Transport for Greater Manchester

Metrolink Phase 3

Monitoring and Evaluation Second Report
March 2021

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1 Executive Summary

1.1 Introduction

1.1.1 To provide evidence on the extent of achievements of Metrolink Phase 3[1] and to learn lessons for future infrastructure planning and delivery, TfGM has overseen a series of monitoring and evaluation activities. As well as demonstrating what Phase 3 has achieved to GMCA, this also provides insight to the Department for Transport, fulfilling a funding condition associated with central government's grant contribution to the programme.

1.1.2 Initial findings were presented in the Metrolink Phase 3: Monitoring and Evaluation Early Findings Report that was published in 2016.

1.1.3 The evidence presented in the second report was collected in the period up to and including 2019. It therefore pre-dates the impact of COVID-19 on the transport system in Greater Manchester.

1.1.4 The monitoring and evaluation evidence gathering has drawn upon the original aspirations for the Phase 3 schemes in formulating a series of research questions. These research questions were designed to enable learning about Metrolink Phase 3's impacts – both transport and wider economic/ society ones - and have been used to structure data gathering and insight generation.

1.1.5 The research questions have also been used to structure this executive summary - sharing the main findings and how TfGM intend to take forward the findings in future work.

1.2 Findings in relation to transport objectives

1.2.1 What travel patterns are being fulfilled using the new extensions?

- Some lines have a bigger share of commuting travel and lower share of leisure and other markets: **The nature of some lines, with some offering faster journey times than others, means that different markets are attracted. Depending on transport and wider objectives, this has important implications for planning future infrastructure based on the objectives for the corridor to be served.**

[1] Comprising the extensions to Ashton-under-Lyne, East Didsbury, Oldham and Rochdale, and Manchester Airport.

- There is a clear network effect, meaning that there is a significant proportion of Metrolink users that travel from one line to another: **Need to ensure that this type of travel between transport corridors is fully taken account of in future network planning, so that the range of travel options and usage is fully catered for.**

1.2.2 How would people behave if Metrolink was not available?

- Metrolink is attractive to those who have cars available and this will differ by the demographics of areas served and the competitiveness of Metrolink in different corridors: **Key assumptions about modal shift and competitiveness of rail-based services can be drawn from these findings and used in understanding the likely mode shift performance of different types of public transport provision.**

1.2.3 What impact has there been on changes in carbon emitted?

- Due to its non-fossil fuel power source, Metrolink has resulted in a significant reduction in carbon emissions: **Future provision of a similar nature can make a major contribution to the challenge of reducing carbon emissions.**

1.2.4 How does patronage compare with forecast levels?

- Pre-covid patronage performance was lower than patronage as anticipated when the original demand forecasts were drawn up over a decade ago. This was due to a range of external and Metrolink-specific factors but, pre-covid at least, the patronage position was steadily improving: **To take account of wide range of influencing factors and the uncertainty surrounding these, a wider range of scenarios in relation to factors such as those specific to Metrolink performance and external economic conditions should be used in future demand forecasting.**

1.2.5 Has park and ride provision been effective in securing reductions in car mileage?

- The limited evidence shared in this report indicates that not all park and ride users come from travellers who would otherwise drive all the way to their destination: **Future strategy and business case planning should take this finding into consideration and the exploration should be encouraged of a wider array of means of access beyond car access to Metrolink, rail and guided bus-based stops.**

1.2.6 How has usage of the Oldham and Rochdale Line changed relative to the former heavy rail line?

- A major uplift in usage is possible when moving from a largely-neglected and low service level rail service to a much more attractive new light rail service: **This major growth in usage, and associated benefits, should be taken account of in future planning.**

1.3 Findings in relation to economic and social objectives

1.3.1 What change in public transport network accessibility has been achieved through the system's expansion?

- There has been a significant improvement in public transport access to employment, further education and healthcare, an improvement that is particularly noticeable for the more deprived communities of Greater Manchester: **Particularly with the advent of new technology, there is the potential to build upon access improvements from future infrastructure provision to ensure that people have a better awareness of the wider range of opportunities now available to them.**

1.3.2 How have businesses on Metrolink corridors outside the city centre been affected?

- Benefits have been identified by businesses in terms of improved customer and labour force catchments, as well as opportunities for business travel, although some businesses also have the perception that new lines have opened up their businesses to greater competition to the benefit of other Greater Manchester businesses: **There is an opportunity to better understand the unique characteristics of different areas to be served by future transport infrastructure improvements, and reflect on how businesses in these areas can be best supported.**

1.3.3 What economic impacts across Greater Manchester have the infrastructure investment brought about[2]?

- Statistical modelling has demonstrated a positive association between improved public transport accessibility due to Phase 3 and economic growth, but the work has yet to separate out true cause and effect: **There is scope for further analysis of the economic**

[2] Note that the original research question related to the city centre but, due to a change in approach, has been broadened out to cover the entire conurbation.

impacts of Phase 3 and other investment programmes in the future.

1.3.4 What has been the impact of proximity to Metrolink stops on house prices in Greater Manchester?

- Due to increased attractiveness of residential areas, results from house price studies generally show a strong relationship between house price changes and proximity to Metrolink: **House price changes are a good indication of the strength of economic benefits brought about by increases in public transport accessibility.**

1.3.5 What impact on communities in Wythenshawe has been observed?

- Survey work and in-depth interviews in the Wythenshawe area have revealed positive impacts on the communities in the area, with a particular expansion of travel horizons within the area, to other parts of south Manchester and beyond to the regional centre: **The wider social and economic impacts of a step-change in transport provision should be considered in the development of future business cases and evaluation programmes.**

1.4 Next steps

1.4.1 The detailed findings presented in this report will be used to inform future scheme and strategy development in Greater Manchester, and will be augmented with future evidence from a more general programme of insight, subject to resources being available.

1.4.2 The future programme will touch on some of the topics covered in this report as well as any relevant new areas. It is likely to be broader in scope and cover a wider range of transport interventions than Phase 3 alone.

2 Introduction

2.1 Purpose of this report

2.1.1 This report sets out the findings from a series of monitoring and evaluation activities relating to Metrolink Phase 3 – the extensions to Ashton-under-Lyne, East Didsbury, Oldham and Rochdale, and Manchester Airport.

2.1.2 The report is a follow-up to the Metrolink Phase 3 Monitoring and Evaluation Early Findings Report, published in 2016. As the programme has matured, so the nature of the monitoring and evaluation activities carried out in intervening years and reported here has evolved to focus on different aspects of the programme's outcomes and impacts.

2.1.3 It should be noted that the evidence shared in this report was all gathered before the emergence of COVID-19 and therefore pre-dates the impacts of the pandemic on Phase 3 and the wider Metrolink network.

2.2 Research questions

2.2.1 Throughout the monitoring and evaluation evidence gathering, drawing on the original aspirations for the Phase 3 schemes a series of research questions were formulated. These research questions have been used to structure data gathering and insight generation.

2.2.2 The Early Findings Report looked at research questions concerning the scheme context and lessons learnt from scheme delivery. It also provided initial findings in relation to transport impacts. The executive summary from the report is included as Appendix A.

2.2.3 This report looks at research questions related to transport objectives and to economic and social objectives, the latter including aspects such as regeneration, which has been a key driver for the programme in general. Note that the questions marked with an asterisk were covered in the Early Finding Report. This report includes fresh and/or updated evidence in relation to these questions.

2.2.4 The research questions related to transport objectives were:

- What travel patterns are being fulfilled using the new extensions?*
- How would people alter their travel behaviour if Metrolink was not available?*

- What impact has there been on changes in carbon emitted?
- How does patronage compare with forecast levels?*
- Has park and ride provision been effective in securing reductions in car mileage?*
- How has usage of the Oldham and Rochdale Line changed relative to the former heavy rail line?*

2.2.5 The research questions related to economic and social objectives were:

- What change in public transport network accessibility has been achieved through the system's expansion?*
- How have businesses on Metrolink corridors outside the city centre been affected?
- What economic impacts across Greater Manchester have the infrastructure investment brought about?
- What has been the impact of proximity to Metrolink stops on house prices in Greater Manchester?*
- What impact on communities in Wythenshawe[3] has been observed?

2.2.6 There had been an intention to assess net impacts on casualties[4], i.e. casualty reduction due to the shift from different modes minus casualties associated with the introduction of new lines. This was not, however, carried out as the number of casualties directly arising from the system is difficult to assess and the number of casualties saved from modal shift is limited.

2.2.7 Another area of intended coverage was the progress towards eventual long-term outcomes and, while there isn't explicit coverage of this, this report's content seeks to address this area of research.

2.2.8 Finally, there had been the intention to examine outturn appraisal assumptions and value for money. Due to the way in which individual elements of the Phase 3 programme were progressed in different stages and because programme costs contain a large proportion of costs that are shared across different elements, it has not been possible to take this area of work forward. It may be noted, however, that as capital costs

[3] The specific emphasis for the Airport Line on regeneration in Wythenshawe by means of greater connectivity to south Manchester and the regional centre in particular is reflected in a specific study on community impacts in the area.

[4] Collisions involving injury to individuals.

have been in line with forecasts but patronage has been lower, benefit cost ratios, while still denoting that benefits exceed costs by a significant margin for the programme as a whole, will have fallen in relation to those anticipated at the business case stage.

2.3 Structure of this report

2.3.1 The remainder of the report is structured around the achievement of transport objectives (Section 3) and the achievement of economic and social objectives (Section 4).

2.3.2 The report is badged as a 'second report' as the report is not the final word on research to be carried out on Metrolink Phase 3. Any such research in the future, however, will be set in the context of the overall programmes of investment undertaken in Greater Manchester and such research will not solely focus on Phase 3. The types of future activity are explained in the concluding remarks, Section 5.

3 Achievement of transport-related objectives

3.1 Make-up of usage of Phase 3 lines

3.1.1 Based on estimated trips from ticket sales and free concessionary travel, estimated usage of the Phase 3 lines taken together was 19.75 million trips in 2019/20.

3.1.2 Adult passengers travelling towards the city centre were surveyed about their travel patterns on all lines outside the city centre. These surveys took place towards the end of 2018. Appendix B contains a longer description of the surveys and their findings.

3.1.3 Commuting to or from work was a key journey purpose for all lines on weekdays. There is variation between lines that can be accounted for by the make-up of the residential catchment area, the employment centres served, the degree to which the line is faster or slower than other lines, and when the line opened.

3.1.4 On average, due to less of an established pattern of travelling to employment centres such as the regional centre, Phase 3 users undertake a lower proportion of commuting among the full range journey purposes, than Phase 1 (Altrincham, Bury) and Phase 2 (Eccles) users. For Phase 3 this was estimated at 50.3% and for Phases 1 and 2 combined 57.4%. East Didsbury Line Users are closer to the average for Phases 1 and 2 users, at 57.0%.

3.1.5 In terms of weekday movements for all journey purposes between lines, Phase 3 users have fewer trips that start or end in the city centre zone (57.1%) compared to Phase 1 and 2 users (65.7%). Again, the East Didsbury line is somewhat different from the other Phase 3 lines, in that 72.8% of users were city centre-orientated.

