Travel in London

Report 6

MAYOR OF LONDON

TRANSPORT FOR LONDON

EVERY JOURNEY MATTERS

Overview

Travel in London report 6

Travel in London summarises trends and developments relating to travel and transport in Greater London. Its principal function is to provide an interpretative overview of progress towards implementing the transport and other related strategies of the Mayor of London, together with an evidence and analysis base for the general use of stakeholders and policymakers whose responsibilities cover many different aspects of transport and travel in London. This sixth Travel in London report draws on the latest available data, generally reflecting the 2012 calendar year, or the 2012/13 financial year, and sets these in the longer-term context of the evolution of transport and associated trends in London.

This report also contains 'Spotlight' chapters, focusing on contemporary analytical concerns in transport. This year, topics covered are: what we can learn from large-scale surveys of the travel behaviour of Londoners about how travel patterns have evolved over the last 40 years; measuring the transport legacy of the 2012 Olympic and Paralympic Games, and monitoring achievement of the Roads Task Force vision for London's streets and roads.

Another year of good progress for travel and transport in London

The year 2012 through to 2013 saw continued progress with the implementation of the Mayor's Transport Strategy (MTS). Many aspects of transport and travel in London have improved over the last decade, as detailed in previous Travel in London reports, and these improvements continued in the latest year. The year 2012 also saw London's successful hosting of the Olympic and Paralympic Games, and the role that London's transport networks played in supporting the Games was particularly successful.

Overall travel demand

Key headlines over the latest year in this longer-term context have included:

- On an average day in 2012, 25.9 million trips were made to, from or within London - an increase of 1.5 per cent over the previous year. This most recent increase continues a decade-long trend of increasing demand for travel in London, which is known to have largely reflected population growth in London.
- The 1.5 per cent increase in trips in London during 2012 compares to the long-run average annual increase of 1.1 per cent over recent years. There was also a 1.5 per cent increase in the number of journey stage in London, signifying a pick up in the rate of growth of travel demand, reflecting among other things the emergence from the recent recession.
- This means that there are now 14.4 per cent more trips, and 19.8 per cent more journey stages, in London on an average day than in 2000.
- Following release of results from the 2011 Census of population, London's population is now known to have increased at a faster rate over the last decade than previously thought. The new numbers for 2011 showed London's resident population to be 8.2 million, 4.8 per cent higher than previously estimated. London's population is now approaching the previous peak of 8.6 million, reached during the 1930s. This higher-than-expected increase in population has

been a major factor driving increased travel demand in London over the last decade.

- New projections of London's future population, based on the 2011 Census, suggest that it will continue to grow rapidly, with London growing by the size of Birmingham and Glasgow combined by 2031. This rapidly expanding population will further exacerbate demand pressures on the transport networks, meaning that new infrastructure and services planned as part of MTS to cater for growing demand will be required some years ahead of the original timeframes.
- The established trend of a progressive shift in mode share away from private transport towards public transport, walking and cycling has been a major feature of the past decade and has continued in the latest year. There was a 0.9 percentage point fall in the private transport mode share, and a 0.9 percentage point increase in the public transport mode share (at the trip level).
- In 2012, 44.2 per cent of journey-stages in London were made by public transport, compared with 33.3 per cent made by private transport, principally the car.
- This means that, over the period since 2000, there has been an 8.4 percentage point net shift in mode share to public transport away from private transport at the trip level, and a 9.2 percentage point net shift away from private transport.
- In practical terms this means that if mode shares had not changed in this way, and all other things had remained equal, there would have been almost 2 million additional car driver trips per day in 2012 in London than there actually were.

Travel demand trends for the principal modes of transport

There was strong growth in patronage across London's public transport networks, with a 2.3 per cent increase in the annual number of public transport journey stages and a 4.3 per cent increase in kilometres travelled on public transport over the latest year. However, volumes of road traffic in London continued to fall, reflecting what has now been a well-established trend over the last decade.

In terms of the individual public transport modes:

- On the Underground, patronage grew strongly once again, with 6.1 per cent more passenger kilometres travelled and 5.0 per cent more journey stages compared with 2011/12 – the third successive year of increases around the five per cent mark, reflecting London's recovery from recession and the Tube upgrade programme.
- Patronage on the Docklands Light Railway (DLR) particularly reflected the 2012 Games, but also the longer term demand effects of the substantial capacity increases that had been put in place beforehand to cater for the Games and facilitate regeneration. Overall DLR patronage in 2012/13 was 16.3 per cent above that of 2011/12, reflecting an average annualised rate of growth of 9.6 per cent since 2000 and successive extensions to the network.
- London Overground maintained the strong trend of growth, with 21.5 per cent more journey stages in 2012/13 compared to 2011/12, again in part reflecting the completion of the orbital network in December 2012 and the role of the network in serving the Olympic Park.
- By contrast however, bus journey stages in 2012/13 were broadly similar to those of the previous year, recording a slight fall of 0.4 per cent. Over the past four years the historic high rates of growth in bus travel have levelled off, this

also reflecting a period of relatively slow growth in bus service provision, although reliability of the network remains at best-ever levels.

