  - Team Valley North
- West Newcastle – A69 Lemington Park and Ride
- Cobalt Corridor – Northumberland Park P&R (including AB&T)

7.4.3 Effective integration is about good links between Metro and buses, trains and cars, but should also include facilities that go beyond the traditional and make full provision for electric car users, car club users, cyclists and pedestrians, with the emphasis on ensuring that all of the perceptual, physical, informational and financial barriers to integration are removed or reduced as far as possible.
Conclusions and Recommendations

7.5.1 The corridors outlined in this section are those considered at this stage to have greatest future potential for future development, based upon demand forecasts and/or the likelihood of changes to land-use patterns that make construction a realistic proposition supported by a robust business case.

7.5.2 The identified corridors represent exciting opportunities to extend the reach of Metro to areas not currently served, and to introduce on-street operations to the Tyne and Wear area for the first time. At this stage of the strategy they represent the beginning of an ongoing conversation with local and regional stakeholders as to how Metro can ensure that the area gets the sustainable transport network it requires throughout the decades to come. Further detailed technical analysis will be required to assess their financial and operational viability.

7.5.3 Recommendations in respect of these network extension proposals are as follows:

- Undertake further technical feasibility work with key stakeholders in respect of those corridors that appear to have the best prospects in terms of demand, deliverability and financing.
- Ensure that these corridors are incorporated as appropriate into long-term transport plans and economic plans.
- Monitor these corridors for forthcoming developments that could be a catalyst for implementation.
Section 8: FINANCING OPTIONS

8.1 Context

8.1.1 Identifying and securing adequate funding from reliable sources are critical considerations for this strategy. Fleet renewal, and the construction of any extensions to the existing network, will be major developments for Nexus on a similar or greater scale to the Phase 2 Asset Renewal Programme. Given the extent of public funding already invested in the ongoing renewals programme, it is vital that funding is sourced to guarantee the long-term future security and growth of Metro. Before progressing to the preparation of detailed business cases in due course, there needs to be an understanding of the risks and opportunities attached to securing funding, and the likelihood of that level of funding becoming available at the appropriate time from one or more sources.

8.1.2 Background research for the strategy demonstrates that several methods of prudential borrowing, loan financing and ‘earn back’ models have been used, or are being evaluated by other UK systems. For the most part, such models use the principle of a loan advanced in the prospect of a long-term repayment stream sourced by significant patronage growth and future fares revenues.

8.1.3 In relation to the existing network, this is not seen as an appropriate solution, as a rising debt repayment schedule set alongside modest patronage growth and a rising cost base and/or reduction in revenue grant support could result in future fare increases outpacing inflation, causing Metro to become uncompetitive relative to other modes. Indeed, the central approach adopted to financing the renewal of the existing Metro network in Reinvigoration Phase 2 was that capital expenditure should be funded in the main from government grant (with 10% sourced locally) but with efficiencies in operating costs such that both the central and local taxpayer benefited from a planned reduction in the net subsidy over the length of the first Metro operating concession which was awarded to DB Regio Tyne and Wear Limited in 2010.

8.1.4 Therefore, the over-riding principle to the financing of this strategy is that as far as is practicable, funding arrangements for investment in the ‘steady state’ existing infrastructure should also not add to the future revenue cost base and the core proposition at this stage is that the final phase of Metro reinvigoration, comprising the procurement of a new fleet of trains, will be funded in the main via central government sources, preferably through capital grant.

8.1.5 Any extensions to the existing network are more likely to be funded through a portfolio of funding consisting of grants and/or loans from a variety of sources depending on individual circumstances, including such as the following:

- Central government funding
- ‘Planning gain’ and developer contributions
- Borrowing against future fares revenue where there is demonstrable demand evidenced by a sound business case

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54 Including local tax increment financing and the Community Infrastructure Levy as appropriate
• EU funding for specific objectives, such as through the European Regional Development Fund programme
• Regional funding streams, currently via the Single Growth Fund
• European Investment Bank loan finance
• Commercial sponsorship opportunities
• Local government funding

8.1.6 In each case where an extension of the Metro network is proposed, the creation of a detailed business case will explore these various funding streams in greater detail. As mentioned earlier in the strategy, provision of additional train fleet to operate over new lines could be funded separately through the same channels or as part of a wider fleet renewals programme.

8.1.7 Future financing of the existing Metro system and any network extensions will be always be subject to external influences. Independent economic forecasts of regional and national Gross Value Added have been commissioned to provide an insight into the most likely outcomes, but the vulnerability of the regional economy to global shocks has been clearly shown in recent years, and this unpredictable threat is likely to persist.

8.1.8 Some funding options are likely to be linked to future concession arrangements, and these may include elements such as Design, Build, Maintain and Operate which will link funding for rolling stock and/or network extensions to the nature of the operating agreements that Nexus is able to conclude going forward. For example, additional new rolling stock and network extensions at Nottingham Express Transit have been procured through the mechanism of a long-term concession concluded between Nottingham City Council and concession holder Tramlink Nottingham (an Alstom/Taylor Wimpey joint venture).

8.1.9 Further discussion of funding options takes place in Appendix 2.

8.2 Conclusions and Recommendations

8.2.1 Nexus will actively investigate all options for the future financing of Metro that offer the best combination of security, flexibility and value for public money.
Section 9: SUMMARY OF RECOMMENDATIONS

Existing Network Demand

- Monitor existing and predicted future demand for Metro closely.
- Monitor regional and national economic and planning trends.
- Maximise demand through the delivery of reliable services that meet customer requirements.
- Liaise closely with the Local Economic Partnership to ensure the optimum locations of development proposed within the Strategic Economic Plan.
- Liaise with district planning authorities to ensure that the principles and detailed design of developments are planned so as to maximise accessibility by Metro.
- Work with local authorities on the introduction of new stations on the existing network where these are justified by demand, sought by local communities and are operationally feasible.

Fleet Renewal

- Commission as a priority, a study to establish the maximum train throughput using Nexus’ existing signalling system
- Assess the financial and practical implications of a further, final ‘Life Extension’ refurbishment of the existing Nexus vehicles in 2025, compared to procurement of a new fleet
- Undertake consideration and economic assessment of options for the design of a new Nexus Metro vehicle type or types

Power Supplies

- Retain 1500V DC operation for Nexus’ own on-track network, and investigate the implications of either extending this to on-street operation or using 750V DC in a separate on-street fleet.
- Consider a dual-voltage 1500V DC / 25kV AC facility as a key specification for a new fleet.
- Consider the energy-efficiency benefits of regenerative braking in detail in the design of both new vehicles and renewed substations.
- Monitor and feed into Network Rail’s plans for future regional roll-out of electrification.

Depot Facilities

- Establishment of options and outline costings to refurbish the existing Gosforth Depot to provide long-term sustainability of operations.
- Estimate the costs of a brand new main depot.
- Identify and come to an initial view about alternative sites for a new main depot, or smaller out-stabling depots.
- Identify the likely disposal proceeds of Gosforth Depot, were it to be sold.
- Come to a conclusion about the preferred options on the site of a main depot and stabiling facilities.
Signalling and Control

- Undertake more detailed research into the rationale(s) and potential benefits and disadvantages of a fundamental change to the Metro signalling and control system, compared to the retention of a broadly like-for-like system.
- Continue engagement with the COMET/NOVA working group of worldwide Metro networks which is currently examining CBTC and increased automation.

Energy Supply, Efficiency and Renewables

- Continue on an ongoing basis to identify and implement cost-effective energy-saving opportunities on Metro
- More work be carried out on the opportunities for renewable energy generation or contracting
- Given its long-term criticality to Metro operation, establish a formal Energy Strategy

Customer Requirements

- Develop and maintain close contact with Metro users and non-users to establish a deep understanding of customer preferences.
- Incorporate customer requirements into the design of new rolling stock as far as practicable.
- Ensure that Metro fares and ticketing products are simple to understand and relate to users’ needs.
- Continue to provide accurate and timely proactive and reactive service information in formats that customers want, taking account of wider accessibility needs.
- Design new and refurbished stations that are modern, safe and welcoming.
- Promote Park and Ride facilities where feasible and justified by demand.