3.1.6 Another feature of the East Didsbury Line is that only 5.8% of trips start and end within the line. Figures for intra-line movements are much higher for the Oldham and Rochdale Line (34.6%) and the Airport Line (31.5%), reflecting the length of the lines and also the number of key destinations served by them.

3.1.7 Section 3.2 provides some commentary on car availability of travellers on Phase 3 lines and travel choices, were Metrolink not available to passengers.

3.1.8 The surveys have been valuable in understanding different travel patterns on different lines for marketing purposes and for future transport planning. The surveys will also be valuable for setting a baseline for

monitoring and encouraging future recovery of different passenger markets in the short to medium term, given Coronavirus.

3.2 Attractiveness to car available travellers and modal shift evidence

3.2.1 Passengers who participated in the travel pattern surveys in October and November 2018 referred to above were also asked "was a car or van available for the journey you are describing?". The findings, set out in Table 3.1, give an indication of the high level of attractiveness of Metrolink to those with a car available on all Metrolink Lines. Approaching half of Phase 3 line users said that they could have made the journey by car or van.

Table 3.1: Availability of a car or van for the journey being made

Line	Car Available	No Car Available	Total	Sample Size
Altrincham	53.5%	46.5%	100.0%	1,460
Bury	50.3%	49.7%	100.0%	1,343
Eccles	38.9%	61.1%	100.0%	892
Ashton	37.2%	62.8%	100.0%	608
East Didsbury	57.6%	42.4%	100.0%	1,143
Rochdale	45.7%	54.3%	100.0%	977
Manchester Airport	42.4%	57.6%	100.0%	606
Peak	48.9%	51.1%	100.0%	4,784
Off-Peak	45.4%	54.6%	100.0%	2,245
Phase 1 & 2 Lines	47.6%	52.4%	100.0%	3,695
Phase 3 Lines	45.7%	54.3%	100.0%	3,334
All Surveyed	**47.7%**	**52.3%**	**100.0%**	**7,029**

3.2.2 Table 3.2 provides an indication of modal shift by including in the survey the question "If Metrolink was not available for the journey you are describing, what would you have done instead?".

Table 3.2: Stated behaviour if Metrolink was not available for the journey being made

Line	Travelled by Alternative Means					Other Travel Behaviour		Total	Sample Size
	Travelled by bus	Travelled by car (as driver)	Walk/cycle/ other	Travelled by train	Travelled by car (as a passenger)	Not made the journey	Travelled elsewhere		
Altrincham	36.6%	30.4%	7.3%	10.6%	4.7%	9.5%	1.0%	100.0%	1,373
Bury	56.6%	25.8%	2.6%	2.2%	5.6%	6.0%	1.3%	100.0%	585
Eccles	46.9%	18.0%	14.0%	3.6%	10.3%	6.8%	0.4%	100.0%	1,326
Ashton	56.5%	13.1%	13.0%	5.5%	6.9%	4.1%	0.9%	100.0%	1,100
East Didsbury	53.8%	18.6%	8.4%	9.8%	5.0%	3.8%	0.6%	100.0%	809
Rochdale	53.9%	20.8%	4.4%	8.8%	6.0%	5.3%	0.9%	100.0%	591
Manchester Airport	49.0%	19.2%	7.2%	8.8%	8.9%	6.3%	0.6%	100.0%	972
Peak	49.0%	24.7%	7.8%	7.5%	5.9%	4.5%	0.6%	100.0%	4,507
Off-Peak	51.4%	17.5%	6.8%	6.0%	7.4%	9.6%	1.4%	100.0%	2,249
Phase 1 & 2 Lines	46.7%	24.7%	8.0%	5.5%	6.8%	7.4%	0.9%	100.0%	3,508
Phase 3 Lines	53.3%	17.9%	8.3%	8.2%	6.7%	4.9%	0.8%	100.0%	3,248
All lines	**49.8%**	**22.2%**	**7.5%**	**7.0%**	**6.4%**	**6.2%**	**0.9%**	**100.0%**	**6,756**

Note: Sample sizes are smaller for this question as "Don't know" responses were removed.

3.2.3 It should be noted that there are limitations to using this question to infer clear answers about modal shift and other travel responses. This is the case, in particular, as travellers may react to the question by thinking about their short-term response in circumstances such as network disruption, rather than thinking through what a longer-term response might be (e.g. which might include live or work somewhere else).

3.2.4 Furthermore, over time one would expect the proportion of car abstraction to increase, reflecting the attractiveness of the system gradually impacting on more complex combined destination and mode choice options. These impacts typically take longer to take effect than pure mode choice changes for trips with the same start and end points.

3.2.5 Exploring these complex behavioural responses would be more suited to work of a more exploratory, i.e. qualitative, nature than a survey format allows for.

3.2.6 The statistics nevertheless suggest a healthy level of modal shift on Phase 3 lines, with some 18% of Metrolink users saying that they would drive in the absence of the new extensions. This is a key assumption that can be used, depending on the context, in future transport planning.

3.3 Implications of mode shift evidence

3.3.1 Applying the 17.9% modal shift from car as driver from Table 3.2 (above) to TfGM's estimate of 17.95 million Metrolink Phase 3 trips in 2019/20

gives an estimate of annual car trips taken off the road by Phase 3's introduction.

3.3.2 From the survey evidence on trip distance, these trips equate to some 38.8 million car km removed from the roads. Further technical details on the estimates in this section are contained in Appendix C.

3.3.3 Figures on fuel consumption, car fleet mix and CO_2 emissions were used in the calculation CO_2 equivalent emissions saved. The energy source for Metrolink is a mix of renewables – mainly wind and solar – and nuclear power, so effectively a zero carbon transport mode in its operation.

3.3.4 The overall calculation resulted in an estimated 6,700 tonnes of CO_2 equivalent having been saved by Phase 3 in 2019/20.

3.3.5 It may be noted that the above calculation does not take account of embedded carbon, i.e. the carbon involved in the provision of the infrastructure and trams, so relates to operation of the system alone.

3.3.6 Similar steps were used in the calculation of local air pollution, NO_x. Again the calculations are reported in the same appendix, with a reduction of 12.8 tonnes of NOx estimated for 2019/20 as a result of users transferring from car to Metrolink Phase 3.

3.3.7 The figures for car trips and car kilometres removed, CO_2 reduction and NO_x decrease give an indication of the scale of the contribution of Metrolink Phase 3 to sustainable transport in Greater Manchester.

3.4 Explanatory factors behind differences from patronage forecasts

3.4.1 The Early Findings Report found that Phase 3 outturn patronage in 2014/15 was approximately half of the level of patronage anticipated by that time. Further work was anticipated at the time of the report to understand and quantify reasons for differences from forecasts and further research on this has been carried out by Systra and is summarised here. More technical detail is contained in Appendix D.

3.4.2 By 2018/19 it was found that Phase 3 patronage had continued to grow and was at 69% of forecast patronage. So, there remains a gap but there has been a considerable closing of the difference between outturn and forecast Phase 3 usage.

3.4.3 Through in-depth examination and quantification of a range of factors it has been possible to attribute the differences by line, explaining the differences for each line. Among the larger explanatory factors for the different Phase 3 lines are:

- Lower development-related patronage in Oldham and Rochdale town centres than expected;
- Only recently increased service frequencies on the Ashton Line, resulting in build-up yet to come in the analysis year of 2018/19;
- Lower service frequencies than expected on the Airport Line;
- Longer tram journey times than assumed in the planning forecasts, with journey times further lengthened to allow for greater safety margins over the years; and,
- Slower growth in the Greater Manchester economy, in terms of GVA, than anticipated, although this is partially offset by stronger growth in employment in the period to 2018/19 than had been foreseen.

3.4.4 The exception to the ability to quantify reasons for the difference between outturn and forecast patronage was for the Oldham and Rochdale Line. In this case, it is the view of TfGM that the closure of the heavy rail line for several years during construction of Metrolink and the lower income nature of much of the residential catchment area of the line could be further explanatory factors.

3.4.5 The variation between outturn and forecast for many of the key inputs to the demand forecasting process for Phase 3 indicates the need for future infrastructure demand forecasting to explore a wider range of scenarios than was typically the case at the time when the Phase 3 forecasts were created.

3.4.6 The difference in passenger revenues from forecasts is significant, but finance costs have been much lower than anticipated due to much lower interest rates than were originally built into the finance model, the lower rates due in large part due to limited economic growth. A further mitigating factor was that a degree of contingency relating to the forecast Phase 3 net revenue contribution to financing costs was built in. Furthermore, the overall funding model drew on overall Metrolink network revenues, i.e. including Phases 1 and 2, rather than Phase 3 alone.

3.5 In-depth surveys at selected sites of park and ride usage

3.5.1 Park and ride user surveys were carried out to better understand the impact of car park provision on travel choices. The surveys were

undertaken on one weekday at Hollinwood in 2018 and at Sale Water Park in 2019.

3.5.2 As well as getting travel pattern information on the journey being made, the surveys also asked park and ride users "If no car parking was available at this stop, what would you do instead?". They were also asked what they would do if their alternative would be to park near their current stop (Hollinwood only) or if they would have chosen to drive to another stop or station in circumstances where those options were also not available.

3.5.3 In the case of Hollinwood:

- 21% said their alternative was to drive all the way; and,
- this rose to 33% if those who said they would also drive all the way if they were unable to park near the stop or drive to another stop or station were unable to choose those options and are also included.

3.5.4 For Sale Water Park:

- 8% said their alternative was to drive all the way; and,
- this rose to 11% if those who said they would also drive all the way if they were unable to drive to another stop or station but were unable to choose that option were also included.

3.5.5 The majority of park and rider users in the absence of parking at their stop would therefore make use of Metrolink or other public transport in some way, as opposed to driving all the way (further details of the approach and the survey findings are reported in Appendix E). Therefore, in different circumstances, park and ride can be a more or less effective means of taking car traffic off the roads and reducing congestion and environmental impacts.

3.5.6 Future work at TfGM will develop the concept of travel hubs – a development of the existing approach to park and ride. Travel hubs intend to take a more rounded view of improving the access leg to public transport stops and stations. The aim is to increase public transport customer numbers and support a vision for a greater share for sustainable transport modes in Greater Manchester, while supporting de-carbonisation of the car mileage that is incurred to access the rapid transit stops and stations.

3.5.7 Subject to feasibility and business case, the travel hubs ambition extends beyond traditional park and ride to include integration of active travel, public transport, demand-responsive transport, shared mobility and drop-off provision. Features to be investigated include parking/storage

and electric charging infrastructure for both private and shared vehicles. Facilities that benefit our customers and could generate net revenue for TfGM such as commercial activity (e.g. convenience shops) and logistics (e.g. delivery lockers) will also be investigated.