- National Rail demand on 'London and Southeast' (L&SE) operators increased by 3.9 per cent, continuing the strong rate of growth in demand for National Rail services seen over the last decade.
- Road traffic in London continued to fall, with 0.7 per cent fewer motor vehicle kilometres in 2012 compared with 2011, although traffic in outer London rose slightly. This follows a two per cent fall the previous year. In 2012, 10.9 per cent fewer vehicle kilometres were driven than in 2000.
- Interestingly, the well-established trend towards reduced levels of traffic in London has now been seen for the last five years at the national level, with Great Britain vehicle-kilometres in 2012 0.4 per cent lower than in 2011. However, very latest data for London for 2013 shows traffic levels *increasing* over equivalent months in 2012 – although it is too early to confirm this as a sustained trend.
- Cycling levels continued to increase, with cycle stages 1.8 per cent higher than in 2011. There was a 1.4 per cent increase in cycle flows on the Transport for London Road Network (TLRN) major road network in 2012/13 compared to the previous year. This follows increases of 15 per cent and 9 per cent in 2010/11 and 2011/12 respectively.
- There are a number of reasons for the slowdown in cycling growth, in addition to the relatively poor weather during much of 2012. Delivery of new cycling infrastructure slowed in 2012/13 in the run up to and during the Games period, reflecting a moratorium on new project construction. Further, the implementation of the Better Junctions cycle safety review has impacted on the pace of delivery of major new cycle programmes, including the Barclays Cycle Superhighways.
- The Mayor published his Vision for Cycling in March 2013. In it he outlined plans to spend £913m on cycling over the next ten years. This investment will deliver a step change in cycling provision that will support the growing number of cyclists in London.

London's hosting of the 2012 Games saw large-scale changes to volumes of travel and patterns of travel demand over several weeks during summer 2012. Record levels of patronage were seen on London's major public transport modes, and the transport networks operated well to support the 'Public Transport Games'. However, increased spectator traffic, focused on particular parts of the network, was largely offset by reductions in travel for other non-Games purposes. The net effect of the 2012 Games on these annual estimates of travel at the London wide level are therefore small, although they are a noticeable factor when interpreting annual trends for certain modes, particularly the DLR.

Public transport supply

Public transport in London has, over recent years, benefited from the longest run of sustained high operational performance and service provision ever recorded. All key indicators of service provision have shown a marked trend of improvement over the last decade, and this improved still further in the latest 'Olympic' year.

The role of the transport networks in supporting the 2012 Olympic and Paralympic Games was particularly successful. The networks provided enhanced levels of service and operated with exceptional levels of reliability.

- A total of 75.6 million train kilometres were operated on the Underground in 2012/13, up from 72.4 million in 2011/12. This was the third successive year of strong growth, following a track record of growth over much of the period since 2000, although the additional services put in place to support the 2012 Games will have been a (relatively minor, in the annual context) factor here.
- Underground train kilometres operated are now 18.5 per cent above those of 2000, and 7.1 per cent above those of the previous peak in 2008/09, with the benefits of the Tube upgrade programme, including the current programme of renewal of the entire sub-surface train fleet, now being evident.
- 490 million vehicle kilometres were operated on the bus network in 2012/13, up by 1 million kilometres from 2011/12, although reflecting the relatively slow rate of increase in service provision on the bus network since 2004/05 following the major increase in the preceding five years.
- DLR substantially increased its service offering ahead of the 2012 Games. Recent enhancements included the extensions to Woolwich and to Stratford International, and also the lengthening of many services from two-car to three-car trains.
- DLR train kilometres operated in 2012/13 were 16.8 per cent above those of 2011/12, reflecting these enhancements and special levels of service provision during the Games. Since 2000 the service offered on the DLR has increased at an average of 6.6 per cent per year. As well as having a direct role in supporting the Games, these enhancements will have a much longer-term role supporting regeneration in east London.

These developments enabled 34.5 per cent more bus kilometres and 18.5 per cent more Underground kilometres to be operated in 2012/13 compared to 2000/01. In East London, the DLR has almost doubled the level of service operated over the period, whilst the second half of the decade saw the complete transformation of the London Overground network.

Performance of the transport networks

Alongside increased public transport provision, there have been sustained improvements to the quality and reliability of public transport services. Service reliability indicators in 2012/13 for the major public transport modes were at, or close to, best-ever levels, including an exceptional performance to support the 2012 Games.

- Levels of service reliability on the Underground again reached new highs in 2012/13, with reliability at 97.6 per cent and a further substantial reduction in excess journey times – down to 5.3 minutes in 2012/13 from 5.8 minutes in 2011/12.
- Bus reliability, as measured by excess waiting times, matched the best ever minimum of 1.0 minute first achieved in 2010/11. This means that the average customer has to wait just one minute longer for a bus than they would otherwise do if the service ran perfectly to schedule.

- Reliability continued to increase on the DLR in 2012/13, with the percentage of scheduled services operated increasing from 97.7 per cent in 2011/12 to 98.5 per cent in 2012/13, this on top of substantial increases to the level of service offered.
- London Tramlink returned a reliability value of 97.3 per cent of scheduled services operated - down from previous years, and the lowest level since 2004/05, but still consistent with the excellent reliability levels seen elsewhere on Transport for London's (TfL's) public transport networks.
- The overall performance of National Rail services in London was relatively mixed in 2012/13, with the Public Performance Measure (PPM) increasing for some train operating companies and decreasing for others. However, typical PPM percentage values are in the low 90s, somewhat behind other public transport networks in London, although reflecting a different measurement basis.
- Indicators of overcrowding on National Rail reflected the continuing growth in patronage, except where offset by increases to capacity provided by several of the train operating companies during the year.
- London Overground recorded the second highest Public Performance Measure (PPM) score amongst London and southeast operators (96.6 per cent), and had an overcrowding score, according to the Department for Transport's 'PiXC' (Passengers in Excess of Capacity) measure, of zero, albeit reflecting only the radial part of the network (Euston to Watford).
- Journey time reliability on London's road network has remained fairly constant, averaging between 89 and 90 per cent for the past three years, excluding the exceptional conditions during the 2012 Games. This compares to a current 'working target' for this measure of 89.5 per cent.