Concession

- The key recommendation is to remain open-minded as to the exact definition of a future concession framework, as it is likely to be shaped by several key factors including:
  - Customer requirements.
  - Availability of finance and loan guarantees.
  - Progress towards the identification of viable network extensions.
  - Design, Build, Operate and Maintain options.
  - Assessment of strengths and weaknesses of the existing concession arrangements.
  - Opportunities to achieve economies of scale.
  - The concession renewal process should, if possible, be based around a three-package approach with the option retained to combine or separate as governed by financial and market factors and constraints.
Network Extension Corridors

- Undertake further technical feasibility work with key stakeholders in respect of those corridors that appear to have the best prospects in terms of demand, deliverability and financing.
- Ensure that these corridors are incorporated as appropriate into long-term transport plans and economic plans.
- Monitor these corridors for forthcoming developments that could be a catalyst for implementation.

Finance

- Actively investigate all options for the future financing of Metro that offer the best combination of security, flexibility and value for public money.
Appendix 1: CASE STUDIES OF OTHER UK URBAN RAIL NETWORKS

A1.1 Manchester Metrolink

A1.1.1 Manchester Metrolink is a light rail network which currently serves areas including central Manchester, Altrincham, Bury, Oldham, Eccles and Rochdale and is an example of a network built in response to a need identified during the 1980s for a more integrated and efficient network of public transport due to the poor north-south connections across Manchester city centre. Due to the vagaries of 19th century railway development, two almost independent networks came into being north and south of the city centre, with many journeys across the city requiring a half-mile walk between the two main railway stations, Piccadilly and Victoria. At the time the Tyne and Wear Metro was being built serious consideration was given to a ‘Picc-Vic Tunnel’ connecting the two Manchester railway hubs, however nothing was progressed and it was not until a decade later that firm plans were made for a surface-level network, part street-running, partly on former suburban rail routes that would plug the accessibility gaps existing between areas of the Greater Manchester conurbation.

A1.1.2 Government approval was granted in 1988; however an arrangement was imposed on the scheme known as a “complete concession” approach whereby private organisations were invited to submit tenders for designing, building, operating and maintaining (DBOM) the network as well as stipulating that the network must be constructed in phases. The first phase opened in 1992 at a cost of £154 million connecting Bury with Altrincham via the streets of central Manchester. It has since grown organically and is now a major urban light rail network with 69 stops running through seven of the ten boroughs of Greater Manchester. The network operates on a mixture of designated light railway alignments (segregated from other traffic) and as an on-street tramway (shared with pedestrians and vehicles). All trams are monitored by CCTV, as well as there being an emergency call point on both trams and platforms. Like Nexus Metro the network is unstaffed, but is regularly patrolled by a dedicated Metrolink police unit.

A1.1.3 Transport for Greater Manchester (TfGM) owns the network, and RATP Dev UK Ltd operates and maintains the Metrolink network under a 10-year contract with TfGM which runs until July 2017. The network operates approximately 19 hours per day. Extensions to the network throughout the past five years include to MediaCityUK and Chorlton in 2011, with the latest openings to East Didsbury and Ashton-under-Lyne during 2013. The second city crossing via Deansgate was approved in October 2013, relieving the bottleneck caused by all routes funnelling into the existing Piccadilly route. By 2016, when the current expansion programme is due to be completed, Greater Manchester will have one of the largest light networks in the UK, with forecasts of 45 million passengers per year comparable with those for Metro.

A1.1.4 Network details

<table>
<thead>
<tr>
<th>Description</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of trains</td>
<td>126, both T68 and M5000 tram variants</td>
</tr>
<tr>
<td>Power supply</td>
<td>750V DC with overhead line equipment</td>
</tr>
<tr>
<td>Maximum speed</td>
<td>80 km/h</td>
</tr>
<tr>
<td>Tram capacity</td>
<td>206 per train (58 seated)</td>
</tr>
</tbody>
</table>
Gauge: 1435mm
Park and Ride: At ten sites across the network
Operating Mode: Driver operated, with line-of-sight signalling (GoA0)
Depots: Trafford Park and Queens Road
A1.2 London Tramlink

A1.2.1 London Tramlink is a light rail network in south London operated by London Tramlink, an arm of TFL. It serves seven National Rail stations en route and one interchange with the London Underground. Tramlink runs on a mixture of on-street tracks shared with other traffic, dedicated tracks on public roads and off street tracks consisting of new alignments, former railway lines and one section of alignment (but not track) shared with a third-rail electrified Network Rail line.

A1.2.2 Traffic began to create serious traffic congestion problems in Croydon area during the 1980s and to help counteract these effects the Croydon Tramlink Act received Royal Assent in 1994 and Tramlink Croydon Limited (TCL) was awarded a 99-year lease to design, finance, build and operate the network. The total project cost around £200 million of which around £125 million was government-funded. In 2008 Transport for London (TfL) reached an agreement to buy the Tramlink concession for £98 million and TfL now owns and operates the network outright.

A1.2.3 The network comprises four routes with an overall track length of 28km. There are 39 stations in total which are unstaffed with automated ticket machines. All stops are fully accessible and include CCTV and a passenger help point.

A1.2.4 Annual passenger journeys in 2012/13 were 30.1 million. All TfL ticket products are valid on Tramlink. Cash fares and pay as you go Oyster card fares are available as on London buses, although special fares may apply when using Tramlink feeder buses.

A1.2.5 Tramlink operates at speeds up to 80 km/h on the “line of sight” principle. Signalling is only provided to regulate the movement of trams at junctions and at single line sections. All street running signalling is controlled by the highway traffic signal controllers provided by London Streets. Off street signalling follows highway principles and is managed by LT’s Engineering team.

A1.2.6 The Mayor’s Transport Strategy for London includes possible extensions to the Tramlink network which could be developed at relatively modest cost. An initial review of potential Tramlink extensions has been prepared and as a result TfL has expressed a wish to carry out initial development on evaluation work on six routes.

A1.2.7 Network details

<table>
<thead>
<tr>
<th>Number of trains</th>
<th>30 (24 Flexity Swift CR4000 &amp; 6 Variobahn)</th>
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</thead>
<tbody>
<tr>
<td>Power</td>
<td>750 V DC overhead line supply</td>
</tr>
<tr>
<td>Maximum Speed</td>
<td>80 km/h</td>
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<tr>
<td>Capacity</td>
<td>200 (72 seats in newest trams)</td>
</tr>
<tr>
<td>Gauge</td>
<td>1435 mm</td>
</tr>
<tr>
<td>Park and Ride</td>
<td>No</td>
</tr>
<tr>
<td>Operating Mode</td>
<td>Driver operated (GoA0)</td>
</tr>
<tr>
<td>Depots</td>
<td>Therapia Lane depot</td>
</tr>
</tbody>
</table>
A1.3  Nottingham Express Transit

A1.3.1  Nottingham Express Transit is a light railway network which runs on a mixture of on street running and reserved track. The line is 14km long of which 4km is on street and currently serves 23 stations within the City of Nottingham area.

A1.3.2  Construction of the scheme lasted 16 years from inception to implementation, opening in 2004 at a cost of £200 million. The building of the network was influenced by high population density, and complex road network due to Trent river crossings and road congestion. A special purpose company consortium, Arrow Light Ltd, was created to design, build, fund, operate and maintain NET Line 1.

A1.3.3  Nottingham Express Transit is day-to-day funded through the proceeds of the Nottingham Workplace Parking Levy, which is also the main source of funding for network extensions. Further details of the principles and practicalities of the levy are covered elsewhere in the strategy.

A1.3.4  Annual patronage is currently 7.7 million. Tickets are sold on-board by conductors as well as the option to purchase online; however it is intended longer-term to replace the conductors with a combination of station based ‘ambassadors’, platform ticket machines and electronic ticketing.

A1.3.5  Future development of the network comprises a two-line extension serving the southern and western suburbs of Nottingham. The two lines in total will see an additional 17.4km of track provided with 28 new stops at a total cost of £570 million. The expansion of Park and Ride policy continues with 2500 new spaces divided between the Chilwell and Clifton terminals.

A1.3.6  Network details

Number of trains  15 Inceto AT6/5’s
Power  750V DC overhead line supply
Maximum speed  80 km/h
Capacity  191 (62 seated)
Gauge  1435 mm
Park and Ride  5 sites with 3000 free spaces
Operating mode  Driver operated (GoA0)
Depots  One
A1.4  **Sheffield Supertram**

A1.4.1 Supertram is the light rail network for the Sheffield area. It opened in 1994 at a construction cost of £240 million. It is owned by South Yorkshire Passenger Transport Executive (SYPTE) and operated and maintained by Stagecoach under a long-term operating concession.