3.6 Patronage on the Oldham and Rochdale Line

3.6.1 A comparison has been made between the estimated number of trips on the Oldham Loop heavy rail service in its last full year of operation and recent data on the estimated number of trips carried by Metrolink on the Oldham and Rochdale Line.

3.6.2 The heavy rail service was discontinued in October 2009, so 2008/09 was the last full year of operation for which Office of Rail Regulation data on station usage was available. Data on estimated total station entries and exits were obtained for the stations between Manchester Victoria and Rochdale for the year 2008/09. To avoid double counting of trips travelling within the Oldham Loop, trips travelling within the line were taken into account. These within-line trips were estimated at 15% of Oldham Loop trips, based on Automatic Passenger Count observations supplied by Northern Rail.

3.6.3 Based on these data sources and methods, it was estimated that 1,150,000 trips were carried on the Oldham Loop line in 2008/09. Had the Oldham Loop heavy rail services followed the trends of other rail services into central Manchester, it is likely that patronage growth of 27% would have been achieved in the period to 2019/20, or a figure of 1,461,000 trips for that year.

3.6.4 Estimates of trips by Metrolink line were derived from the analysis of sales data by ticket type, converted into trip data using factors on trips made by ticket type. The sales-derived trips were then factored to take account of other sales of Metrolink tickets, such as multi-modal tickets sold at rail stations or on buses. Further factors were applied to take account of free concessionary travel.

3.6.5 For 2019/20, the results of these calculations were that 6,125,000 trips were estimated to have been made on the Oldham and Rochdale Metrolink Line. This represents an increase by a factor of:

- 4.3 relative to the 2008/09 heavy rail figure accounting for likely growth in heavy rail in the period to 2019/20 had the service continued; and,
- 5.4 relative to the 2008/09 heavy rail figure.

3.6.6 The more-than-quadrupling of the use of the alignment can be explained by the increase in service frequency, the longer period of service operation, the increased number of stops serving the corridor, and the better penetration of Oldham and Rochdale town centres as well as the city centre.

3.6.7 Understanding the scale of change from a low to high quality rail-based service is important for comprehending the scale of potential change in future transport planning activity.

4 Achievement of economic and social-related objectives

4.1 Changes in Greater Manchester residents' door-to-door access to key destinations

4.1.1 The change in door-to-door access by public transport is a key factor influencing Phase 3 outcomes and impacts. Overall times and costs with and without Metrolink Phase 3 were calculated using a public transport model in relation to access to the following opportunities:

- healthcare, i.e. major hospitals – for the population as a whole;
- employment – for those aged 16-75; and,
- colleges of further education – for 16-19 year olds.

4.1.2 A further calculation of changes in access was made for those living in the more deprived communities in Greater Manchester. The approaches adopted are set out in more detail in Appendix F, along with a detailed tabulation of findings.

4.1.3 In summary, the analysis shows that public transport door-to-door access has improved by 10% or more for the following proportions of the Greater Manchester population:

- 18.2% for employment;
- 18.8% for further education; and
- 19.8% for healthcare.

4.1.4 As the Phase 3 Metrolink corridors are generally located in corridors with concentrations of deprivation, the figures for the proportion of the 10% of the most deprived Greater Manchester population are more pronounced. For this part of the population, the improvements of 10% or more in public transport door-to-door access were recorded for substantial proportions of the 10% most deprived:

- 30.5% for employment;
- 27.8% for further education; and,
- 29.5% for healthcare.

4.1.5 The changes in overall times and costs of door-to-door access to opportunities across Greater Manchester facilitated by Metrolink Phase 3 are encouraging. The analysis work makes the assumption that residents

have good knowledge of the transport network and the range of opportunities at different destinations that are available to them. In the future, new technologies may be able to better communicate access to such opportunities in a more tailored manner.

4.2 Impacts on businesses in Phase 3 Metrolink corridors

4.2.1 A study was carried out by AECOM to look at the impacts on businesses located on the Ashton, Oldham and Rochdale, and East Didsbury Lines and at the MediaCity stop. Central to the approach were telephone interviews carried out with senior representatives of 450 businesses. These were undertaken before each line opened and at 1-year after and 3-years after intervals.

4.2.2 The telephone interviews were complemented with 30 case studies and a range of stakeholder interviews with organisations with an interest in economic development and regeneration. Further, existing evidence was drawn in from UK Business Register and Employment Survey and Business Demography data from the Office for National Statistics.

4.2.3 In terms of key findings, variability has been demonstrated between the four extension corridors in the extent of impact, with greater positive impacts experienced by businesses at MediaCityUK and along the East Didsbury Line. A minority of businesses said they had experienced negative impacts, though stakeholders were less likely to be aware of these negative impacts.

4.2.4 Stakeholders were particularly positive about the impacts yet to be realised by the Metrolink network and felt it would help to facilitate development opportunities more quickly than would otherwise be the case. It was highlighted that the connectivity offered by Metrolink can make locations more attractive to business by improving the perception of an area owing to the wider catchment area for employees.

4.2.5 The first research objective used to structure evidence gathering was “To understand and determine business impacts including changes in employment within Metrolink corridors, particularly at the key sites Kingsway Business Park, Central Park, Etihad Campus and MediaCityUK”. Key impacts observed were that:

- Businesses recognise the accessibility benefits of the new lines with enhanced perceptions for retaining existing and recruiting new staff. To date, this does not appear to have contributed to large scale recruitment across the corridors or upskilling;

- Manchester City Centre was not in the study area, but interviews with stakeholders highlighted the positive impact that the access to a wider labour market is likely to have had for businesses in this area;
- The attributed impact on jobs relating to Metrolink is relatively small to date and may not yet have been fully realised;
- The overall assessment of jobs and GVA along the corridors found there was a more positive impact along the East Didsbury corridor and surrounding MediaCityUK compared with the East Manchester and Oldham and Rochdale lines, where more negative impacts were reported in the period to date, potentially due to customers being taken away from the area; and,
- Businesses had difficulty in isolating the impacts of Metrolink from other background factors in attributing impacts. Wider contextual factors are more likely to have been significant and low levels of growth may have reduced the significance of this factor.

4.2.6 With regards to the second research objective, "To understand and determine business changes in perception of place", it was found that:

- Interviews with businesses have highlighted that perceptions of their site, against a number of indicators, have improved since the new lines have opened. Some businesses were able to specifically make a connection between the Metrolink extension and the enhanced perception; and,
- The surveys did not identify a strong link between the investment and businesses relocating, expanding or moving to higher value operations to take advantage of the Metrolink network.

4.2.7 In relation to the research objective "To understand how Metrolink investments have contributed to fulfilling regional stakeholders' strategic objectives for economic development and regeneration", the following observations were made:

- Stakeholders have emphasised the positive contribution that the investment has made to the corridors and regeneration sites. It is recognised that there is a clear pathway between enhanced accessibility and stimulating investment but that there are a wide range of influencing factors;
- Positive impacts have been experienced in relation to Strategic Added Value (SAV), particularly the catalytic effect of the

investment in the Metrolink network but co-ordinating activities are likely to be greater prior to opening; and,

- Further research would be required to understand the perceptions of investors with regards to the Metrolink expansion.

4.2.8 Through this work benefits have been identified by businesses in the Phase 3 corridors in terms of improved customer and labour force catchments, as well as opportunities for business travel, although some businesses also have the perception that new lines have opened up their businesses to greater competition. In future infrastructure improvement work there is an opportunity to better understand the unique characteristics of different areas to be served by investment, and reflect on how businesses in these areas can best be supported.

4.3 Greater Manchester-wide economic impacts

4.3.1 Exploratory research was carried out by Ove Arup to better understand the relationship between increases in public transport accessibility, e.g. as reported in Section 4.1, and Greater Manchester economic performance. Economic performance relates to changes in commercial rents, often taken as a proxy for productivity change, and changes in employment.

4.3.2 There is a strong belief in the UK that there are strong linkages between transport infrastructure investment and economic performance. Robust statistical evidence of this is, however, very rare. A particular challenge is how to isolate out cause and effect, i.e. to distinguish between correlation and causation.

4.3.3 Metrolink Phase 3 was felt to provide the opportunity to research linkages between transport and the economy. Appendix G provides a technical summary of the work carried out.

4.3.4 A range of statistical models of varying degrees of complexity was estimated for the period in which public transport accessibility had improved due to Metrolink Phase 3. While the models did point to strong linkages between accessibility increases and commercial rents, with areas within 1 km of Metrolink stops experiencing an average uplift of 6.5% relative to control areas, despite the sophistication of the models that were deployed, separation of correlation and causation for the datasets explored was not possible.

4.3.5 Employment, for which changes are generally slower to take effect, was also challenging to model in statistical terms, with a lack of clear findings emerging at this time.

4.3.6 The positive house price effects noted in Sections 4.4 and 4.5 later in this report, point to clear economic impacts brought about by the Metrolink system. These may suggest additional areas for future research.

4.3.7 Furthermore, other avenues for research work in the area of transport and the economy in Greater Manchester remain. These include using Office for National Statistics data on productivity at a small area level, to explore relationships between transport investment business output. It is expected that further analysis will be carried out in the future on the broader context of the Greater Manchester economy and a wider range of transport investments including, but not limited, to Metrolink Phase 3.

4.4 House price effects of proximity to Metrolink and rail in Greater Manchester – study by the Nationwide

4.4.1 Independent of any TfGM studies, Nationwide Building Society has carried out statistical modelling of the relationship between house prices and proximity to railway stations and Metrolink stops in Greater Manchester[5].

4.4.2 The research examined how the proximity to a Metrolink stop or railway station impacted upon property prices in Greater Manchester after taking account of other property characteristics, such as property type, size and local neighbourhood type.

4.4.3 The econometric analysis made use of Nationwide's house price index dataset for Greater Manchester and focused on properties within 5km of a rail station or Metrolink stop in the county. The research did not separate out the impact of a Metrolink stop relative to that of a railway station, or of new stations/ stops relative to more established ones.

4.4.4 The premium compared to a property located 1,500m from a stop or station was estimated at:

- 7.8% for a property located 500m from a stop or station, or £8,300 based on average prices that Nationwide determined in the area (was 4.6% in 2014 analysis by Nationwide);

[5] https://www.nationwide.co.uk/-/media/MainSite/documents/about/house-price-index/2019/Transport_special_feature_Jun_2019.pdf; Method used explained in 2014 publication: http://www.nationwide.co.uk/~/media/MainSite/documents/about/house-price-index/greater-manchester-transport-special-2012.pdf - both documents last accessed August 2020.

- 5.4% for a property located 750m from a stop or station (was 3.2%);
- 3.3% for a property located 1,000m from a stop or station (was 2%); and
- 1.5% for a property located 1,250m from a stop or station (was 0.9%).

4.4.5 The 2014 report from Nationwide provides some more detail on the approach taken, which it is understood was replicated in 2019:

"The methodology correlates the price paid for a property against the set of property characteristics (including the property type, age, number of bedrooms, number of bathrooms, floor area and parking/garages), locality (local neighbourhood as described by ACORN) and distance from the nearest station. For each case in the sample, the straight line distance to the nearest station (National Rail or Manchester Metrolink) was calculated. Our research is based on the proximity to a station and does not take account of the service provision or indeed the typical travel time to central Manchester. However, Denton and Reddish South stations were excluded due to the exceptionally limited service provided. Only properties within 5km of a station were included."