Supporting economic development and population growth and improving transport opportunities for all Londoners

The last decade has seen progressive development of London's public transport system in order to support population and economic growth and, from mid-decade, the immediate needs of the 2012 Games and the longer-term Games transport legacy - intended to support growth and regeneration in east and south east London. By proving increased capacity, connectivity and operational reliability on the public transport networks, TfL supports the continuing growth and economic development of London. It also improves transport opportunities available to Londoners, in terms of their ability to access jobs, services and other opportunities.

- Continuing development to the transport system, in terms of increased connectivity, has been reflected by the fact that, in 2012, the average Londoner could access 989,450 jobs within a 45 minute travel time by public transport.
- London's transport system is becoming more accessible. There has been a 10 percentage point increase in the MTS indicator of public transport accessibility over the last five years although, at 46 per cent, more than half of the public transport system is not accessible on this measure.
- TfL's record is one of prudent cost control and asset management. Net operating costs per passenger kilometre have remained broadly stable over the most recent four years, albeit values for 2012 were affected by provision for the 'once off' 2012 Games. Overall asset condition continues at high levels, with

substantial investment, such as the complete replacement of the train fleet on the sub-surface Underground lines offsetting the normal ageing process for all TfL's assets.

- The real fares level measures the average actual fare paid in London per kilometre travelled. In 2012, the average adult composite bus and Underground fare paid fell to 21.6 pence per kilometre, from 21.8 pence per kilometre in the previous year.

Improving the safety and security of Londoners

The last decade saw strong improvements to the principal indicators of safety and security on London's transport networks. However, 2012 saw increases in the number of people killed or seriously injured on London's roads, and also increases in the number of people injured whilst travelling on public transport.

- The last decade saw strong improvements to the principal indicators of road safety in London. Progress in reducing the number of people killed or seriously injured on London's roads has slowed in recent years, and improving safety for vulnerable road users, who now account for 80 per cent of KSIs in 2012, is key to delivering London's casualty reduction target.
- Safe Streets for London, London's Road Safety Action Plan, was published in June 2013. It sets a new road safety target to reduce killed and seriously injured casualties on London's roads by 40 per cent by 2020, based on a 2005-09 average baseline. It also describes a new approach to understanding the level of risk on London's roads to identify effective road safety interventions.
- The use of risk evidence, alongside other information about the road network, is central to making London's roads safe. Groups (in terms of gender, age, ethnicity, location, mode, etc) for whom safety can be most improved have been identified using this analytical approach.
- On the Underground in 2012/13 there was one fatality and 156 other injuries – an increase in the injury rate of 20.9 per cent compared to the previous year, although the recent trend is of relative stability in this measure despite rapidly increasing demand. On the bus network, casualty numbers showed an increase, of 8.2 per cent on those of 2012.
- Rates of reported crime across the public transport networks continued to fall, continuing the encouraging trend since the middle of the last decade. In terms of reported crime, levels are now about half of what they were in 2005/06.

Transport, air quality and greenhouse gas emissions

London's air quality has improved in recent years, although emissions of two local air quality pollutants continue to pose a challenge, and rates of reduction in London's greenhouse gas emissions are running behind applicable climate change reduction targets.

- On an equivalent basis, emissions of particulate matter (PM_{10}) from ground-based transport in London fell by 17.7 per cent between 2010 and 2012, with London now generally meeting European Union air quality limit values (ambient concentrations) for this pollutant at sites where this is assessed.
- Emissions of oxides of nitrogen (NO_x) from ground-based transport fell by 12.4 per cent between 2010 and 2012, although further very substantial reductions

(up to 80 per cent) are necessary to enable London to comply with limit values for nitrogen dioxide.

- Emissions of carbon dioxide (CO_2), London's major greenhouse gas, from ground-based transport fell by 4.0 per cent between 2010 and 2012. This compares to an indicative reduction of 6 per cent over this period required to meet climate change CO_2 reduction targets.

The contribution of transport to quality of life and the journey experience

Applicable indicators of public perception/customer satisfaction with aspects of the transport system and the journey experience, including those for each of the principal public transport modes, have all shown an upward trend since the latter part of the last decade. Major upgrades to the transport system, such as the transformation of the London Overground and Tube upgrades, have been reflected in sharp improvements to the customer evaluation of these modes. However, aspects of the customer experience of the overall urban realm, of which transport is just one part, tend to attract lower scores than those for the transport elements themselves, highlighting the importance of wider public realm schemes and station upgrades, such as the recent upgrade at Blackfriars.

'Spotlight' topics in this Travel in London report

Understanding long-term travel behaviour change in London

This report contains an exploratory analysis of long-term change in travel by London residents since 1971. It highlights and quantifies several trends that are relevant to understanding current and projected future travel patterns, and acts as an input into a wider TfL study that seeks to refresh understanding of the nature of the 'drivers of travel demand' in London, and apply these insights to TfL's forecasting tools, such that future projections of travel demand can be improved.

Large-scale household-based surveys of London residents travel have been undertaken on a broadly comparable basis each decade since 1971. Over this 40-year period there have been fundamental changes to many aspects of travel demand and individuals' travel behaviour, ultimately reflecting social, economic and transport system change. For example, car ownership and use among Londoners rose to a peak in 1991, and has subsequently fallen back. Travel by women and their participation in the workforce rapidly increased between 1971 and 1991, such that in 2011/12 it was the case that women made the majority of trips on the transport system. Public transport usage declined during the 1970s and 1980s, but picked up rapidly during the 1990s and particularly strong growth in public transport demand has been a key feature of the last decade.