A1.4.2 The network has three lines in total totalling 29km in length running on a mixture of on-street running, reserved right of way, and former railway alignment. Supertram uses its own control network for on-street running and at junctions.

A1.4.3 Tickets are sold on board via a conductor which improves staff presence on board and allows tickets to be systematically checked. Current ridership stands at 15 million passenger journeys per year. The service runs at a frequency of 10 minutes during the day and 20 minutes off peak on the two main lines, Yellow and Blue.

A1.4.4 The current fleet comprises heavyweight Siemens trams with a high power-to-weight ratio to cope with the steep hills encountered on some of the routes (up to 10% gradient). There is some service integration with commercially operated and secured services across the area, particularly along the Hillsborough corridor.

A1.4.5 Plans exist alongside the eventual arrival of the HS2 network to the Sheffield area to build a new Supertram line in the Dore area of Sheffield to provide cross-city connections with the proposed Meadowhall high speed rail station.

A1.4.6 The Supertram network is also notable as the location for the current UK tram train trial which will combine operations over Supertram and Network Rail tracks between Sheffield city centre and Rotherham. The tram train project is projected to cost £58m, funded around two thirds via DfT grant and one third through Network Rail financing upgrades to its infrastructure. The strategic justification for tram train on this corridor is mainly the potential for regeneration of the corridor. Seven new vehicles are being procured from Vossloh: three for the existing Supertram operation, three for the tram train operation, and one spare; nevertheless all of the new vehicles capable of tram-train operation.

A1.4.7  **Network details**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of trains</td>
<td>25</td>
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<td>Power</td>
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<td>80 km/h</td>
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<tr>
<td>Capacity</td>
<td>88 seated and 155 standing</td>
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<td>Gauge</td>
<td>1435 mm</td>
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<tr>
<td>Park and Ride</td>
<td>6 sites</td>
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<tr>
<td>Operating mode</td>
<td>Driver operated, on-board conductor (GoA0)</td>
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<tr>
<td>Depots</td>
<td>Nunnery Lane</td>
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</tbody>
</table>
A1.5 Docklands Light Railway

A1.5.1 Docklands Light Railway (DLR) is an automated network which opened in 1987 at an initial cost of £77 million to serve the Docklands area of east London. DLR emerged as to serve the need for cost effective public transport to the former Thames docks to stimulate a major programme of regeneration.

A1.5.2 The initial network comprised two routes, but, due to the Docklands area developing more quickly than anticipated, trams were extended to 2-car units and the network was expanded into the heart of the City of London. There have been additional extensions to the network from 1994 including to Woolwich Arsenal, Lewisham, London City Airport, and a line from Canning Town to Stratford.

A1.5.3 Although the majority of the stations are elevated, from the outset the network has been fully accessible. The stations have high platforms, level with the tram floors. Due to the trams being automated (GoA3), a Passenger Service Agent (PSA) is on board every tram and is responsible for patrolling the train, checking tickets, making announcements and controlling the doors. They can also take control of the train if there is equipment failure or in an emergency.

A1.5.4 The network is 40km long and has 45 stations. There are seven main routes, although two routes only operate at certain times of day. Average frequencies of the services are between 6-8 minutes. Current passenger journeys for 2011/12 were 78.3 million per annum. The network is part of the TfL London ticketing network, which includes Oyster pay as you go. There are no ticket barriers at DLR stations; correct ticketing is enforced by PSAs.

A1.5.5 Following a successful six-month trial, DLR now allows cyclists to take their bikes on the network outside of peak hours on Mondays to Fridays and without restrictions at weekends and on bank holidays.

A1.5.6 A future potential extension is from Gallions Reach via Barking to Dagenham Rock, designed to include the provision of five new stations designed to ensure integration with re-development of the area.

A1.5.7 Network details

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<td>Power</td>
<td>750V DC</td>
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<tr>
<td>Maximum speed</td>
<td>80 km/h</td>
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<tr>
<td>Capacity</td>
<td>Total capacity per car of 284 (70 seating)</td>
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<tr>
<td>Gauge</td>
<td>1435mm</td>
</tr>
<tr>
<td>Park and Ride</td>
<td>None</td>
</tr>
<tr>
<td>Operating mode</td>
<td>Automated with driver-controlled option (GoA3)</td>
</tr>
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<td>Depots</td>
<td>2</td>
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</table>
A1.6   Glasgow Subway

A1.6.1 The Glasgow Subway has some similarities with Metro in terms of its role in carrying large number of people short distances in inner-city areas; in other respects it is a unique network.

A1.6.2 The Subway has non-standard 1219mm-gauge tracks, and comprises twin tunnels on a 10.6 km circular route north and south of the River Clyde serving inner-city areas of Glasgow. Each circuit takes 24 minutes to complete and at peak times 4-minute headways apply. Smart ticketing technology will be in place prior to the 2014 Commonwealth Games. It is owned and operated by the Strathclyde Partnership for Transport (SPT) with approximately 12.5 million journeys made on the network each year. The route is fully underground. Flat fares are used with one fare for each of single, return, day and season tickets regardless of distance travelled.

A1.6.3 The Scottish Government has announced that it intends to majority-fund a £300 million revamp of the Subway which will see the replacement of 35 year-old rolling stock. There is an aspiration for future Unmanned Train Operation (GoA4) using a Communications-Based Train Control (CBTC) network; as the Subway is 100% underground and completely segregated this should be fairly straightforward to implement. Subway trains currently use Automatic Train Operation (GoA2) technology.

A1.6.4 Network details

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<tr>
<td>Maximum speed</td>
<td>80 km/h</td>
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<tr>
<td>Capacity</td>
<td>Total capacity per car of 284 (70 seating)</td>
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<tr>
<td>Gauge</td>
<td>1219m</td>
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<tr>
<td>Park and Ride</td>
<td>4</td>
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<tr>
<td>Operating mode</td>
<td>Automated, driver starts train (GoA2)</td>
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<td>Depots</td>
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</table>
A1.7  Merseyrail

A1.7.1 Merseyrail is different to the other UK case studies in this section as it is not a light rail network at all. It uses conventional heavy rail rolling stock and operating technology, with track infrastructure owned and operated by Network Rail and trains leased by the train operating company Serco - Abellio. Its purpose within this section dealing with other networks is as a heavy rail comparator scheme in terms of its unique operating structure, and also the similarities of the network to Tyne and Wear in terms of city centre tunnels and distances between station stops.

A1.7.2 The Merseyrail franchise is awarded by the Merseyside Passenger Transport Executive rather than the Department for Transport which currently issues all other rail franchises in England and Wales. This situation exists because its tracks are self-contained and are separate from the rest of the railway – no other services normally operate over the third-rail network. As a result of this isolation, the franchise-holder has explored the potential for vertical integration – as recommended by the McNulty Report55 - where responsibility for maintenance of the track is transferred from Network Rail to Merseyrail, however for the time being the Integrated Transport Authority has decided against changes to the established framework.

A1.7.3 The Merseyrail franchise covers a 25-year period from 2003. Because the franchise is locally specified and managed, it has a different focus and delivery framework to that of larger rail franchises. The rolling stock used on Merseyrail will need to be replaced shortly as it dates from the 1970s. New stock should be in service by 2019 and will have the option of dual voltage capability so it can be used on both the existing 750V DC third rail and the national standard 25kV AC overhead electrification system. The network is fairly unique in nature, which increases the need for a bespoke fleet of trains. Potential tram train links to the existing network to allow for on-street operation are also being examined.

A1.7.4 Supporters of longer franchise agreements cite developments such as M to Go, a combination of ticket offices and retail stores at several locations across the Merseyrail network. The concession-style structure of Merseyrail means that the franchisee does not take revenue risk, but receives an agreed management fee. However, there are incentives to grow revenue, with profit-share between Merseytravel and Merseyrail above an agreed threshold. So far Merseytravel has re-invested all such profits in the public transport network, such as the refurbishment to Liverpool Central.

Appendix 2: POTENTIAL FUNDING SOURCES

A.2.1. EU Funding

A2.1.1 Funding streams such as the European Regional Development Fund (ERDF) and the European Social Fund (ESF) are applicable although they are usually supplementary sources of funding are awarded on a competitive basis and not therefore guaranteed. In addition, the size, scope and eligibility of ERDF programmes vary over time.