4.4.6 The findings from Nationwide's research indicate that a significant proportion of people find proximity to Metrolink and rail to be an attractive property feature in Greater Manchester, reflected in the uplift in house prices documented here.

4.5 House price effects of proximity to Metrolink in Greater Manchester – study by the University of Leeds

4.5.1 Funded by TfN, WYCA and ESPRC, this study[6] included analysis of house price effects in Greater Manchester - as an area that had experienced a significant increase in rail-based accessibility due to the expansion of Metrolink. As the study covers the period from 1995 to 2018, both Phase 2 (Eccles Line) and Phase 3 impacts on house prices will have been picked up over this time period.

4.5.2 The statistical model developed, known as a hedonic price model, made use of house price and related data for 1,636 Lower Super Output Areas for which there were no missing values for any one year. Over 24 years,

[6] Land Value and Transport, Modelling and Appraisal, Institute for Transport Studies, University of Leeds. https://transportforthenorth.com/wp-content/uploads/LVT-Phase-2-Final-Report-ITS-2019.pdf last accessed August 2020. Note that the study includes some observations on the Eccles Line but these are not reported here as most stops on that line were part of Phase 2.

1995 to 2018, this provided 39,264 observations over time and across areas. The model separates out areas with an intervention, "treatment areas" with a new Metrolink stop, from control areas. In doing so, allowance is made for causality.

4.5.3 In headline terms, the statistical modelling found that past changes in accessibility due to Metrolink network expansion led to a positive and statistically significant uplift of 6.3% from being within 1km of a Metrolink stop. This uplift is for average sold prices in each LSOA, having controlled for average house price increases across the Greater Manchester area, property type mix and the effects of LSOA characteristics that were assumed not to vary over time.

4.5.4 The analysis included a breakdown by Metrolink Line, as show in Table 4.1. The research team reports that there are statistically significant uplifts on the Airport Line (+20.6%) and the East Didsbury Line (+10.5%). In addition, other lines do not show a statistically significant uplift (at the 95% confidence level), although there is some evidence of an uplift on the Ashton Line (+7.5) at a lower confidence level.

Table 4.1: Property value uplifts within 1km of new Metrolink station

Area	**Uplift within 1km of stop**
New Metrolink stops, 1999-2017	+6.3%
Line	**Uplift within 1km of stop**
Airport	+20.6%
East Didsbury	+10.5%
Ashton	+7.5%*
Oldham & Rochdale	-1.1%*

Notes: * The authors note that the results for Ashton and for Oldham and Rochdale are not significant at the 95% level of significance, meaning that the findings are uncertain for those lines. TfGM note that the Airport Line findings may also be influenced by change over time in the Wythenshawe area, e.g. a lessening in levels of deprivation.

4.5.5 In relation to the findings by line, some commentary on the findings is provided by the authors of the paper. In summary, these are that:

- Although the Airport line passes through a number of deprived LSOAs around Wythenshawe, it is distinctive in having a major concentration of employment at each end (Manchester City Centre and the Airport), which increase accessibility to employment from intermediate stations. The East Didsbury Line also passes through some of the more affluent areas in the south of Manchester, in terms of household income;

- Parts of the Rochdale, East Manchester and Eccles lines serve areas of higher deprivation and relatively low income. It is probable that low underlying levels of property demand constrained the growth in prices in these places; and,
- Oldham and Rochdale Line was the line that replaced an existing rail line so potentially the step change in accessibility was smaller.

4.5.6 As with Nationwide's research, the findings on house price uplifts from the University of Leeds' statistical analysis point to a significant increase in attractiveness in areas close to Metrolink stops.

4.6 Findings from Wythenshawe communities on the impacts of the Airport Line

4.6.1 A study of impacts on Wythenshawe communities of Metrolink's introduction to the area was carried out by Ipsos MORI. At the core of the approach was the conduct of 1,023 interviews of residents in Wythenshawe, exploring positive and negative impacts on transport opportunities and community wellbeing. The interviews were supplemented by drop-in focus groups in Wythenshawe town centre and 10 business interviews.

4.6.2 In particular, findings from the survey provide strong evidence that Metrolink has enhanced the social experiences of residents and led to enhanced employment opportunities:

- Of those who say that changes to public transport have increased the range of places they travel to when socialising, over four in five (83%) say this is because of the tram;
- Of those who say that changes to public transport have increased the range of places they travel to when taking part in leisure activities, 85% say the tram has most contributed to this; and,
- Travel by tram is seen as a 'treat', it is a leisure activity in itself for some residents.

4.6.3 While proportionally fewer residents have seen an impact on their access to job opportunities, this is likely to only be relevant for those who have sought new employment over the last few years. Of those who have (and for whom the tram has made more destinations accessible to them), the vast majority (84%) say the tram has contributed most to giving them access to a wider range of places where there are job opportunities.

4.6.4 Residents have seen greatest benefit of the Airport Line to travel into the city centre:

- Of those who travel to the city centre, the most popular mode of transport is tram – half of those (52%) use this mode to get into town;
- Two-fifths (43%) of 'new' residents (i.e. those who have lived in the area for less than five years) think travel into the city centre has got better since they have lived in Wythenshawe; and,
- City centre connectivity has improved even more for those who have lived in Wythenshawe for longer - over two-thirds (68%) think the ease of travel has improved.

4.6.5 The Airport Line also plays an important role for those travelling to Manchester Airport – a quarter of residents (24%) use tram to travel there, while the ease of getting there has also improved, albeit to a lesser extent than the ease of getting to the city centre.

4.6.6 From the small number of interviews with firms carried out, the impact on local businesses has also been positive, but perhaps more muted. Some have seen disadvantages.

4.6.7 Importantly, there is a perception that the tram has been the catalyst for additional investment and regeneration of the town centre and its hinterlands. Half of residents (52%) say Wythenshawe has become a better place to live since the Airport Line opened, with only 15% saying it has got worse. Around two in five residents (42%) say the tram is the best thing about living in Wythenshawe.

4.6.8 New businesses have established themselves in Wythenshawe, which contribute to the perception that the area is 'on the up'. Businesses in the town centre report that they have seen an increase in footfall, while other businesses relocated to be near tram stops. In particular, it appears that there are more visitors than previously to the town centre from outside of the Wythenshawe area, which is perceived to be attributed to the tram.

4.6.9 Not all businesses across all sectors, however, have reaped the benefits:

- Because residents can now access places further afield more easily, localised footfall has become more dispersed with residents travelling outside of Wythenshawe to shop, depending on the type of business; and,
- Businesses have not really experienced a noticeable change in those applying for jobs, e.g. from a wider catchment area.

4.6.10 The tram has had a limited impact on employee commuting behaviours, partly because adapting home and/or employment location in response to a new travel opportunity can take a long time to take place. It was noted that:

- Commuting by car is still common;
- The tram is perceived as expensive for some workers, which is why they don't use it;
- Some large-scale employers are not well served by the tram network at this time. For example, the tram does not run particularly close to Wythenshawe Hospital, while the size of the Airport City site means that it can be impossible for employees to get to their place of work on the Airport City site from the tram terminus, due to a lack of onward connections.

4.6.11 The tram has led to positive changes in resident travel behaviour, while negative impacts on other modes are not obvious:

- A third of residents (32%) say they use the tram more often compared to 12 months ago, with 6% saying less often. Patronage is therefore growing, and it is one of two transport types (along with walking) which has seen a net increase in use over that time (an increase of 26 percentage points). Encouragingly, it is young people (16-34) who are the primary demographic driving this increase;
- As a result of using the tram more often, around a third of people who use the tram more often (34%) drive their vehicle less often, while a further one in ten (9%) travel less often as a passenger. This is a positive shift from private vehicle usage to using public transport;
- Half of those using the tram more often (51%), however, now use the bus less often as a result. The tram is therefore impacting on the demand for bus;
- Despite this, the impact on bus routes is not a significant concern for residents. It was mentioned by some residents in relation to some routes, but it certainly isn't a top of mind concern and is often referenced in the context of a particular route which is now no longer serviced.

4.6.12 Despite the positive impact of the tram, negative perceptions still exist, mainly around ease of use and cost. There remain pockets of the community who think that the tram is not for them and they would be unlikely to consider using it:

- The tram is still inaccessible for some areas of Wythenshawe. For example, those living in the Northenden ward, which is not serviced by the tram, and those living in the catchments furthest away from a tram stop have seen little benefit from it;
- Two-thirds (65%) think affordability of the tram is an issue. Only two-thirds of residents (65%) see the tram as affordable, while employers think that cost is a key reason why employees don't use it more often. The perception of cost is also an issue for non-users; and,
- Ease of use – the qualitative research illustrates that 'how the tram works' remains a mystery for some residents, some of whom think it is difficult to navigate and understand the ticket options. This appears to have been increased since the introduction of the zonal ticketing system, with many finding it confusing.

4.6.13 Wythenshawe has a strong sense of identity with deep, working class roots. There is, however, evidence that Metrolink, and the development in locations such as the airport, has precipitated a change in the demographic.

4.6.14 For example, there are more upper/middle class people moving into the area (compared to other social grades) since Metrolink was opened – 22% of those who have moved to Wythenshawe are in the ABC1 categories compared to only 13% of those in C2DE. Although this does not account for individuals who move away from Wythenshawe it may still be indicative of the changing demographics in social grade within the area. Residents who are in the DE social grade are more likely to say Wythenshawe has got worse as a place to live, as are those who are disabled (physical and mental), those aged 65+, and the unemployed, suggesting that the changes in the area have not had as much of an impact among the most vulnerable.

4.6.15 In overall terms, it was concluded from the resident interviews that the Airport Line has had a positive impact on the community of Wythenshawe. The impact has varied depending on demographic, ward and personal circumstances, but four in five residents acknowledge the positive impact it has had, with only 5% saying that it has been negative.

4.6.16 The research on Wythenshawe residents' experiences will be valuable in developing future investment cases in that it provides some good insights into how travel horizons and travel patterns have developed as a result of a major intervention.

5 Concluding remarks

5.1.1 The preceding sections have set out the findings of monitoring and evaluation activity carried out in recent years and mark the conclusion of research work that solely focuses on Metrolink Phase 3.

5.1.2 A wider set of research supporting Greater Manchester's ambitions for transport is now envisaged that draws on some of the issues raised in this report but is much broader in scope.

5.1.3 The ongoing research programme will, as resources allow, include:

- Developing an understanding of the travel market and the outlook for Metrolink demand;
- Analysis of different approaches to handling uncertainty in patronage (and hence revenue) forecasting, including scenario planning relating to COVID-19 and other external factors, and assessing how the handling of uncertainty can be incorporated into future investment decisions;
- Defining requirements relating to the investment programmes, including the passenger perspective on these;
- Further work to understand the relationship between transport investment and local economic performance.