Supporting a successful London 2012 Games and securing their legacy

The 2012 Olympic and Paralympic Games are now regarded as having been a major success – both as sporting events but also in the way that London's transport networks supported them. Securing the longer-term transport legacy of the Games is an important part of the Mayor's Transport Strategy. Transport improvements are a fundamental facilitator of the wider Games legacy, which seeks to work towards social and economic convergence between the six Olympic growth boroughs (Barking and Dagenham, Newham, Tower Hamlets, Greenwich, Waltham Forest and Hackney) and the rest of London over a circa 20-year period. A number of other specific transport goals were also set, including aspirations to increase the

participation in 'active travel', such as walking and cycling, in the area. It is also important that rapid development and regeneration are not achieved at the expense of deterioration in travel or other environmental conditions, such as air quality.

Progress towards transport legacy goals will be monitored through Travel in London reports. This report sets out an extended baseline of quantitative indicators that will be used to track achievement of these goals over the coming years. Whilst it is too early to see obvious effects subsequent to the actual Games themselves, many elements of the enhanced transport networks in the area (the 'physical transport legacy') are already in place and delivering benefits. The beneficial effects of expansion of the Docklands Light Railway, for example, in providing for growing demand can clearly be seen in double-digit annual increase in patronage.

By and large quantitative indicators of social and economic well-being, travel behaviour and environmental quality primarily reflect the unique social and geographical context of each borough. Whilst it is certainly evident that the growth boroughs are relatively disadvantaged economically, it is not necessarily the case that travel behaviour differs from what might otherwise be expected, given the geographical context, or is in any sense 'bad', given the recent infrastructure investment in the area, although more recent improvements will take time to become apparent in the data. Rates of car ownership and use are relatively low, for example. Children resident in the growth boroughs are already significantly more likely to walk than other children in London, although this may be more reflective of socio-economic conditions in those boroughs than a response to the Games. Tracking relative change, looking for differential change in these indicators against 'control' areas in other parts of London, and understanding the wider context of growing population and economic activity will be key to understanding the developing legacy in future years.

Monitoring progress towards the Roads Task Force vision for London's roads and streets

The Roads Task Force was set up by the Mayor in July 2012 to consider the challenges facing London's roads and streets. Its report, 'The Vision and Direction for London's Streets and Roads' was published in July 2013 and sets out a comprehensive new vision for London's roads.

Key to addressing these challenges is the identification of road types or street families for classifying London's roads, together with a 'toolbox' of improvement measures that could be applied to roads across the street types according to present and anticipated future needs.

The street types recognise and facilitate the idea that individual roads can serve different priorities at different times, potentially enabling London's roads to 'work harder' to meet the diverse requirements placed on them. The process for taking the vision forward will involve the definition of appropriate 'service levels' for different parts of the road network; the measurement of how roads currently perform against these; the setting of goals for improvement appropriate to the local context; the monitoring of their achievement, and the appreciation of the effects of this on the wider operation of the road network in London.

Travel in London reports will be the vehicle through which progress is monitored and reported, and this edition sets out a proposed framework of quantitative

indicators that will be measured and reported against in future reports. These initial proposals will be developed over the coming year in collaboration with stakeholders, and an update and baseline will be provided in Travel in London report 7, published towards the end of 2014.

1. Introduction and contents

1.1 The Travel in London report 6

Travel in London is TfL's annual publication that examines and summarises trends and developments relating to travel and transport in London. It provides an authoritative source of key transport statistics as well as topical evidence-based analysis, and tracks trends and progress in relation to the transport and other related strategies of the Mayor of London. It provides an interpretative overview and commentary that looks across the immediate impacts of TfL and its delivery partners, as well as external influences and trends, in shaping the contribution of transport to the daily lives of Londoners and the economic vitality of the Capital.

1.2 Monitoring the implementation of the Mayor's Transport Strategy

Travel in London reports aim to provide a comprehensive and objective evidence base for the formulation of transport policy. The Mayor of London published his Transport Strategy (MTS) in May 2010. Alongside his London Plan, Economic Development Strategy and Air Quality Strategy, these strategies map out the transport policy framework for London over the next few years. More recently, policy documents have been produced that address individual issues, such as the Mayor's Vision for Cycling and the Roads Task Force vision for London's Streets and Roads. The MTS is built around six transport goals:

- Supporting economic development and population growth.
- Enhancing the quality of life for all Londoners.
- Improving the safety and security of all Londoners.
- Improving transport opportunities for all Londoners.
- Reducing the contribution of transport to climate change and improving its resilience to the impacts of climate change.
- Supporting the delivery of the 2012 Olympic and Paralympic Games and their legacy.

At the top level, the long-term transport outcomes sought by the MTS are monitored through a set of 24 quantitative 'Strategic Outcome Indicators'. These indicators are 'outcome-based', reflecting changes in conditions experienced by Londoners. They provide a manageable means of assessing the overall direction and pace of change in relation to MTS goals. However, they do not cover all aspects of transport that will be of interest and do not, of themselves, provide a detailed understanding of topical transport issues. It is therefore necessary to take a broader and deeper view of transport trends and the factors affecting them. Collectively this leads to relevant policy insights and evidence to support the formulation of future transport policies. Providing these insights and evidence base is the core role for Travel in London reports.

1.3 Structure and content of Travel in London report 6

This sixth Travel in London report is organised across three main sub-sections, focusing on:

- **Travel demand and transport network performance (chapters 2 to 4).** This section assembles and summarises trends and developments in travel demand and transport network operational performance by mode of transport, including

the underlying factors that influence these, such as population and economic growth. This section focuses on the first of the Mayor's six transport priorities – supporting economic development and population growth - and also provides essential contextual information.