A2.1.2 ERDF is the main vehicle by which the EU delivers its regional policy aiming to address the level of regional imbalances across the member states. As the EU has increased in size, so the focus of ERDF assistance has moved towards poorer and more peripheral nations than the UK. Nonetheless, the fund is still responsible for providing aid to regions to improve their level of economic competitiveness. The indicative allocations of ERDF and ESF for the period 2014-2020 have been announced, with €6.2 billion allocated to England, of which €539.6 million is allocated to the North Eastern LEP area. This is a significant sum however these funds represent the primary source of European funding across the entire LEP area for innovation, business, skills and employment so there will be competition for these resources.

A2.1.3 Metro would be more likely to seek ERDF support post-2020 and at this stage it is not possible to gauge the level of potential funding available, or the eligibility criteria. Applications are typically made during time-limited funding calls. ERDF support would most likely comprise only a minor element of a total funding package and would be dependent on the applicability of the programme and the availability of funding at a future point in time. Greater Manchester PTE secured 7.5% of the cost of phases 1 and 2 of Metrolink during the 1990s, and Nottingham Tram secured €4.2 million or 1.5% of the cost of the original network in 2004 from ERDF.

A.2.2 Central Government Funding

A2.2.1 Construction of the original Metro network during the 1970s was almost entirely funded by government direct grant. Regardless of the policies of a future administration or the UK’s financial position this is unlikely to happen to the same degree in the future, despite the success of Nexus in securing over £350million from government in respect of Metro Reinvigoration Phase 2. Where fleet replacement and extension proposals are in prospect the government will expect to see local contributions, private sector funding and other sources comprising the overall financing package.

A2.2.2 Notwithstanding the above, central government funding is still likely to comprise the largest single element of financial support for the next phase of Metro renewal and expansion. Where this support is likely to differ from that offered in the past is in the conditions attached to its use; for instance, the effective requirement to institute an operating concession in return for guarantees of future funding streams.

A2.2.3 Metro’s dual role of fostering economic development and meeting social needs together with Tyne and Wear’s relatively low density of population and level of GVA productivity combine to suggest that the network will not meet its total fixed and operating costs through revenue over the medium term, although long-term demand forecasts are more encouraging.\^56 In this environment, central

\^56 Metro Demand Study MVA 2012.
government support will still be vital. In order to establish a convincing business case to government to take forward for detailed consideration and a favourable outcome it will be essential to demonstrate the following:

- Sound value for money with a positive BCR.
- Detailed analysis of operational models to ensure best practice.
- Compliance with national economic, social and environmental policy goals.
- Evidence of private sector and business sector engagement and support.
- Optimal energy efficiency and CO₂ emissions reductions.
- Alignment where appropriate with developments on the national rail network.
- A track record of consistent success in major programme delivery.

A2.3 Regional Government Funding

A2.3.1 The landscape of regional governance has changed considerably over recent years, and this process will continue. The concept of greater devolution in policy terms has been embedded in central government decisions such as the devolution of major schemes and the trend towards local devolution and management of local passenger rail services. To date the effectiveness of the process has not been matched by an appropriate level of resources, but if the new frameworks deliver there is every prospect that these will follow. In addition, the creation of a Combined Authority with boundaries coterminous with the North Eastern Local Enterprise Partnership offers the potential for more extensive transport and land-use planning at a city-region level.

A2.3.2 The emerging framework offers great potential for the wider Metro network extension proposals to be planned and funded at a level that will improve city region-scale transport networks and meet the aspirations of adjacent areas of County Durham and Northumberland for improved transport links to and from Tyne and Wear.

A2.4 Single Growth Fund

A2.4.1 The 2012 Heseltine Report into UK economic growth recommends the creation of a single pot of funding for the work of Local Enterprise Partnerships. The proposal, broadly accepted by government, is to amalgamate 47 different funding streams in the categories of Skills, Local Infrastructure, Employment Support, Housing and Business Support into a single funding stream. This would comprise existing funding sources including local authority capital for infrastructure, DfT funding for local transport projects, and tax increment financing.

A2.4.2 The Single Growth Fund is potentially a positive opportunity for the future of Metro, as the concept, if applied as intended, will achieve economies of scale that will reflect the strategic contribution that Metro makes to sustainable movement at a city region scale. Beyond the high level benefits however is the fact that Metro will remain in a competitive funding situation at a regional level and may well be competing with additional local requirements from which it has historically been ring-fenced. Progress towards the implementation of a single pot on these lines will need to be closely followed as a member of the Combined Authority, and a clear vision of the benefits of Metro widely publicised to ensure that the network features highly in the frame of major infrastructure

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investment decisions. Such a policy would be in line with one of the Heseltine Report’s recommendations, which states:

“Formal collaborations between local authorities across functional economic market areas on matters covering economic development, regeneration and transport should raise the capacity of the areas to drive growth.”

A2.5 Local Government Funding

A2.5.1 At present local government is operating under constrained financial circumstances which are likely to continue over the medium-term. Despite this, there are likely to be continuing opportunities to benefit from wider government initiatives targeted at economic regeneration in which Metro will be able to play an integral part. A present day example is the City Deals programme where Newcastle and Sunderland, alongside other cities outside London, have been able to bid for funding to allow them to work with a city’s wider metropolitan area and across local authority boundaries, sectors, and professions – bringing together governments, cities, neighbouring authorities and local business leaders. The details of the Newcastle City Deal concentrate upon measures that will strengthen the city region economy through the creation of a city-centre Accelerated Development Zone and the implementation of Tax Increment Financing powers, described in more detail below. The net effect will be to increase economic activity and employment levels across the urban core through a programme of investment funded through localised business rate revenues. The annual uplift to GVA is estimated at £520million.58

A2.5.2 The Greater Manchester City Deal commits to funding an extension of Metrolink to Trafford Park as part of a programme of infrastructure investments that enhances city region-scale GVA, and light rail and tram train enhancements also feature in the City Deal plans of Nottingham and Sheffield respectively. At the appropriate time, Metro enhancements will be put forward for consideration as part of the Newcastle Region and Sunderland and the North East City Deals programmes in view of the contribution which the network brings to city region connectivity.

A2.6 Revenue Hypothecation of Local Taxes

A2.6.1 Nottingham Express Transit directly benefits from a regular income stream, reaped from the proceeds of the city-wide Workplace Parking Levy (WPL). An estimated £322m over a 14-year period will be directly invested in transport improvements, principally the Phase 2 extensions of the tram network towards Clifton and Chilwell. This is set down as a requirement in the legal order accompanying the levy59.

A2.6.2 Levying roughly £1 per day on each parking space of all employers within the City of Nottingham with 11 or more spaces will fund a large proportion of the costs of extensions to the city’s tram network. However the WPL was introduced in the face of significant public opposition from employers and the public, and, significantly, was not the subject of a public referendum; similar measures proposed related to congestion charging in Manchester and Edinburgh were voted down by participants in referenda there. Long-term political commitment by City of Nottingham Council and the unitary nature of the city’s political governance, including the presence of a municipally-

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58 Newcastle City Deal 2012. Gov.UK
59 The City of Nottingham Workplace Parking Levy Order 2008
owned city bus operation, appear to have helped the process through to implementation, and a
general public acceptance. No other UK local authority has yet followed Nottingham’s lead with
respect to workplace parking levies.

A2.6.3 Given that the population of Tyne and Wear is greater than that of the Greater Nottingham urban
area there could be potential for the introduction of such a measure in the long term, however the
political and economic ramifications are such that it should not be relied upon as a means of
financing the future of Metro.

A2.6.4 Hypothecation of revenue from car travel towards other modes of transport, including public
transport, has been present in central London since the introduction of the Congestion Charge in
2003. Currently at £10 per day with several exemptions, the Charge produced an annual net income
of £137m during 2011/12\textsuperscript{60}. Of this income a substantial proportion is spent on the maintenance and
improvement of the Tube. Similarly to Nottingham, the Congestion Charge was imposed without a
referendum. In both cities, despite considerable initial public concern, this has died down as the
local populace has got used to the new situation, and perhaps more importantly, can see a direct
(due to hypothecation), highly-visible outcome of these taxes in the form of much-improved public
transport networks.