A Appendix A: Executive Summary from the Early Findings Report

A.1 Introduction

A.1.1 This one year after monitoring and evaluation report focuses on three extensions to the Metrolink network that form part of the Phase 3 programme of works. These are the extensions to Oldham and Rochdale town centres, East Didsbury and Ashton-under-Lyne. There is also some coverage, albeit limited coverage due to it only having opened relatively recently, of findings in relation to the Airport Line.

A.1.2 With the completion of the Second City Crossing in 2017, Transport for Greater Manchester will have successfully delivered by far the largest expansion of any modern tram network in the United Kingdom.

A.1.3 The report is a 'one year after' report as it relates to evidence collected up to one year after the last part of Phase 3 that the Department for Transport contributed funding towards came into operation. As such, the report presents early evidence from the initial period of operation of the expanded network.

A.1.4 Where possible, in order to enable the Department of Transport to understand the results of central government investment, findings are reported separately by line.

A.1.5 The short-term nature of this initial report means that it offers more in terms of scheme outputs rather than outcomes, which are inevitably still emerging and subject to short-term exogenous factors. The initial findings reported in this one year after report will be augmented by further monitoring and evaluation activity in the coming years. This further work will cover the areas included in this report and, in addition, the study of longer-term issues such as impacts on the economy. These will be made available in a 'five years after' report in 2019, i.e. five years after the last extension part-funded by the DfT came into operation.

A.2 Network expansion

A.2.1 Approval and funding of Metrolink Phase 3 was secured in a number of stages. Phase 3A, comprising the conversion of the Oldham-Rochdale heavy rail 'Loop Line' and extension to Chorlton (both funded in part by the DfT), together with the East Manchester extension to Droylsden (funded locally) formed the initial component of the expansion programme. Phase 3A was awarded initial approval in 2006 in the DfT major scheme business case process, with full approval in 2008. The DfT-supported programme was extended in 2010 through the award of full approval of further extensions to Ashton-under-Lyne and East Didsbury.

A.2.2 A new operations and maintenance contract was awarded in 2007. Subsequently, a bespoke Metrolink Phase 3 design, construct and maintain contract for the new extensions was awarded in 2008.

A.2.3 Both the Metrolink Phase 3 design, construct and maintain contract and the operations and maintenance contract were designed to enable subsequent expansion of the programme. The DfT supported schemes and the Droylsden extension have also been augmented by further locally funded expansion. This has included extensions to Manchester Airport via Wythenshawe, a loop off the Phase 3A Oldham and Rochdale Line passing through Oldham town centre, an extension from Rochdale railway station to Rochdale town centre, and lastly, a new route across Manchester city centre, the Second City Crossing.

A.2.4 Prior to the development of the Phase 3 extensions, a programme of capacity and renewal works was agreed with DfT in 2005. As a consequence the Phase 3 programme was procured against a background of significant investment and works to the existing Metrolink system. Among other items, investment included the first of a new-to-Metrolink type of tram, track replacement on the Bury and Altrincham Lines, a new signalling and control system, and accessibility improvements to existing Metrolink stops.

A.2.5 Other external funding has enabled additional Metrolink development. The most notable example of this has been the MediaCityUK extension, comprising a spur off the existing line to Eccles via Salford Quays. This short extension was a significant factor in the BBC's decision to locate its new northern headquarters in Salford Quays. The level of commercial development at MediaCityUK simply would have not been possible without the enhanced public transport capacity provided by this Metrolink extension.

A.2.6 Locally funded additions to Metrolink Phase 3 have included a programme of park and ride facilities. These have comprised a mixture of new sites and expansion of existing, heavily used facilities. In the case of Hollinwood and Derker, new car parks integral to the Phase 3A scheme have been augmented by local funding to provide significantly larger capacity. Furthermore, using local resources the tram fleet has been expanded beyond that originally anticipated to enable the original set of trams to be retired, enabling more efficient operation than a mix of new and old trams would have allowed for.

A.2.7 As noted earlier, the Phase 3 programme has, and continues to be, delivered under a bespoke design, construct and maintain contract – supported by a delivery partner. The combination of this contract with the operation and maintenance contract has provided the necessary

flexibility to augment the programme as new funding streams were confirmed.

A.2.8 Weekday service frequencies of at least 5 trams per hour on all of the Phase 3 extensions have contributed significantly to the connectivity of the transport network in Greater Manchester. Passenger numbers have increased on all the new lines even though the core of the system is affected by works associated with the construction of the Second City Crossing. Higher service frequencies are planned to be introduced following completion of the Second City Crossing and as passenger demand requires.

A.2.9 In due course, once the Second City Crossing is complete in 2017, the Phase 3 programme will deliver an increase in passenger capacity of all public transport (bus, rail and Metrolink) into the regional centre of almost 10%, relative to the without-Phase 3 situation. At the time when this report was prepared in 2015, the increase in overall public transport capacity into the city centre was 5%, compared to a without-Phase 3 scenario.

A.2.10 In the future the infrastructure provided by Phase 3 has the potential to support further capacity increases over time, including the proposed Trafford Park Line services, the operation of double trams in response to growing passenger demand and the introduction of tram-train routes.

A.3 Initial findings

A.3.1 Despite the complexity of the overall programme described above, Metrolink Phase 3 has been delivered within overall budget and on schedule. The report notes that there are variances contained within the relevant budget of £764 million, relating to the part of the programme elements that the DfT has contributed to, but any changes in cost have been allowed for through adoption of best practice risk management techniques and the delivery of offsetting cost savings.

A.3.2 The major line openings were achieved on schedule. In the event, however, the timing of sub-sections varied from the dates that were published originally. This was due in part to the scale of technical change and system integration issues in relation to existing Metrolink systems. These challenges included a new signalling and control system.

A.3.3 As the earlier technical and integration challenges were overcome, and with the benefit of experience and lessons learnt during the course of the programme, delivery subsequently accelerated. Airport Line services were able to commence over a year ahead of the published date. This demonstrated the value of the continuing contract arrangements that

permitted an experienced team to retain knowledge and apply it as the project expanded.

A.3.4 In terms of initial impacts, the report illustrates the strategic significance of the Metrolink extensions, where for each of the key destination types of employment, further education and healthcare, there is a significant increase in public transport accessibility at a Greater Manchester level.

A.3.5 In the case of the corridors benefiting from the extensions, half of the population in the corridors experience an increase in public transport accessibility to employment and healthcare of 10% or more. This means that there is a 10% or greater reduction in the overall time required to access a range of each type of opportunity. For further education, over a third of the population experience an increase in public transport accessibility of 10% or more. Over 180,000 people in the corridors have benefited from this scale of increase in public transport accessibility.

A.3.6 In the case of deprived communities, the improvement in accessibility is more marked than for the corridor population as a whole.

A.3.7 From another perspective, the ability of Metrolink to attract people out of their cars, observed from Phases 1 and 2 of Metrolink development, has been confirmed in the case of Phase 3. Initial findings at this early stage are that a quarter of all trips on the new extensions would have been made by car if the option of travelling by tram had not been available.

A.3.8 Furthermore, across Phase 3 survey findings indicate that over a quarter of new park and ride users would have otherwise driven all the way to their destination and a further 4% would not have made their trip at all had the parking spaces not been provided.

A.3.9 The period since 2006 has seen dramatic changes in the economic background following the 2008 start of the recession, against which the Metrolink Phase 3 programme has been delivered. While the programme's delivery has supported the Greater Manchester economy, the various scheme business cases were based on pre-recession rates of economic growth, development activity and growth in employment. The report analyses the effects of lower than anticipated economic growth and other factors on out-turn patronage.

A.3.10 Other factors considered in relation to patronage development related to the nature of business cases developed prior to the Second City Crossing case, namely that they only considered committed expansion of the Metrolink network. For this reason, the business cases for the extensions covered in this report did not take account of the potential effects on Metrolink services of the construction of the Second City Crossing or

other system enhancement works. This has affected service frequencies in particular.

A.3.11 Patronage figures are nevertheless an important measure of progress towards delivering eventual longer-term outcomes. Patronage figures for the most recent year of operation have been compared to the figures that were expected at this stage of maturity of the Phase 3 network. Patronage for 2014/15 was found to be approximately half the level that had been anticipated by this time (in the original business cases).

A.3.12 Further analysis was carried out in order to understand this difference. Part of the overall difference was attributed to factors external to Metrolink and related to the relative weakness of the economy in recent years; these factors include suppressed growth in regional GVA and in city centre employment, plus significant developments that have yet not materialised along the corridors in comparison to the original business cases.

A.3.13 The remainder of the difference that it has been possible to explain to date relates to the technical development of Metrolink services on the Phase 3 network; these are primarily service frequencies and tram speeds. Frequencies will be improved in the future, once the Second City Crossing is operational. Tram speeds will also be improved in the future, as the network will be stable for a number of years, allowing opportunities to tighten up run times to be taken up. Other factors that have affected capacity in the recent years, such as periods of city centre closure and single line running relating to the Second City Crossing, will also be lifted and will enable a more extensive range of marketing activity to take place.

A.3.14 In the meantime, patronage has been growing across the Phase 3 network. In the case of the Oldham and Rochdale Line, patronage has more than tripled since Metrolink's introduction, in comparison to the last full year of operation of the Oldham Loop rail service.

A.4 Conclusions

A.4.1 Some of the main positive lessons learnt in relation to delivery of Phase 3, obtained through interviews of the delivery team, were that:

- the appointment of a contractor with an ability to extend services offered enabled the retention of knowledge for the benefit of efficiently delivering an expanding programme of works;
- the decision to appoint a delivery partner and create an integrated delivery team allowed for an effective mix of public and private sector resources, scaled to the phases of the programme, to be deployed;

- secondment of delivery team staff into utilities companies enabled accelerated agreement and delivery of utility diversion works;
- mirroring the structure of the contractors' team via the delivery team structure enhanced working relationships and the monitoring of progress;
- creation of a Disability Design Reference Group meant that opportunities to make the network fully accessible were exploited at all stages of design and delivery;
- development of go-live procedures to enable all necessary tasks to be completed assisted in the active management of the run-up to opening new sections; and
- development of a computer-based driver training simulator halved the time it took for drivers to become familiar with new routes.

A.4.2 Other lessons learnt observations that require further reflection were that:

- the impacts of suppressed economic growth and development activity have had a negative impact on outturn patronage performance in the initial period of operation, not anticipated at the business case stage; and
- success in securing funds for further expansion of the Metrolink network, beyond that taken account of in earlier-stage business cases, has meant that disruptive short-term operational impacts of further network expansion were again not anticipated in the original business cases prior to the Second City Crossing business case.

A.4.3 To sum up, the report presents interim findings in relation to the implementation of Metrolink Phase 3. In overall terms, the programme has been delivered on time and on budget. Early indications are that the system's expansion is beginning to generate the benefits anticipated, which is encouraging. The 'five years after' report will revisit the areas covered by this report as well as examining longer-term impacts, such as those on the economy of Greater Manchester.