- **Progress with MTS transport goals (chapters 5 and 6).** Chapter 5 is framed around assessing progress towards the wider canvass of MTS transport goals relating to quality of life, transport opportunities, improved safety and security and climate change. It also considers other topics closely related to MTS or other Mayoral strategies, such as local air quality. Chapter 6 comprises a summary assessment of progress in relation to the MTS goals, based around the 24 formal strategic outcome indicators for the MTS, and highlighting areas requiring particular attention going forward. It is intended that the emphasis and coverage given to specific topics in this section will vary from year to year, reflecting contemporary issues and interests.
- **Spotlight chapters (chapters 7 to 9)** continue the established role of providing an extended analytical focus on specific topical transport-related themes from year-to-year. This year there are three Spotlight chapters. **Chapter 7** looks at long-term change in the travel behaviour of Londoners, comparing data across five large-scale travel surveys undertaken in 1971, 1981, 1991, 2001 and 2011. The principal objective here is to better understand the relationship of observed travel demand trends in London over this extended period to the key 'drivers' of travel demand, and this exploratory analysis forms an input to a wider project on this topic being undertaken by TfL. **Chapter 8** provides an update on progress with monitoring the transport legacy of the 2012 Olympic and Paralympic Games, focusing this year on base lining travel behaviour change in the six Olympic host boroughs. **Chapter 9** gives an introduction to TfL's developing thinking on monitoring the implementation of the Mayor's Roads Task Force vision, and how this will be underpinned by an effective basis of evidence and understanding.

1.4 Further information

For specific technical queries on the contents of this report, readers should contact **TILenquiries@tfl.gov.uk**.

Travel demand and the performance of the transport networks

2. Travel in London

2.1 Introduction and content

This chapter looks at overall travel demand trends in Greater London, in terms of the overall number of trips made and the mode shares for the different forms of transport. Sections 2.2 to 2.4 provide consolidated estimates and trends for all people travelling in Greater London, including residents and visitors, covering all of the main transport modes. Sections 2.5 and 2.6 look more widely at trends in factors that constitute the underlying drivers of travel demand – London's population and economy, focusing in particular this year on emerging new data on London's population from the 2011 Census. Overall travel demand trends and mode shares provide the basic backdrop against which to assess the outcomes of existing transport policies, and to frame new ones in the context of changing demand patterns.

Previous Travel in London reports consolidated historic information on travel trends in London over the last decade or more. Key features of these trends have been:

- Sustained growth in demand for travel, reflecting population and employment growth but also wider social and economic factors.
- A substantial and sustained shift in mode share away from private car and towards public transport.
- Substantial growth in demand on the principal public transport networks, reflecting population growth and corresponding substantial increases to the supply of public transport, alongside progressively declining volumes of road traffic.

These trends are in broad alignment with the objectives of the MTS, and the latest data for 2012 suggest that they have continued. However, there are some emerging areas where particular attention will be required going forward, most notably that the observed increase in population and travel demand in London is running substantially ahead of that expected by the MTS. This is exacerbating demand pressures on the existing transport networks, and bringing forward in time the points at which substantial new transport infrastructure, and/or policies to more effectively deal with increased demand, will be required.

2.2 Journey stages in London

Essential background and terminology

This section updates consolidated estimates of total travel in London on an average day. A **Trip** is defined as a one-way movement from an origin to a destination in order to achieve a specific purpose, for example to go from home to work. Each trip may involve travel by one or more individual modes of transport. These component parts of trips are referred to as **Journey Stages**. Key concepts relating to Trips, Journey Stages and Main Mode of travel were explained in Travel in London report 5 [1].

Travel in London report 5 also discussed the requirement that had arisen for TfL to revise the methodology used for calculating estimates of trips and journey stages in London. This requirement arose from changes to the input data series used to derive the estimates, most notably the release of data from the 2011 Census of

population, which revealed London's population to be higher than previously understood, but also series relating to road traffic volumes and bus passengers. The figures shown in table 2.1 are therefore on a consistent basis from 2007 to 2012.

Total number of stages

Daily journey stages in London in 2012 were 30.3 million, up from 29.9 million in 2011 and 29.3 million in 2010. This is a 1.5 per cent increase in journey stages in the latest year. In 2012 there were 17.3 per cent more journey stages per day in London than in 2002.

Table 2.1 Aggregate travel volumes in Greater London. Estimated daily average number of journey stages by mode, 1993 to 2012. Seven-day week.

	Millions of journey stages										
Year	Rail	Under-ground	DLR	Bus (incl. tram)	Taxi /PHV	Car driver	Car passenger	Motor cycle	Cycle	Walk	All modes
1993	1.4	2.0	0.0	3.1	0.3	6.8	3.7	0.2	0.3	5.2	23.0
1994	1.4	2.1	0.0	3.1	0.3	6.8	3.8	0.2	0.3	5.2	23.2
1995	1.5	2.1	0.0	3.3	0.3	6.8	3.7	0.2	0.3	5.2	23.4
1996	1.5	2.1	0.0	3.4	0.3	6.9	3.8	0.2	0.3	5.2	23.7
1997	1.6	2.2	0.1	3.5	0.3	6.9	3.8	0.2	0.3	5.3	24.1
1998	1.7	2.4	0.1	3.5	0.4	6.9	3.8	0.2	0.3	5.3	24.4
1999	1.8	2.5	0.1	3.5	0.4	7.1	3.8	0.2	0.3	5.4	25.0
2000	1.8	2.6	0.1	3.7	0.4	7.0	3.8	0.2	0.3	5.4	25.3
2001	1.8	2.6	0.1	3.9	0.4	6.9	3.7	0.2	0.3	5.5	25.6
2002	1.9	2.6	0.1	4.2	0.4	6.9	3.7	0.2	0.3	5.5	25.9
2003	1.9	2.6	0.1	4.6	0.4	6.8	3.6	0.2	0.4	5.6	26.2
2004	2.0	2.7	0.1	5.0	0.4	6.7	3.6	0.2	0.4	5.7	26.7
2005	2.0	2.6	0.1	5.0	0.4	6.6	3.5	0.2	0.4	5.7	26.7
2006	2.1	2.7	0.2	5.2	0.4	6.6	3.7	0.2	0.5	5.8	27.3
2007	2.3	2.9	0.2	5.9	0.4	6.4	3.9	0.2	0.5	5.8	28.5
2008	2.4	3.0	0.2	6.2	0.4	6.3	3.6	0.2	0.5	5.9	28.7
2009	2.3	2.9	0.2	6.3	0.4	6.3	3.7	0.2	0.5	6.0	28.8
2010	2.5	3.0	0.2	6.3	0.3	6.3	3.8	0.2	0.5	6.1	29.3
2011	2.7	3.2	0.2	6.4	0.4	6.1	3.9	0.2	0.6	6.2	29.9
2012	2.9	3.3	0.3	6.5	0.4	6.0	3.9	0.2	0.6	6.3	30.3
Percentage change 2011 to 2012	*6.6*	*5.9*	*13.3*	*0.7*	*7.6*	*-1.0*	*-1.0*	*-1.4*	*1.8*	*1.3*	*1.5*
2002 to 2012	*56.1*	*28.7*	*113.1*	*55.6*	*11.4*	*-12.8*	*4.1*	*-12.8*	*80.1*	*12.6*	*17.3*