A2.6.5 As with a workplace parking levy, a congestion charge levied upon motorists entering central
Newcastle/Gateshead and/or Sunderland would generate an on-going funding stream to provide
capital and revenue finance for Metro. Although there is little prospect of either of these
mechanisms being introduced currently, it is recommended that should there be a shift in regional
or national policy towards them over time (with pressure for some form of road-pricing expected to
increase as fuel duty revenues decrease over the medium/long term), then the principle as a means
of funding Metro should be thoroughly investigated. Equally, detailed planning for the network
should not be predicated upon their being implemented for the foreseeable future.

A2.7 Local Tax Increment Financing

A2.7.1 Tax Increment Financing (TIF) is a public financing method that is used to fund redevelopment,
infrastructure, and other community-improvement projects. The provisions for this are contained
within the Local Government Finance Act 2012.\textsuperscript{61} TIF works by allowing local authorities to borrow
money for infrastructure projects against the anticipated increase in business rates income expected
as a result of the said infrastructure project. The UK TIF model is based on reinvesting a proportion
of future business rates from an area back into infrastructure and related development. It applies
where the sources of funding available for a scheme to deliver economic growth and renewal cannot
cover the cost of infrastructure required by the scheme. The upfront funding may be borrowed from
public or private sources, or it may be provided by the developer from capital available to it.
Previously local councils had been unable to retain business rates revenues, so had been unable to
borrow against them.

A2.7.2 If successful, TIF can lead to increased regeneration and long-term benefits. However key to the
success of any TIF initiative is the ability to predict that a long-term increase in the income accruing
from business rates will result from the introduction of the infrastructure. To achieve this in the case

\textsuperscript{60} TFL Annual Report and Statement of Accounts. TFL and Mayor of London 2012.
\textsuperscript{61} Tax Increment Financing. Commons Library Standard Note 2013
of Metro it will be necessary to demonstrate how network extensions will unlock development potential, increase economic activity and enhance the benefits of agglomeration. Were councils to confirm through their Local Development Frameworks that all future developments should be prioritised along Metro corridors, this would help greatly with the reliability of predictions for TIF.

A2.7.3 As legislation stands Nexus is not able to raise TIF funding itself; that power rests with rate-levying authorities, so any allocation towards the Metro network would be by agreement with those areas which would benefit from extensions.

A2.7.4 TIF and City Deals have similar structures. The ‘earn back’ arrangement that Manchester City Council has secured through its City Deal will allow the council to invest in transport infrastructure with the benefit of a long term, ring-fenced income stream.

**A2.8 Prudential Borrowing**

A2.8.1 The Local Government Act 2003 allowed local authorities to borrow to invest in capital works and assets so long as the cost of that borrowing was affordable and in line with principles set out in a professional Prudential Code. Most debt of this type is long term and 74% of this is secured from the Public Works Loan Board, a statutory body operating within the UK Debt Management Office, an Executive Agency of HM Treasury. Fixed rate long-term loans are typically currently available at around 3% for a 20-year period allowing long-term financial planning to take place on this basis subject to reasonable certainty of a future income stream to allow repayment. About 66% of local authorities availed themselves of powers to finance capital expenditure through self-financed borrowing in 2010-11.

**Earn Back – the Greater Manchester model**

A2.8.2 The Earn Back model applying in Manchester builds on the GM Transport Fund established in 2009 following an unsuccessful referendum on an area-wide congestion charge that would have provided an income stream for transport improvements. Investment is prioritised on the basis of net GVA impacts at the Greater Manchester level; and most of the £1.2bn programme finance is being provided locally through Prudential Borrowing against revenues and a levy on the local authorities, pro-rated to population.

A2.8.3 The Earn Back Model uses a formula, linked to changes in rateable values over time at the conurbation level, to provide a revenue stream to Greater Manchester over 30 years if additional GVA is created relative to a baseline. Earn Back provides an additional incentive for local authorities to prioritise local government spending to maximise GVA growth. If successful in driving economic growth, under Earn Back Manchester will receive a larger proportion of resultant tax take generated from this growth than would otherwise be the case under business rate retention. The ‘earned back’ resources would be used for further investment, similarly prioritised on net GVA impact at an area level, in theory creating a genuine ‘virtuous circle’ which rewards local authorities for delivering growth.

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62 The Prudential Code for Capital Finance in Local Authorities (Summary) CIPFA 2011.
63 Local Government Financial Statistics England No.22 2012. DCLG/ONS.
The Greater Manchester area is likely to benefit from this framework because it has the following attributes important to success:

i. A large local investment fund – GM is pooling resources to generate a £1.2bn local investment fund, which is big enough to drive above average growth.
ii. The right economic geography – Earn Back will operate across the functional economic area to reduce displacement locally.
iii. Track record of GVA prioritisation – Greater Manchester has demonstrated the ability to prioritise investment decisions based on impact on GVA through its Transport Fund.
iv. Strong governance across the economic area – through the Greater Manchester Combined Authority a track record has been created of multiple authorities pooling resources, sharing risks and benefits, agreeing strategic investment programmes and working together to deliver.

The locally funded element of the programme is expected to deliver a short term boost to demand in excess of £2bn by 2016. In the longer term the forecast economic impact of the local contributions exceeds £1bn per annum by 2025. At least 25% of the impact is predicted to derive from productivity gains. In addition, operating at conurbation scale will reduce displacement from elsewhere in the city. The Greater Manchester Combined Authority asserts that the GVA-led and self-sufficiency principles behind the Earn Back model provide strong support to further progress the transport investment programme established through the original Greater Manchester Transport Fund set up in 2009 in the wake of the congestion charge referendum.64

Although the Greater Manchester process is an evolving one, the early signs are positive and it is a model that the Tyne and Wear area must consider strategically as a means of amassing investment capital for the long term future of Metro. Manchester’s population is 2½ times greater than that of the Tyne and Wear area, but by other comparisons the two areas have similarities, not least in terms of GVA per person and the form and function of their light rail networks. The Manchester model demonstrates the advantages of effective joint working and strategic governance which the Combined Authority will provide.

A2.9 Local Authority Bonds

Due to increases in the repayment rates applied by the Public Works Loan Board in relation to gilts65 a number of local authorities have acquired credit ratings to enable themselves to issue bonds on the capital markets. Some authorities are considering pooling their resources in this initiative to achieve economies of scale in expertise, procurement and legal matters, as well as critical mass. An advantage of this method is that local authority bonds are not classed as public sector borrowing, so they can be used to match-fund European grant programmes.

The approach is still under development. The Local Government Association has recommended the introduction of a collective agency66 which would raise funds from capital markets at regular intervals and on-lend funds to participating authorities. The agency would be rated by at least two credit rating agencies, and with appropriate capitalisation and governance arrangements.

64 City Deal Future Transport Prioritisation. Greater Manchester Combined Authority 2012
65 A bond issued by the UK government
66 Local Authority Bonds – a local government collective agency. LGA 2012.
A2.9.3 The longer term success of the concept is likely to depend upon the extent to which the proposal can continue to undercut the level of interest rates offered by the Public Works Loan Board, and on the ability to raise funds on capital markets. It is recommended that the process is kept under review as it evolves, as a potential alternative source of loan capital.

**A2.10 Community Infrastructure Levy**

A2.10.1 Another potential source of funding for individual new Metro stations is the Community Infrastructure Levy (CIL) which local authorities can levy based on the scale of individual development opportunities. The purpose of CIL is to ensure that costs incurred in providing infrastructure to support the development of an area can be funded (wholly or partly) by owners or developers of land. Therefore if the provision of Metro as a sustainable transport link is seen as key to the opening up of a defined geographical area, then CIL contributions could be applicable in planning terms.

A2.10.2 The nature of the CIL framework is more suited to contributions towards individual stations than entire route corridors. The guidance surrounding CIL indicates that the levy is site-based and therefore the scale of any contribution towards infrastructure will be dependent upon the size and value of development proposals. Local authorities have considerable freedom in terms of deciding what CIL income can be spent on and could choose to allocate the income to infrastructure other than transport. The scope for CIL contributions towards Metro station and network enhancements is therefore limited in scope and would necessarily be by agreement with the relevant local planning authority. Once a CIL regime is in place it will downgrade the importance of the traditional Section 106 contribution which was formerly attached to planning permissions for major developments.

A2.10.3 The application of CIL in its infancy and therefore the rates that can be levied on development remain fluid and subject to alteration. As case law becomes established over coming years, it will become easier to determine the extent to which it can be relied upon as a potential local funding source. For guidance, rates applied in some the areas now introducing CIL are of the order of £115 per square metre, typically around £11000 per dwelling.