B Appendix B: Technical Details - Make-up of usage of Phase 3 lines

B.1.1 In order to understand how the Phase 3 lines were being used in comparison to Phase 1 and 2 lines, travel surveys were handed out on neutral weekdays - i.e. Tuesdays, Wednesdays or Thursdays - in October and November 2018. Surveys were handed out to those aged 16 or over, travelling towards the city centre at all stops except for those in the city centre and between the hours of 0630 and 1900. 7,331 self-completion surveys were returned and counts of customers boarding trams were used to ensure that the survey responses were reasonably representative by Metrolink stop and time of day.

B.1.2 Table B.1 reports the findings of these weekday surveys in respect of journey purpose and shows that commuting is a dominant reason for using all Phase 3 lines.

Table B.1: Journey purpose of weekday Metrolink passengers

Line	Usual place of work	Shopping	Sport or enter-tainment	Visiting friends or relatives	Another place visited on business	Educ-ation	Personal business (e.g. bank)	Hospital / GP	Other	Total	Sample size
Altrincham	58.7%	10.2%	11.1%	4.4%	5.8%	4.3%	2.9%	1.2%	1.3%	100%	1,477
Bury	54.3%	13.2%	8.1%	5.9%	4.2%	8.0%	2.9%	2.3%	1.2%	100%	1,361
Eccles	59.6%	9.6%	10.6%	3.8%	7.5%	2.5%	2.6%	2.0%	1.7%	100%	888
Ashton	47.0%	16.0%	9.4%	6.0%	7.0%	8.1%	3.1%	2.7%	0.6%	100%	607
East Didsbury	57.0%	10.6%	15.2%	4.3%	4.5%	1.6%	3.5%	2.2%	1.0%	100%	1,133
Oldham & Rochdale	48.8%	16.7%	9.3%	6.6%	4.6%	7.2%	3.8%	1.8%	1.2%	100%	1,005
Manchester Airport	45.1%	16.5%	6.6%	8.3%	3.9%	4.3%	1.9%	6.8%	6.5%	100%	646
Peak	71.1%	4.3%	8.2%	3.4%	4.5%	4.4%	1.5%	1.5%	1.1%	100%	4,817
Off-Peak	20.7%	29.4%	14.3%	9.2%	7.0%	6.6%	6.1%	4.0%	2.6%	100%	2,300
Phase 1 & 2 lines	57.4%	11.0%	10.0%	4.8%	5.8%	5.1%	2.8%	1.8%	1.4%	100%	3,726
Phase 3 lines	50.3%	14.8%	10.6%	6.1%	4.9%	5.2%	3.3%	2.9%	1.9%	100%	3,391
All surveyed	**54.2%**	**12.7%**	**10.3%**	**5.4%**	**5.3%**	**5.1%**	**3.0%**	**2.3%**	**1.6%**	**100%**	**7,117**

B.1.3 Note that the sample sizes listed in the survey response tables are unweighted numbers and are provided in order to give an indication of the degree of confidence that can be placed in the different table entries.

B.1.4 Table B.2 provides a perspective on travel within Phase 3 lines, to the city centre zone and onward to the pre-Phase 3 lines. There is a particularly high incidence of travel, approximately a third of trips made, within the Oldham and Rochdale Line and also the Airport Line. For the Oldham and Rochdale Line this may be explained by the two district centres and the length of the line. In the case of the Airport Line, Manchester Airport

itself is a strong trip attractor and it appears that Wythenshawe Hospital is also an important trip attractor.

Table B.2: Travel patterns within and between lines

Line	City Zone/ Cornbrook	Altrincham	Bury	Eccles	Ashton	East Didsbury	Oldham & Rochdale	Manchester Airport	Total	Sample Size
Altrincham	71.6%	14.0%	4.0%	4.9%	1.3%	1.5%	2.3%	0.5%	100.0%	1,514
Bury	64.4%	5.6%	19.5%	4.4%	0.9%	2.7%	1.2%	1.2%	100.0%	1,403
Eccles	61.1%	5.4%	3.9%	11.1%	5.3%	4.9%	5.7%	2.7%	100.0%	918
Ashton	63.9%	4.0%	2.7%	10.2%	16.8%	1.4%	0.0%	0.9%	100.0%	633
East Didsbury	72.8%	4.3%	2.2%	9.1%	1.8%	5.8%	2.6%	1.4%	100.0%	1,170
Oldham & Rochdale	49.8%	3.0%	2.6%	4.7%	1.3%	3.6%	34.6%	0.5%	100.0%	1,030
Manchester Airport	42.1%	6.1%	1.5%	5.0%	1.4%	9.8%	2.5%	31.5%	100.0%	663
Peak	66.3%	6.6%	4.6%	6.2%	2.9%	3.7%	7.0%	2.7%	100.0%	4,934
Off-Peak	54.4%	6.4%	9.1%	7.7%	3.5%	4.1%	9.9%	4.8%	100.0%	2,397
Phase 1 & 2 Lines	65.7%	8.3%	9.1%	6.8%	2.5%	3.0%	3.1%	1.5%	100.0%	3,835
Phase 3 Lines	57.1%	4.3%	2.3%	7.3%	5.3%	5.2%	9.9%	8.6%	100.0%	3,496
All Surveyed	**62.2%**	**6.5%**	**6.1%**	**6.7%**	**3.1%**	**3.8%**	**8.0%**	**3.4%**	**100.0%**	**7,331**

B.1.5 The table also shows a significant proportion of travellers making cross-city journeys, thought these statistics may be influenced by survey participants making such journeys having the opportunity to fill out a survey on both outward and return journeys. The survey relates to adults and therefore school pupils, who tend to make a fairly large share of trips within lines, are not taken account of in these statistics.

B.1.6 The surveys have been valuable in understanding different travel patterns on different lines for marketing purposes and for future transport planning. The surveys will also be valuable for setting a baseline for monitoring and encouraging future recovery of different passenger markets in the short to medium term, given Coronavirus.

C Appendix C: Technical Details - Implications of mode shift evidence

C.1.1 Applying the 17.9% modal shift from car as driver from Table 3.2 in the main report to TfGM's estimate of 17.95 million Metrolink Phase 3 trips in 2019/20 gives an estimate of annual car trips taken off the road by Phase 3's introduction.

C.1.2 For 2019/20 some 3.2 million car trips have been taken off the road by Phase 3, where car would otherwise have been the main mode (i.e. car making up the longest part of the journey from origin to destination).

C.1.3 Average car trip length taken off the roads was calculated, using the starting Metrolink stop to destination[7], also from the Phase 3 survey data. So, as an example, a Metrolink trip where someone started from the outskirts of Bury and drove to Radcliffe, before travelling to Manchester town hall, would use the crow's fly distance from Radcliffe to the town hall as the car km taken off the roads.

C.1.4 An estimate of 38.8 million car km in 2019/20 removed from the roads by Metrolink Phase 3 results from these calculations.

C.1.5 Using national figures[8] for 2019 on fuel consumption, fleet mix (assuming that petrol, diesel and electric vehicles do the same number of km per trip) and CO_2 equivalent emissions per litre of fuel or kWh at 25km/hour give CO_2 equivalent emissions of 0.17 kg per km.

C.1.6 Combining these factors with car km removed give a figure that equates to the removal of 6,700 tonnes of CO_2 equivalent in 2019/20 as a result of Phase 3.

C.1.7 Metrolink is 100% powered by zero carbon generated electricity, this is supplied by a mix of renewables - mainly wind and solar - and nuclear. For these reasons, it was assumed that increased tram kilometres are not associated with any CO_2 equivalent emissions.

C.1.8 A key indicator of local air pollution is the level of nitrous oxides, NO_x, and so calculations were made in respect of NO_x emissions removed by Phase 3.

C.1.9 The initial step in this calculation was to combine figures for the mix of petrol and diesel cars by engine class (e.g. Euro 6), sourced from the Greater Manchester fleet composition from Greater Manchester Clean

[7] Note that taking the origin to destination distance would overestimate car km removed in the case of Metrolink users who drove to their start Metrolink stop. To maintain a conservative estimate, a conversion factor from crow fly distance to actual distance on the road was also not applied.

[8] TAG July 2020 databook accessed Sept 2020 at: https://www.gov.uk/government/publications/tag-data-book

Air Plan modelling, with emission estimates from national estimates[9] at a speed of 25 km/hour and assuming an equal distribution across engine sizes. This yields an overall NOx emission factor of 0.05 g/km for petrol cars and 0.6 g/km for diesel cars for 2019.

C.1.10 Applying the g/km factors to the Phase 3 reduction in car kilometres travelled, assuming the TAG engine type mix of 48.3% petrol, and 50.7% diesel, the remaining 1% being electric engines, gives a reduction in NO_x of 12.8 tonnes in 2019/20.

C.1.11 Particulate matter is produced by both tram movements and the car travel that Metrolink replaces. In the absence of detailed data for Metrolink emissions, no calculations in relation to this pollutant were carried out.

C.1.12 The figures for car trips and car kilometres removed, CO_2 reduction and NO_x decrease give an indication of the scale of the contribution of Metrolink Phase 3 to sustainable transport in Greater Manchester.

[9] https://naei.beis.gov.uk/resources/rtp_Copert5_NOxEFs_final.xlsx accessed September 2020.

D Appendix D: Technical Details - Explanatory factors behind differences from patronage forecasts

D.1.1 The Early Findings Report found that outturn patronage in 2014/15 was at 48% of anticipated patronage at that stage. It provided a broad quantification of factors that helped to explain the gap between outturn and forecast usage. The report also committed to further research to better understand and quantify the full range of factors behind the differences from forecasts and this review work, carried out by Systra, is reported here.

D.1.2 With changes in Metrolink operations and in the Greater Manchester economy, many aspects of these calculations have changed in the intervening years to 2018/19. The current overall Phase 3 position is that 69% of forecast patronage has been reached by 2018/19, so there remains a gap but there has been a considerable closing of the difference between outturn and forecast Phase 3 usage.

D.1.3 Table D.1 reports forecast patronage, quantified explanatory factors, adjusted expected demand after explanatory factors are taken account of, and outturn patronage by Phase 3 line.

D.1.4 Forecast patronage has been updated to 2018 to take account of the forecast years for the different lines and background growth in Metrolink patronage. Explanatory factors are quantified and then added to or subtracted from these forecast figures, e.g. added to if they are a factor contributing to an increase in expected patronage.

D.1.5 This results in an adjusted expected demand that can be compared to outturn patronage to show the level of explanation (in % terms) of the explanatory factors for each line.