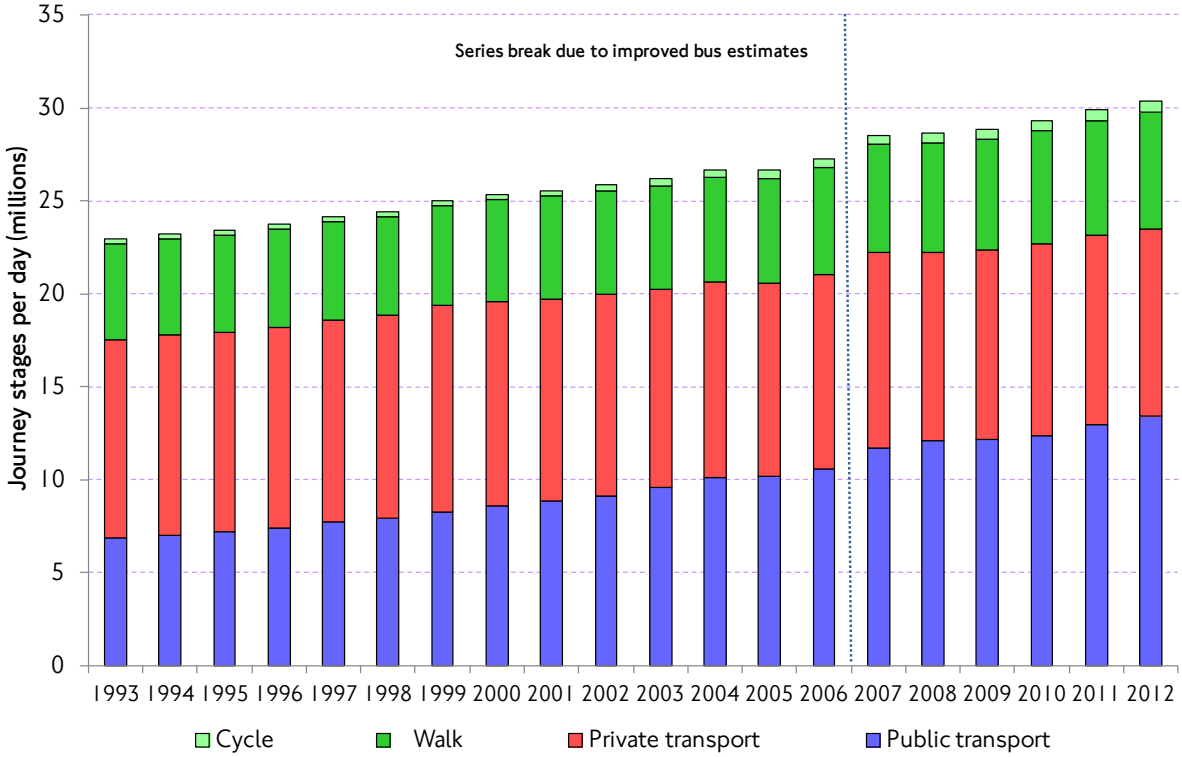
Source: TfL Planning, Strategic Analysis.
1. A journey stage is a part of a trip made by a single mode of transport.
2. Each rail interchange between train operating companies is a new journey stage.
3. Bus journey stages are counted by starting a new stage each time a new bus is boarded.
4. Underground journey stages are counted by station entries; interchanges within stations are ignored.
5. Walks are counted only when they form complete trips (ie walking all the way), not when they are part of trips using other modes of transport.

Annual growth in journey stages was particularly high for public transport, with strong growth of 6.6 per cent and 13.3 per cent on National Rail and DLR respectively, although the latter of course had a particular role in supporting the 2012 Games. Underground stages also increased in 2012 at a faster rate than the

increase in the resident population, and were 5.9 per cent higher than the previous year, while bus stages grew at a lower rate of 0.7 per cent. Car driver stages continued to fall, and were 1.0 per cent lower than in 2011. The number of cycle stages also increased again, albeit at a lower rate of 1.8 per cent. The net result of these changes is a continuation in the established trend of increased public transport use in London, with a corresponding continued shift away from private motorised transport.

Notable from table 2.1 is the ten-year trend, showing a 17.3 per cent increase in total journey stages from 2002, with rail stages up by 56.1 per cent over the same period. Also notable is the 80.1 per cent increase in cycle stages since 2002.

Figure 2.1 Aggregate travel volumes in Greater London. Estimated daily average number of journey stages, 1993 to 2011. Seven-day week.