A2.10.4 The rate at which CIL and other developer-related funding streams will accrue depends on the pace of development, which is normally linked to rates of economic growth. In Edinburgh, land values along Leith Waterfront fell by up to 80% between 2007 and 2011 with the onset of the economic recession. Therefore timing and an element of good fortune will also be necessary pre-requisites to maximising the potential level of planning gain.

**A2.11 Private Sector Funding**

A2.11.1 The majority of capital investment schemes to UK light rail networks involve an element of loan finance provided through the UK banking sector. There are two main routes to accessing this type of finance, either directly as a PTE, or indirectly through concession holder(s)

A2.11.2 There are many sources of such funding which rely on a commercial rate of return to operate; the cost to Nexus at any given time will therefore be governed to some extent by the prevailing level of

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interest rates. A major source of such funding is the European Investment Bank (EIB), a quasi-private sector institution run for the public good.

A2.11.3 The EIB is the EU’s non-profit long term lending institution which uses finance to fund ‘sound and sustainable projects that contribute to EU policy objectives’\textsuperscript{70}. Transport is one of the EIB’s funding priorities and past schemes that have been brought to fruition with the help of EIB loan finance include £500 million of loans over 30 years to the (then) Greater Manchester PTE to fund the third phase of construction of Metrolink, financing new trains and additional infrastructure – some 30% of total project costs. The EIB cites lower financing costs (due to the EIB’s strong institutional backing from EU member governments), fixed interest rates and diversification of finance as amongst the benefits to TfGM.

A2.11.4 EIB funding appears to have potential to provide the level of funding that fleet replacement and network extensions will require. Clearly there would be criteria to agree for both parties before making any arrangements, not least the source of funding to repay the loan over a long period of time. TfGM has made repayment assumptions based on future fares revenue that will accrue from new patronage attracted from new and improved Metrolink provision.

A2.11.5 Further detailed investigation of the potential of EIB financing and appropriate repayment options is recommended, liaising with partner organisations who have direct experience of acquiring EIB loans.

A2.11.6 Where the concessionaire is responsible for securing funding to allow it to meet its contractual commitments it is more common for a private sector source to inject funding, compensated by a commercial rate of return. Sometimes this takes the form of a leasing agreement as discussed in Section 6. In this situation Nexus would be two steps removed from actual ownership of rolling stock but would also have reduced requirement for up-front funding and on-going maintenance liabilities.

**A2.12 Farebox Income**

A2.12.1 Transport for Greater Manchester’s funding package for Phase 3 of Metrolink includes a degree of Prudential Borrowing against future fare-box revenues.\textsuperscript{71} This is potentially a high-risk strategy unless future revenues can be plotted with some degree of certainty. Critically, TFGM and Metrolink have grasped this nettle, with their ITA/CA agreeing to increase fares by 1% above inflation as part of a medium-term financial strategy. A ring-fenced element of fares, or possibly a small additional ‘Network Extension Levy’ could be dedicated towards repayment of borrowings however were these to be applied in a declining market they could result in a loss of patronage which would further depress income. It could also be argued that any additional levy should be imposed on all members of the local population rather than just Metro passengers, because of the much wider economic, social and environmental benefits of an extended Metro network. It is recommended that this option is not pursued until other avenues have been considered. That said, the integration of Metro service and fares within a Quality Contract Scheme where the impact of competing bus operations is ameliorated could alter the dynamics of patronage fluctuations, although even this would not be an effective buffer against the fluctuating global economic conditions of recent times.

\textsuperscript{70} www.eib.org

\textsuperscript{71} City Deal: Future Transport Prioritisation. Greater Manchester Combined Authority 29/07/12.
A2.13 Other Potential Income Sources

A2.13.1 The options described above are the most obvious sources of funding with the potential scale to allow major investment in Metro to be made in the future. Other possible income streams include large-scale sponsorship, and the sale of recovered braking energy, or surplus energy from wind generation.

A2.13.2 Commercial sponsorship of Metro could be a lucrative funding source involving little outlay. Its success in income terms would depend on the ability of Nexus to attract a suitable sponsor, and the willingness to allow the Metro brand to be potentially compromised by another strong brand identity. The Greater London Authority Conservatives have recently been considering the merits of large scale sponsorship of the Tube. There are precedents in terms of transport sponsorship in London, including the Barclays cycle hire scheme and the Emirates Air Line, as the Thames cable car is officially known (£36m over ten years). To date, Transport for London has not been in favour of approving sponsorship which could dilute the iconic Tube brand and is ‘instinctively uncomfortable’ with the renaming of major stations, although advanced negotiations took place with vintners Oxford Landing with regard to the temporary eponymous renaming of Oxford Circus station which did not take place, despite a fee of several million pounds reportedly having been discussed. Other examples of major light rail sponsorship deals exist in Madrid - a €3m deal with Vodafone for Line 2; Philadelphia, where a station has been renamed AT&T in a $5m deal, and a $50m, 12-year deal with Nextel to sponsor one of the stations on the Las Vegas monorail.

A2.13.3 Whilst these initiatives may be in a different scale to that which could realistically be achieved in Tyne and Wear, there may nonetheless be scope to achieve meaningful income through commercial deals with major regional stakeholders that contribute towards new stations or extensions, as has been demonstrated elsewhere.

A2.13.4 Depending on how recovered braking energy from trains is stored (see Appendix 4), it may also be possible to sell this back to the electricity grid, potentially at higher prices than purchased. This approach has been implemented by Philadelphia’s suburban rail system.

A2.13.5 Another radical possibility would be the sale of surplus energy produced by offshore wind generation to the national grid at times of low Metro demand, were Nexus to sign up to a long-term deal with an offshore energy provider in an attempt to become more self-sufficient and sustainable in energy terms.

73 http://www.abb.us/cawp/seitp202/2092b41536222f45c1257b270051e62a.aspx
Appendix 3: NEW FLEET DISCUSSION

A3.1 Below are a number of brief discussions, further details and comparators related to a potential new Nexus Metro fleet.

Crashworthiness

A3.2 While it does not by any means cover the full range of requirements for crashworthiness, it is worth considering the ‘impact resistance’ standards. Currently, the Network Rail standard for crashworthiness includes a frontal impact force of 2000kN, requiring a heavy vehicle structure to withstand. Most worldwide Metro vehicles on typical segregated networks can only resist 400kN; however, Nexus Metro vehicles can resist 800kN, which has been accepted by Network Rail on the Sunderland joint operation, due to both robust signalling and control, and the overall relatively low speed on that line. It should be noted that the vehicles procured by the Sheffield tram-train trial project also have an 800kN frontal impact resistance, and it is hoped that an outcome of the Sheffield project will be formal acceptance by Network Rail of this more modest standard for all future UK tram-train type joint operations on normal, i.e. not high-speed rail lines. For the purposes of this strategy, it is assumed that an 800kN impact resistance will be incorporated into new Metro vehicles, together with other associated features.

Closest comparator vehicles to Nexus

A3.3.1 A number of UK light rail vehicles are described in Appendix 1. However, Manchester Metrolink operates the only other high-floor light-rail vehicles in the UK in 2014. These are Bombardier ‘Flexity Swift’ vehicles (designated M5000), whose dimensions and operating characteristics are similar to current Nexus Metro vehicles, albeit substantially more up-to-date in terms of signalling, regenerative braking etc. M5000s also operate on former standard-gauge railways as do Nexus, though they also have a wheel-rail profile enabling them to operate on-street. As with Nexus Metro, M5000s normally operate in coupled 2-car sets. It is felt that the M5000 vehicles are one of the better ‘starting points’ from which to envisage a new Nexus Metro design, though this design or manufacturer should not be seen as a constraint in procurement terms.

A3.3.2 A similar vehicle design from the same ‘Flexity Swift’ family has been operated on Rotterdam RET since the late 2000s (pictured above). The main differences in this vehicle are that it has an extended
42m length in a single passenger compartment, and has a top speed of 100 km/h. Other potential advantages of a single passenger compartment are:

- Passengers’ improved perceptions of personal safety, due to being always in the same compartment as the driver
- Removal of couplings, leading to reduced maintenance costs and lower operational risks
- Slightly speeded-up driver transition from one cab to the other at the end of a journey

A3.3.3. Sheffield’s new Vossloh tram-train pilot vehicles also offer some similarities to Nexus Metro, in terms of running on operational Network Rail tracks, as well as on-street. Their ‘crashworthiness’ level also matches the current Nexus Metro vehicles. However, the Sheffield tram-trains have low-floor external doors, and a single passenger compartment of mixed high/low floor; they are capable of 110 km/h compared to Nexus Metro’s 80 km/h.