Table D.1: Quantification of explanatory patronage factors

Annual patronage (millions)	Ashton Line	Airport Line	East Didsbury Line	Oldham & Rochdale Line
Expected demand 2018 (A)				
Phase 3a	2.19	-	2.98	6.70
Phase 3b	3.33	5.73	3.49	3.35
Combined	**5.52**	**5.73**	**6.47**	**10.05**
Key model explanatory factors (B)				
Annualisation factors	-0.17	-0.19	-0.32	+0.02
Residual demand build-up	-0.05	-0.30	0.00	-0.15
Supplementary model factors (C)				
Interpeak generated trips	0.00	0.00	-0.22	0.00
Park and ride	-0.44	+0.03	+0.27	+0.10
Development demand	-	-	-	-0.74
City of Manchester stadium	0.00	-	-	-
Mode shift adjustment	0.00	0.00	0.00	0.00
Airport employees/ passengers	-	-0.20	-	-
Outturn explanatory factors (D)				
Metrolink frequencies	-1.20	-0.81	0.00	0.00
Metrolink stops	0.00	-0.32	0.00	+0.17
Metrolink in-vehicle times	-0.79	-1.01	-0.57	-1.05
Metrolink vs. bus fares	+0.29	+0.29	+0.45	+0.68
Economy/ GVA	-0.44	-0.34	-0.68	-1.05
Employment	+0.18	+0.18	+0.24	+0.42
Adjusted expected demand (E = A + B + C + D)	**2.89**	**3.04**	**5.66**	**8.46**
Actual demand 2018/19 (F)	**3.10**	**3.44**	**5.90**	**6.85**
Actual minus adjusted expected (F – E)	+0.21	+0.40	+0.24	-1.61
Actual/ adjusted expected (F/E)	107%	113%	104%	81%

Notes: park and ride demand in this analysis was assumed to largely come from non-public transport sources, whereas statistics in Greater Manchester indicate a mix of public transport and non-public transport sources. Following the addition of further safety margins over time, in-vehicle times were some 10-20% longer than those assumed in the business cases.

D.1.6 The percentage figure in the last row of the table shows that adjusted expected demand is close to actual demand for all lines, with the bulk of patronage differences explained.

D.1.7 The exception to this is on the Oldham and Rochdale Line, for which it has not been possible to determine all explanatory factors behind the patronage gap on the extension. Possible additional explanatory factors for this line include, in the view of TfGM: the fact that the heavy rail line was closed for several years during construction, which may have led some former public transport users to migrate to other modes or change destination, with longer term consequences; and, the possibility that the lower income nature of many parts of the corridor may have affected modal choice.

D.1.8 Among the larger explanatory factors for the different Phase 3 lines are:

- Lower development-related patronage in Oldham and Rochdale town centres than expected;
- Only recently increased service frequencies on the Ashton Line, resulting in build-up yet to come in the analysis year of 2008/09.
- Lower service frequencies than expected on the Airport Line;
- Longer tram in-vehicle times than assumed in the planning forecasts, with journey times further lengthened to allow for greater safety margins after the Croydon incident in 2016; and,
- Slower growth in the Greater Manchester economy, in terms of GVA, than anticipated, although this is partially offset by stronger growth in employment in the period to 2018/19 than had been foreseen.

D.1.9 Similar quantified analysis was carried out to explain differences between outturn and forecast passenger revenue, where the gap in revenues tends to follow the patronage pattern and shares the same explanatory variables. Additional variables relate to the level of average yield per passenger and the level of fare evasion on Phase 3 lines in relation to pre-existing lines.

D.1.10 The overall summary of the review was that the model structure used for the forecasting for the extensions was sound for the most part, but that key assumptions were not always accurate when it came to the outturn value for them. This points to a need for an increased range of sensitivity tests and a role for different scenarios being run through transport forecasting models, to better understand the range of outcomes that may arise in the future.

D.1.11 The difference in passenger revenues from forecasts is significant, but finance costs have been much lower than anticipated due to much lower interest rates than were originally built into the finance model, the lower rates due in large part due to limited economic growth. A further mitigating factor was that a degree of contingency relating to the forecast Phase 3 net revenue contribution to financing costs was built in. Furthermore, the overall funding model drew on overall Metrolink network revenues, i.e. including Phases 1 and 2, rather than Phase 3 alone.

E Appendix E: Technical Details - In-depth surveys at selected sites of park and ride usage

E.1.1 To inform future car parking provision on the public transport network in Greater Manchester, surveys of car park users at Sale Water Park and Hollinwood were carried out by TfGM data collectors on Thursday 20th September 2018 and Tuesday 5th February 2019 respectively. Counts of car park occupancy were also carried out on the survey days, to gauge levels of usage and also to allow for expansion of the survey data to represent the full set of park and ride users.

E.1.2 As well as establishing home origin and destination stop accessed via Metrolink, the key question asked of park and ride users was "If no parking was available at this stop, what would you do instead?" to find out likely behaviour in the absence of park and ride.

E.1.3 Past surveys had used this approach. Some questions about the robustness of the data of some survey participants using their car to access the Metrolink or rail system by alternative means had been raised. For example, if someone said they would drive to another Metrolink stop, was parking off-street or on-street there realistic. And if they couldn't take that alternative course of action, what would they then do instead.

E.1.4 Therefore, to probe alternative behaviours in more depth, follow-up questions were asked, in particular of those who said they would park nearby (Hollinwood only), or would have accessed the Metrolink or rail system by car at another stop or station.

E.1.5 Table E.1 reports the findings of the surveys. In relation to "If no parking was available at this stop, what would you do instead?", the initial response was that 21% of Hollinwood park and ride users and 8% of Sale Water Park park and ride users said they would drive to their destination.

Table E.1: Park and ride user responses – Hollinwood and Sale Water Park

Response	Hollinwood		Sale Water Park	
	Initial response	**Follow-up responses**	**Initial response**	**Follow-up response**
Park nearby	35%	27% of these respondents, **9.3% overall, would drive to their destination** if they couldn't park nearby.	-	Not asked (due to limited parking in the area)
Drive to my final destination	**21%**	Average parking cost these respondents would expect to pay at destination = £6. **Overall, 33% of the total sample would drive to their destination,** if including those who would drive if they could not park nearby or could not park at their alternative stop/ station.	**8%**	Average parking cost these respondents would expect to pay at destination = £7 **11% of the total sample would drive to the final destination,** if including those would drive if they could not park at their alternative stop/station.
Drive to another Metrolink stop/railway station	12%	71% had done this before. 80% of these respondents would park in a car park at the alternative stop/ station. 20% of these respondents, **or 2.2% overall, would drive to their destination** if they could not park at their alternative stop/ station.	35%	20% had done this before. 65% of these respondents would park in a car park at the alternative stop/ station. 8% of these respondents**, or 2.9% overall, would drive to their destination** if they could not park at their alternative stop/ station.
Walk to this stop	10%	83% of these respondents were within 20 minutes' walk.	18%	90% of these respondents were within 20 minutes' walk.
Bus all the way	7%	A variety of routes suggested.	0%	
Get a lift to this stop	7%	67% of these respondents would ask a driver to make a separate journey to drop them off.	1%	
Don't know	4%		0%	
Make the journey less often/not at all	1%		5%	
Taxi to this stop	1%		0%	
Go to a different stop/station by other means	1%	Respondent would walk.	31%	86% of these respondents would walk to the alternative site.
Sample size	*76*		*78*	

E.1.6 As can be seen from the follow-up questions to those who said they would use their car in some other way to access the public transport system, an additional proportion of users said they would drive to their destination:

- 11.5% of Hollinwood park and ride users (i.e. 9.3% and 2.2% from the above table), taking the drive to destination response to 33% (i.e. 21% plus 9.3% and 2.2%); and,
- 2.9% of Sale Water Park park and ride users, taking the drive to destination response to 10.9% (i.e. 8% plus 2.9%).

E.1.7 It may be that the uncertainties associated with this type of research, i.e. asking people for their likely response when they may not have experienced the full range of alternatives, has limitations in terms of the responses not being fully grounded in experience. Therefore, for future planning it may be sensible to take the high side estimates for abstraction from car as the more realistic estimates.

F Appendix F: Technical Details - Changes in Greater Manchester residents' door-to-door access to key destinations

F.1.1 The scale of door-to-door access change is a key factor influencing eventual outcomes and impacts and has thus been subject to scrutiny. The approach used to determine changes in door-to-door access by means of public transport made use of a generalised cost framework, i.e. the full set of time and cost components of a journey, weighted to take account of their relative importance to passengers. Therefore, walk access, wait time, fares, time spent in the vehicle, any transfer penalty and walk egress were all taken into consideration.

F.1.2 The analysis was based on outputs from the Greater Manchester Public Transport Model. Two scenarios were run for each of the time periods examined:

- one with the Phase 3 network included; and
- one without the Phase 3 network but assuming that in the absence of Metrolink, heavy rail services would have run on the alignment via Oldham to Rochdale and, in the case of the Airport Line corridor, that a higher level of bus service provision would have been in place in the absence of Metrolink services.

F.1.3 Reflecting the business case objective of greater network accessibility to key destination types, accessibility changes were assessed for:

- healthcare, i.e. major hospitals – for the population as a whole;
- employment – for those aged 16-75; and,
- colleges of further education – for 16-19 year olds.

F.1.4 The business cases for the extensions also contain an objective to better serve areas that are more deprived. Therefore the analysis also built in levels of deprivation by means of the 2015 Index of Multiple Deprivation[10].

F.1.5 Zones in the public transport model were linked to 2011 Census output areas. The approach used to estimate accessibility made use of a Hansen index, which, for any given origin, takes account of the opportunities in the destination zones and their 'distance' in generalised cost terms.

[10] https://www.gov.uk/government/statistics/english-indices-of-deprivation-2015 last accessed September 2020.

Improvements in accessibility are reflected in an increase in the accessibility index.

F.1.6 Table F.1 provides the results of the Greater Manchester analysis for employment and further education for the morning peak, and for healthcare – access to major hospitals – in the period between the morning and evening peaks.

F.1.7 This shows that public transport door-to-door access has improved by 10% or more for the following proportions of the Greater Manchester population:

- 18.2% for employment;
- 18.8% for further education; and
- 19.8% for healthcare.

F.1.8 As the Phase 3 Metrolink corridors are generally located in corridors with concentrations of deprivation, the figures for the proportion of the 10% of the most deprived Greater Manchester population are more pronounced. For this part of the population, the improvements of 10% or more in public transport door-to-door access were recorded for substantial proportions of the 10% most deprived:

- 30.5% for employment;
- 27.8% for further education; and,
- 29.5% for healthcare.