Source: TfL Planning, Strategic Analysis.

2.3 Trips in London

Total number of trips

The total number of trips in London in 2012 was 25.9 million per day, an increase of 1.5 per cent over the previous year (table 2.2), very similar to that observed for journey stages, and continuing the recently observed trend of growing travel demand.

Table 2.2 Aggregate travel volumes in Greater London. Estimated daily average number of trips by main mode of travel, 1993 to 2012. Seven-day week.

	Millions of trips									
Year	Rail	Under-ground /DLR	Bus (including tram)	Taxi/ PHV	Car driver	Car passenger	Motor cycle	Cycle	Walk	All modes
1993	1.3	1.4	2.1	0.3	6.6	3.6	0.2	0.3	5.2	20.8
1994	1.3	1.5	2.1	0.3	6.7	3.6	0.2	0.3	5.2	21.1
1995	1.3	1.6	2.2	0.3	6.6	3.6	0.2	0.3	5.2	21.2
1996	1.4	1.5	2.3	0.3	6.7	3.6	0.2	0.3	5.2	21.5
1997	1.5	1.6	2.3	0.3	6.7	3.6	0.2	0.3	5.3	21.7
1998	1.5	1.7	2.3	0.3	6.7	3.6	0.2	0.3	5.3	21.9
1999	1.6	1.8	2.3	0.3	6.9	3.6	0.2	0.3	5.4	22.4
2000	1.7	2.0	2.4	0.3	6.8	3.6	0.2	0.3	5.4	22.6
2001	1.7	1.9	2.6	0.3	6.8	3.6	0.2	0.3	5.5	22.9
2002	1.7	1.9	2.8	0.3	6.8	3.5	0.2	0.3	5.5	23.1
2003	1.8	1.9	3.2	0.3	6.7	3.5	0.2	0.3	5.6	23.4
2004	1.8	2.0	3.3	0.3	6.6	3.4	0.2	0.3	5.7	23.6
2005	1.8	1.9	3.2	0.3	6.5	3.4	0.2	0.4	5.7	23.4
2006	1.9	2.0	3.1	0.3	6.5	3.6	0.2	0.4	5.8	23.7
2007	2.1	2.1	3.3	0.4	6.5	3.8	0.2	0.4	5.8	24.5
2008	2.2	2.1	3.8	0.3	6.1	3.4	0.2	0.4	5.9	24.6
2009	2.1	2.2	3.9	0.3	6.2	3.5	0.2	0.5	6.0	24.8
2010	2.3	2.1	4.0	0.3	6.1	3.7	0.2	0.5	6.1	25.3
2011	2.4	2.2	4.1	0.3	5.9	3.7	0.2	0.5	6.2	25.5
2012	2.6	2.4	4.1	0.3	5.9	3.7	0.2	0.5	6.3	25.9
Percentage change										
2011 to 2012	*8.5*	*8.2*	*-0.8*	*9.1*	*-1.0*	*-1.0*	*4.8*	*1.2*	*1.3*	*1.5*
2002 to 2012	*51.9*	*23.5*	*45.9*	*19.0*	*-13.7*	*3.1*	*-12.8*	*63.2*	*12.6*	*11.8*

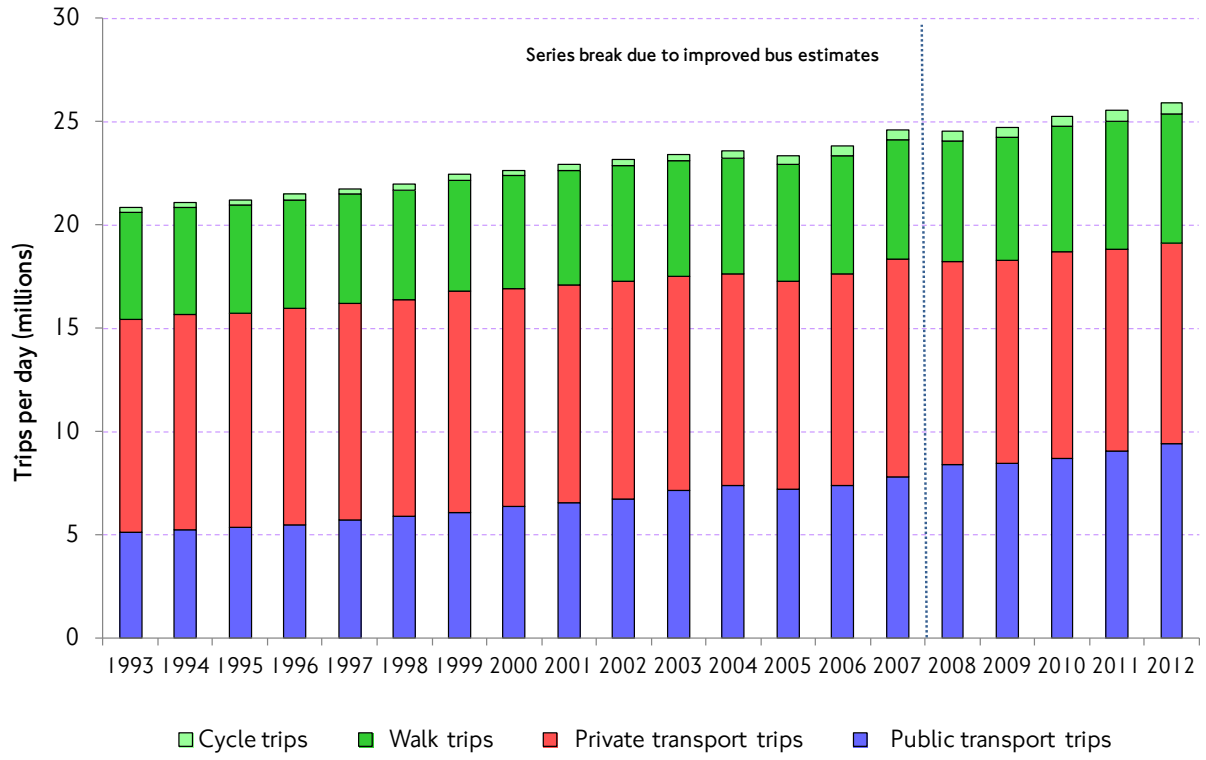
Source: TfL Planning, Strategic Analysis.
1. Trips are complete one-way movements from one place to another.
2. Trips may include use of several modes of transport and hence be made up of more than one journey stage.
3. In tables 2.2 and 2.4 trips are classified by the mode that is typically used for the longest distance within the trip.
4. Round trips are counted as two trips, an outward and an inward leg.
5. Values for 'Rail' include London Overground.