Seating density

A3.4 A table indicating the seating density of some comparator light rail vehicles is shown below, to support the idea that there could potentially be a modest reduction of seating capacity in any future Metro vehicle:

<table>
<thead>
<tr>
<th>Network</th>
<th>Seating density (seats/linear metre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sheffield Supertram (original)</td>
<td>2.5</td>
</tr>
<tr>
<td>Rotterdam RET Flexity Swift</td>
<td>2.5</td>
</tr>
<tr>
<td><strong>Nexus Metro</strong></td>
<td><strong>2.3</strong></td>
</tr>
<tr>
<td>Manchester Metrolink</td>
<td>2.1</td>
</tr>
<tr>
<td>Docklands Light Railway</td>
<td>2.0</td>
</tr>
<tr>
<td>Nottingham NET</td>
<td>1.9</td>
</tr>
<tr>
<td>Edinburgh Tram</td>
<td>1.8 (above-average luggage storage space has been provided on these vehicles due to Airport traffic)</td>
</tr>
</tbody>
</table>

74 [http://tinyurl.com/kmqpoj4](http://tinyurl.com/kmqpoj4)
Appendix 4: ENERGY RECOVERY

A4.1.1 Below is some further discussion about the three options for braking energy recovery which are outlined in Section 4 of the strategy:

(a) **Feeding recovered energy into the overhead line**: In 2013 Nexus agreed to renew and replace the overhead line equipment (OLE) infrastructure on a ‘like for like’ basis. This means that the OLE will not be ideally suited to recovery of braking energy without further modification in future, i.e. around the mid-2020s when a new fleet might come into service.

Assuming that these further modifications take place, it is also the case that on a network with relatively low train frequencies for most of the day such as Nexus Metro, much of the recovered energy may be wasted because there is a higher likelihood that there will not be another train accelerating nearby and able to use it. This situation can be improved slightly by scheduling trains to facilitate this ‘meeting’; however, again, on a network with low train frequencies this will not have a large positive effect.

The use of reversible substations would increase the amount of energy recovered, but at an additional capital and maintenance cost for this infrastructure.

A combination of OLE recovery and reversible substations could perhaps typically save up to 20% of traction energy requirements, for a network with low train frequencies.

(b) **Storing recovered energy in on-board facilities**: This method uses large energy-storage devices, which could be either traditional ‘batteries’, or ‘supercapacitors’, or a combination of both. Energy recovered during braking is simply ‘dumped’ into these devices, and then re-used directly by the same train, for either accelerating/traction energy, or for auxiliary energy to power lights, heating, control systems etc. The advantage of this method is that (assuming there is enough capacity in the storage devices) a very high proportion of the recovered energy could be re-usable. There is a possibility that traction energy requirements could be reduced by up to 40%-50% using this method.

Furthermore, it allows the possibility that trains could actually operate **without OLE** for a certain distance, and use only the on-board storage to power the train. This would enable operation on short on-track extensions or on-street sectors without the need for OLE, or if OLE is present the train being able to proceed to the next station in an emergency involving loss of overhead power.

Developments in on-board energy storage are proceeding rapidly, and it is likely that by the time any new Nexus Metro fleet entered service in the mid-2020s, it will be possible to run a fully-loaded light rail vehicle for 3-4km using on-board storage alone. Vehicles operating in this mode can either return to the mainline OLE to continue their journey, or can re-charge their batteries using rapid ‘flash’ recharging facilities at intermediate stops; recharging can take as little as 30 seconds.

Rhein-Neckar, Nice and Paris are examples of networks currently operating light rail vehicles with on-board energy storage. More advanced ‘flash-recharging’ technology is currently in revenue service in Seville trams, and will come into service on Qatar Metro in 2015.
The downside is that there would be a substantial additional capital cost for each train, and a vehicle weight penalty. Maintenance costs for supercapacitors should be fairly low, and they have long, albeit not unlimited, lifetimes.

(c) **Trackside energy storage**: this option would require relatively modest upgrade to the OLE. It would involve the positioning of trackside units on the approach to a station to recover a train’s braking energy; when a train on the opposite track (i.e. leaving the same station) was accelerating, it would draw energy from this unit before taking it from the OLE. Alternatively, the trackside units can be located at substations. This option could potentially give high energy savings, though obviously involving both capital and maintenance costs. It may also be less likely to be able to assist with getting trains to the next station, in the event of OLE failure. Philadelphia light rail operator SEPTA has installed a trackside energy storage system, with large batteries located at a substation which collect regenerated energy via the OLE. The energy stored is used at network level to supply train demand at peak times, and any surplus can be sold to the wider electricity grid, generating a cash income for the operator.

A4.1.2 Clearly there are a number of potentially viable options for a substantial reduction in traction energy requirements, should Nexus procure a new vehicle fleet. Detailed technical calculations and simulations based on Metro’s network and vehicle characteristics will be required in due course, to determine the most cost-effective option.
Appendix 5: DEPOT SITES

A5.1.1 Below are maps showing ‘sample’ potential sites for a new main depot at Fawdon (to stable most or all of the fleet, plus management offices etc.), and a smaller out-stabling facility at South Shields (for around 6 or 7 two-car trains). It must be stressed that these are hypothetical sites and no decision has been taken by any organisation about whether to move forward with these, or any other potential sites. Also shown is the site at Heaton Depot which Nexus is seeking to purchase.
Appendix 6: SIGNALLING AND CONTROL

Key alternative signalling options are discussed in this Appendix.

A6.1 Manchester Metrolink style

A6.1.1 Manchester Metrolink has a non-typical (but still approved for safety by the Office of Rail Regulation (ORR)) hybrid signalling system which could be characterised in the UITP categorisation as ‘enhanced GoA0’. On Metrolink, trains are fully driver-operated, using line of sight only; there is no in-cab signalling equipment. Critically, there is also no ATP, even on-track at speeds up to 80 km/h. Automated local control units operate interlockings and local signals, both on-track and on-street. Trains are ‘monitored’ from a central facility (using a location-determination system based on a trackside communications cable), but are not centrally ‘controlled’ under normal operating conditions. Separate documents are available describing the Metrolink signalling in more detail, including its operation at points and in tunnels.

A6.1.2 This system would allow for the removal of much of the trackside signalling equipment on Nexus Metro, thereby greatly reducing maintenance costs and generally simplifying the signalling system. Driver efficiency and energy saving could still be maintained by the use of automatic advisory systems like the FASSI system currently in operation on Nexus Metro. This system would also be seamlessly compatible with any on-street mode of operation, should that be implemented in future.

A6.2 Driverless (GoA3) or UTO (GoA4) system

A6.2.1 A GoA3 system, i.e. Docklands Light Railway-style with a Train Attendant, could offer a significant benefit to Nexus, by allowing for a uniformed staff presence in carriages at all or most times (particularly if a new fleet had longer, single-compartment vehicles). A separate permanent staff presence has previously been deemed unaffordable, but enabled in this way could deter the fears of anti-social behaviour which worry passengers and potential passengers, contributing to lower off-peak patronage. It would also mitigate concerns from trades unions about any loss of driving posts, as the drivers could become Train Attendants. On the DLR, Train Attendants assist passengers, monitor onboard behaviour, and control door closing at stations – while being able to drive the trains in emergencies via a much-reduced driving ‘panel’. Drivers maintain their certification by manually driving the trains on Sunday mornings.

A6.2.2 A GoA4 system may involve significant challenges from safety and industrial relations perspectives, but would also lead to a complete removal of train driver costs. In other networks which have converted to GoA4, drivers have been retrained to take other posts within the organisation; this would mean a more gradual realisation of financial savings. Lack of driving costs also means that there are much reduced costs in operating more frequent services (either regularly, e.g. evenings, or one-off, e.g. special events).

A6.2.3 Both GoA3 and GoA4 would require installation of a Communications Based Train Control system (CBTC). CBTC involves the removal of trackside signals entirely, and most of the cabling and equipment, except where this is needed for control of interlockings etc. Trains are monitored and controlled by a mostly automated network management centre. Even depot stabling operations can be automated. Communication is by radio only, and trackside signals are replaced by ‘in-cab
signalling’ (i.e. driver displays) in GoA2 or GoA3, or by nothing in GoA4. Essentially, CBTC replaces an electromechanical signalling system with a fully computer-based control system.