Table F.1: Improvement in door-to-door access

Employment (morning peak, 0800-0900)									
Percentage	**All GM**			**10% Most Deprived Areas**			**25% Most Deprived Areas**		
Change in	**Population**	**Percentage**	**Cumulative**	**Population**	**Percentage**	**Cumulative**	**Population**	**Percentage**	**Cumulative**
Index Value	**(16-75)**		**Percentage**	**(16-75)**		**Percentage**	**(16-75)**		**Percentage**
More than 30%	67,827	3.6%	3.6%	11,618	6.3%	6.3%	25,774	5.5%	5.5%
20% to 30 %	115,100	6.1%	9.7%	19,296	10.4%	16.7%	44,874	9.6%	15.1%
10% to 20%	162,342	8.6%	18.2%	25,758	13.9%	30.5%	54,858	11.7%	26.8%
5% to 10%	291,554	15.4%	33.6%	19,838	10.7%	41.2%	51,874	11.1%	37.8%
1% to 5%	1,058,345	55.9%	89.5%	100,418	54.1%	95.4%	256,325	54.7%	92.5%
Less than 1%	198,695	10.5%	100.0%	8,601	4.6%	100.0%	35,295	7.5%	100.0%
All	1,893,863	100%		185,529	100%		469,000	100%	
Further Education (morning peak, 0800-0900)									
Percentage	**All GM**			**10% Most Deprived Areas**			**25% Most Deprived Areas**		
Change in	**Population**	**Percentage**	**Cumulative**	**Population**	**Percentage**	**Cumulative**	**Population**	**Percentage**	**Cumulative**
Index Value	**(16-19)**		**Percentage**	**(16-19)**		**Percentage**	**(16-19)**		**Percentage**
More than 30%	5,905	4.1%	4.1%	1,076	7.0%	7.0%	2,563	6.6%	6.6%
20% to 30 %	3,586	2.5%	6.7%	404	2.6%	9.6%	1,179	3.0%	9.6%
10% to 20%	17,236	12.1%	18.8%	2,794	18.2%	27.8%	6,240	16.0%	25.7%
5% to 10%	23,572	16.6%	35.3%	2,569	16.7%	44.5%	6,074	15.6%	41.3%
1% to 5%	66,600	46.8%	82.1%	6,643	43.2%	87.7%	15,978	41.1%	82.3%
Less than 1%	25,461	17.9%	100.0%	1,894	12.3%	100.0%	6,877	17.7%	100.0%
All	142,360	100%		15,380	100%		38,911	100%	
Healthcare (between morning and afternoon peaks, 1000-1600)									
Percentage	**All GM**			**10% Most Deprived Areas**			**25% Most Deprived Areas**		
Change in	**Population**	**Percentage**	**Cumulative**	**Population**	**Percentage**	**Cumulative**	**Population**	**Percentage**	**Cumulative**
Index Value	**(All)**		**Percentage**	**(All)**		**Percentage**	**(All)**		**Percentage**
More than 30%	101,511	3.8%	3.8%	21,137	7.7%	7.7%	38,489	5.6%	5.6%
20% to 30 %	81,913	3.1%	6.8%	14,566	5.3%	13.0%	32,370	4.7%	10.3%
10% to 20%	347,545	13.0%	19.8%	45,165	16.5%	29.5%	106,969	15.6%	25.9%
5% to 10%	374,041	13.9%	33.7%	21,569	7.9%	37.4%	80,598	11.7%	37.6%
1% to 5%	1,256,611	46.8%	80.6%	123,304	45.0%	82.4%	303,925	44.2%	81.8%
Less than 1%	520,907	19.4%	100.0%	48,364	17.6%	100.0%	125,105	18.2%	100.0%
All	2,682,528	100%		274,105	100%		687,456	100%	

F.1.9 The changes in overall times and costs of door-to-door access to opportunities across Greater Manchester facilitated by Metrolink Phase 3 are encouraging. The analysis work makes the assumption that residents have good knowledge of the transport network and the range of opportunities at different destinations that are available to them. In the future, new technologies may be able to better communicate access to such opportunities in a tailored manner.

G Appendix G: Technical Details - Greater Manchester-wide economic impacts

G.1.1 Exploratory research was carried out by Ove Arup to better understand the relationship between increases in public transport accessibility brought about by the Phase 3 extensions and Greater Manchester economic performance. Economic performance measures included in the analysis of changes in commercial rents, often taken as a proxy for productivity change, and changes in employment.

G.1.2 There is a strong belief in the UK that transport and other infrastructure investment acts as an engine for growth. This belief, often founded on theoretical work simulating changes in the economy, leads to the presumption that all transport investment is good for the economy.

G.1.3 In terms of empirical evidence, however, studies that demonstrate these strong linkages between transport investment and economic growth are few and far between. For example, in the review of studies in the transport sector in OECD countries, the What Works Centre for Local Economic Growth found that only 29 of 2,300 transport studies met minimum standards for the robustness of their analytical approach[11].

G.1.4 Particular difficulties encountered in studies of transport and economic growth include:

- Distinguishing between correlation and causation, as transport investment and economic growth often occur at the same time at a country level, so separating cause and effect is challenging;
- Complications caused by the 'two-way road effect' where areas needing an uplift in economic activity may find that greater transport accessibility exposes those areas to a greater degree of economic competition;
- Lags between changes in transport accessibility and economic growth are likely, as businesses take a significant amount of time to adjust to improved transport conditions;
- While these changes take effect, in the meantime there are many changes in the wider transport system and in economic circumstances at a local and national level, some of which it will be relatively straightforward to identify and control for, others of which will be more challenging to take account of.

[11] https://whatworksgrowth.org/policy-reviews/transport/evidence-review. Last accessed 12.11.20.

G.1.5 In Greater Manchester there is a strong belief held by stakeholders and businesses that Metrolink is universally good for the conurbation. This is evidenced in the stakeholder and business interviews carried out as part of the scoping within this exploratory analysis, where Metrolink stands out as an iconic brand that helps to define the identity of Greater Manchester. Furthermore, pre-Covid-19, patronage performance in peak periods was very strong and the Metrolink network was a rare example of an urban transport system that covered its operating costs and significantly contributed towards coverage of its financing costs.

G.1.6 Given this context of challenges posed for studies on transport and the economy and the fundamental belief in the success of infrastructure investment, the opportunity to explore economic growth effects of Metrolink Phase 3 was identified. While house price impacts had already been established, and were in the process of being confirmed, by means of robust studies carried out by the Nationwide and the University of Leeds cross-reference to Sections 4.4 and 4.5, a focus on disentangling transport and economic growth was felt a valuable prospect for better understanding the strength of the relationships involved.

G.1.7 The original assignment considered the possibility of studying economic impacts in areas affected by Phase 2 of Metrolink, opened in stages in 2009 and 2010, with a particular focus on examining the Salford Quays area including MediaCity. The small area economic data from national data sources for these areas proved to be of limited quality, and insufficient breadth and depth to be suitable as a foundation for statistical modelling work. Furthermore, in part due to the unique nature within Greater Manchester of the Salford Quays area pre-development, attempts to identify suitable control areas did not yield convincing comparison areas, therefore separation of cause and effect would not be viable.

G.1.8 To deepen the understanding of the economic mechanisms at work, representatives of local authorities, businesses, property agents and developers were carried out. These were valuable in confirming that it is challenging for individual stakeholders to isolate Metrolink impacts from the effects of other transport improvements such as the redevelopment of Manchester Victoria station, secondary effects from land use change and wider macroeconomic factors. However, the interviewees considered Metrolink to have opened up the Greater Manchester labour market and to have enabled workers from a wider area to travel to work in the city centre and in Salford Quays. Wider economic impacts have been felt outside of the Regional Centre and Salford Quays and in towns across Greater Manchester that are connected by Metrolink. These include unlocking development and commuter impacts. There is also a general

perception that Metrolink helped bring more visitors to Manchester and improved 'city vibrancy'.

G.1.9 The scope of the study included the possibility of studying changes in commercial rents, productivity, employment and house prices. It was determined that focusing on changes in commercial rents, in part as a proxy for productivity change, and changes in employment, would allow the study to concentrate on important areas of change. House price studies were covered separately and are reported elsewhere in this report. Commercial rent data was sourced from CoStar, a commercial database, while employment data came from the ONS' Business Register and Employment Survey.

G.1.10 While opportunities to study change elsewhere in Britain were considered, the study determined that a focus on change within the Greater Manchester area would provide a suitable and consistent basis for analysis. Clearly, different areas of Greater Manchester have better or worse levels of public transport connectivity, so that working with a measure of public transport accessibility change brought about by the introduction of Phase 3 services would allow for those areas benefiting from greater accessibility change (known as treated areas) to be distinguished from areas with little change (which can be considered as control areas) has occurred.

G.1.11 The public transport accessibility measure is described in Appendix F of this report. The measure was calculated for each year and LSOA from 2011 to 2018. It was also used in some of the statistical analysis in combination with a measure of proximity to Metrolink, namely within or beyond 1 km of a Metrolink stop.

G.1.12 The public transport accessibility measure has the advantage of being available for each of the LSOAs in Greater Manchester, covering 1,673 areas. One challenge with the measure, however, is that areas that have experienced rapid economic growth in recent times, such as the city centre, are also the areas with the highest level of pre-Phase 3 public transport accessibility. This raises a further challenge in teasing out a key driver of economic growth in these high growth areas.

G.1.13 One of the headline findings for Greater Manchester in the analysis of changes in commercial rents was that areas within 1km of Metrolink stops experienced a 6.5% uplift in rents. While on the face of it this is an encouraging finding, this early analysis had yet to separate out cause and effect, so the statistic cannot be taken as conclusive proof of a relationship between public transport accessibility and commercial rents.

G.1.14 Therefore, more complex statistical modelling was performed using the range of data available to the study. Different models were explored, including:

- An accessibility-based panel regression – in essence, this explores the correlation between commercial rents and accessibility change;
- Fixed effects difference in difference regression models – taking the influence in different areas of Greater Manchester into account and taking into account effects over time for the conurbation and effects specific to each individual area/ LSOA;
- Incidental treatment approach – designed to control for reverse causality, where the cause and effect are uncertain, to provide more robust results;
- Synthetic control group – used to seek to identify a theoretical counterfactual group through a systematic search technique, which can then be compared to the areas treated through the intervention.

G.1.15 A recurrent issue with the analysis appeared to be that it was picking up correlations with economic performance rather than causal relationships. So, for example, the regional centre has exhibited strong economic performance in recent years, while the types of public and private sector businesses in town centres served by Metrolink Phase 3 have experienced significant decline with corresponding falls or limits on commercial rent growth in these areas.

G.1.16 The models developed tend to pick up on these correlations, with many forms of model unable to separate out correlation from causation. For this reason, further models were estimated that explicitly included tests of causality. Unfortunately, these models were unable to conclusively determine that the estimates obtained in other models had been able to separate out cause and effect. This means that a clear relationship between public transport accessibility change and change in commercial rents for Greater Manchester has yet to be established.

G.1.17 Typically, employment changes are slower to take effect than changes to commercial rents. Lack of clear findings from statistical modelling of employment may therefore reflect the longer time lags involved. It may therefore be valuable to re-explore employment effects further in the future, once a longer time series of data has been established. This, however, will inevitably be a complex undertaking, given the wide-ranging way in which the coronavirus pandemic has affected the Greater Manchester economy.

G.1.18 Further avenues for research work in the area of transport and the economy in Greater Manchester remain. These include using Office for National Statistics data on productivity at a small area level, to explore relationships between transport investment business output. It is expected that further analysis will be carried out in the future on the broader context of the Greater Manchester economy and a wider range of transport investments including, but not limited, to Metrolink Phase 3.