A6.2.4 At its most advanced, CBTC allows the current ‘fixed block’ system to be replaced by ‘moving block’; this means that safety is maintained not by a train clearing a fixed section of track before another train is permitted to enter, but instead each train being controlled individually to be just above the minimum stopping distance behind the preceding train at all times, thereby allowing the absolute minimum headways.

A6.2.5 Research indicates that the vast majority of new worldwide urban Metro networks are being installed as GoA3 or GoA4, and a number of existing driver-based networks are being converted, such as Paris Metro Line 1, which completed conversion to GoA4 in 2012. Generally these signalling/control systems work successfully to reduce costs and improve capacity, punctuality and efficiency, while maintaining high levels of safety. It should be noted however that many of the older networks choosing to convert are doing so in the context of rapidly rising passenger demand levels.

A6.2.6 Several key issues exist with any proposal to operate Nexus Metro in GoA3/GoA4 mode:

(a) The fact that Nexus Metro is mostly an above-ground network, with unauthorised track access being relatively easy (roughly one trespass incident was recorded per day between 2010 and 2013, actual figures will be higher). Most worldwide GoA3/GoA4 Metros are entirely underground; others, such as GoA3 Docklands Light Railway or the brand-new GoA4 Brescia Metro, are largely above ground but strictly separated from public access, by either grade separation or very secure boundary fencing and track access.

If deemed to be required, installation of high security fences and barriers throughout Nexus Metro would entail very substantial expenditure for both capital and maintenance revenues, which would significantly affect the payback calculation, particularly on a network with relatively modest passenger loadings. GoA4 would also be likely to require platform edge doors, adding further considerable capital/maintenance costs.

(b) GoA3/GoA4 would not be permitted for the foreseeable future on Network Rail’s Sunderland Line, leading to the likelihood that Green Line drivers would have to join and leave trains (GoA4), or move between the carriage and the drivers’ cab (GoA3), at Pelaw. In GoA4, this could make rostering/scheduling more complex and may eliminate some of the cost savings; for example, most or all vehicles in a new fleet may still need capital spent to provide a drivers’ cab, even though this would only be regularly used on some of them, and only on the Pelaw to South Hylton sector. Further illustration of potential implementation of these options is provided in Figures A6.3.6-1 and A6.3.6-2 below.

(c) Level crossings may be an issue. From initial discussions with the ORR, it is felt that these may be surmountable in regulatory terms, but nevertheless the Green Line for example, with 4 vehicle level crossings on Nexus tracks and 3 on Network Rail tracks, is clearly far from ideal. The Yellow Line, with only one vehicle level crossing on Nexus tracks, may be a better candidate, and it may be possible that only the Yellow Line could be converted to GoA3/GoA4; if GoA3 with train attendants, this would directly address the key sector for anti-social behaviour amongst passengers, which is on the Yellow Line between Newcastle and North Shields. Modern CBTC systems can cater for the
mixed-mode (driver/non-driver) operation which would exist on the Metro central corridor in this scenario. It should be noted also that four pedestrian level crossings on Metro tracks may need to be bridged or stopped up for GoA3/GoA4 operation.

(d) Should there eventually be a mixed operating environment, with Metro vehicles moving from track-based to street-running in some locations such as Washington, then it seems highly unlikely that regulatory approval for driverless vehicles would be obtained. It is possible that a GoA3 system could allow drivers to work in the carriages on-track and move to control the trains on-street, but this would need further investigation with the ORR.

A6.3 Comparison of options

A6.3.1 Some key advantages and disadvantages of each system, as a mid-2020s replacement option, are outlined in Table A6-1. Issues such as safety and resilience are not covered at this strategic level.

A6.3.2 CBTC may prove to be excessively specified for Nexus Metro, unless the ‘High’ patronage prediction were to materialise. Nevertheless, as stated above, it would be far more expensive to retro-fit such a system into a new fleet post-2025, and given the long lifespan of Metro vehicles, a more detailed assessment of this option should still be carried out to establish whether it is feasible and cost-effective. Such an assessment should include the potential for attracting more passengers by reducing fear of crime, and maximising service frequency. There may be an effective intermediate option in vehicle procurement, for example vehicles whose design is ‘future proofed’ to facilitate a lower-cost change to GoA3 operation at a later date.

A6.3.3 The Manchester Metrolink signalling system seems to potentially offer a good fit with Nexus Metro’s network characteristics, though it is recognised that even this would be a substantial departure from the existing signalling and entail substantial conversion cost (though it may well be that Nexus could benefit from not having to pay Metrolink’s technical development costs, if it were able to be transferred to Nexus largely unchanged).
### Table A6-1 – Outline options analysis for Metro signalling & control systems

<table>
<thead>
<tr>
<th>Network context</th>
<th>SCENARIO 1</th>
<th>SCENARIO 2</th>
<th>SCENARIO 3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Replace Nexus GoA1 system ‘like for like’</td>
<td>Manchester Metrolink-style system</td>
<td>GoA3/GoA4 plus CBTC system</td>
</tr>
<tr>
<td>100% on-track, former heavy-rail network</td>
<td>Mixed former heavy rail tracks and new-build on-street</td>
<td>Increasingly a solution of choice on high-demand urban Metro networks</td>
<td></td>
</tr>
<tr>
<td>Ease of installation</td>
<td>Straightforward replacement of well-understood existing system.</td>
<td>Would be a substantial change, as most existing signals on Nexus network would be removed. Installation could take place ‘in parallel’ with existing system before going live. Potential to use trackside cable network/proposed Wi-Fi for vehicle location ID.</td>
<td>Very substantial change, all existing signals on Nexus network removed, and central control network installed. Installation could take place ‘in parallel’ with existing system before going live. Potential to use trackside cable network / proposed Wi-Fi for vehicle location ID.</td>
</tr>
<tr>
<td>Capital costs</td>
<td>Medium? (might be ‘Lowest’)</td>
<td>Lowest? It is difficult to estimate TFGM’s signalling costs as they have gone through various iterations, and also may be ‘sensitive’ at present due to disputes.</td>
<td>Highest? – esp. if platform screen doors required at some/all stations for GoA4. Paris Metro Line 1 cost approx. €600m to convert (75% of cost = new trains).</td>
</tr>
<tr>
<td>Maintenance costs</td>
<td>Highest?</td>
<td>Lowest?</td>
<td>Medium?</td>
</tr>
<tr>
<td>Driving staff costs</td>
<td>Unchanged</td>
<td>Unchanged</td>
<td>Reduction: GoA3 = modest GoA4 = very substantial.</td>
</tr>
<tr>
<td>Flexibility / Scheduling</td>
<td>As existing; headways and overall flexibility constrained by fixed blocks.</td>
<td>Moderate flexibility to add trains for special events, or alter train running in the case of network disruption. This would not be as efficient</td>
<td>Greatest headway benefit, if using ‘moving block’. Additional trains can be inserted onto the network at any time, as the control system will</td>
</tr>
<tr>
<td><strong>Network Rail compatibility (Metro on NR tracks)</strong></td>
<td>Fully compatible with ‘traditional’ NR-style fixed block signalling. New Metro vehicles could contain a NR-compatible emergency brake system (TPWS/AWS) rather than the current INDUSI; the former would need to be retrofitted to Nexus tracks.</td>
<td>Largely compatible; would need a NR-approved automated emergency brake system (TPWS/AWS) installed for use only on NR tracks. Drivers would need additional training on NR signal-based control.</td>
<td>GoA3 and GoA4 will not be compatible with Network Rail operation; drivers are needed to operate on NR infrastructure, and a TPWS/AWS system would need to be installed in vehicles.</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td><strong>On-street operation compatible</strong></td>
<td>Not very compatible; likely to need separate signalling system for on-street</td>
<td>Should be seamlessly compatible with on-street operation</td>
<td>Unlikely to be permitted; would probably need separate system</td>
</tr>
</tbody>
</table>
Driverless operation (GoA3)

In this scenario, the Yellow line is driverless (GoA3 with attendants) while the Green line is driver operated. On the central corridor, the CBTC system would manage trains using both modes of operation.

Above: Figure A6.3.6-1
Driverless operation (GoA4)

In this scenario, all Nexus lines are GoA4 (no staff at all) except on Network Rail. Drivers would join and leave Green line trains at Pelaw.