Included in these totals are all trips with origin, destination or both in Greater London by London residents and by non-residents, including commuters and day visitors from outside London as well as overnight visitors and tourists. The London resident population in 2012 was 8.3 million, 1.3 per cent higher than in 2011, on a comparable basis, and 12.6 per cent higher than in 2002. The larger 'daytime population' of Greater London, including non-resident visitors, was estimated at 9.4 million in 2012, 1.6 per cent higher than the previous year.

Over the 10-year period from 2002, total trips have increased by 11.8 per cent, with particularly notable increases of 51.9 per cent in rail trips, 45.9 per cent in bus trips, and a 63.2 per cent increase in cycle trips (as main mode). Car driver trips decreased by 13.7 per cent over the same period.

Over the most recent year there were again noticeable increases in patronage on rail and Underground, although there was a slight decrease in bus trips (table 2.2 and figure 2.2). Car driver and passenger trips decreased, by a further one per cent. The year 2012 of course included the London 2012 Games. However, in terms of whole-year travel considered here these were relatively short-term events. Also, as was described in Travel in London report 5 [2], although the Games brought major short-term changes to the ways in which people in London travelled, the net effect on total transport demand at the London-wide level in terms of the whole year was relatively small. Therefore, the 2012 Games would not be expected to have significantly affected these annual totals.

Figure 2.2 Trips in London – trend in total travel demand by principal mode. Estimated daily average number of trips by main mode of travel, 1993 to 2012. Seven-day week.



Source: TfL Planning, Strategy Analysis.

Trip rates

Trip rates (the average number of trips per person per day) have been noticeably stable over the whole period covered by table 2.2, at around 2.8 trips per person per day. These rates are calculated for the average daily population, which makes allowance for overnight visitors and commuters from outside London making trips in the Capital. This relative stability indicates that the increase in stages and trips in London is driven primarily by increases in population, both of London residents and visitors to the Capital, rather than individuals making more trips.

Looking specifically at London residents, using TfL's London Travel Demand Survey (LTDS), average trip rates in 2012/13 were 2.51 trips per person per day, lower than the average of 2.77 for all travellers in London. This difference is to be expected,

given that the large majority of non-resident day visitors are already (by definition) in the course of making at least one trip on the day in question.

2.4 Mode shares

Journey stage based mode shares

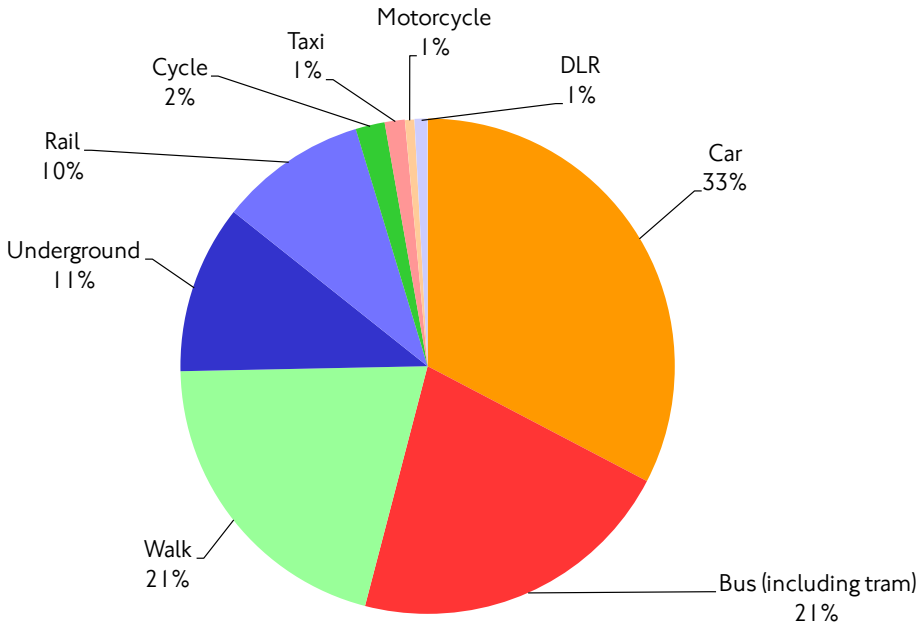
In 2012, 44 per cent of journey stages in London were made by public transport, compared with 33 per cent by private transport. This reflects a now well-established trend of a net shift in London away from private motorised transport to the public transport modes. Since 2000 the public transport mode share for London has increased by 10.1 percentage points. In the latest year, the private transport mode share fell by a further 0.8 percentage points, while the public transport mode share increased by 0.9 percentage points. Cycling and walking mode shares remained at around 2 and 21 per cent respectively. This trend towards higher public transport mode shares has been in evidence since the early 1990s, and has accelerated since the year 2000. Even during the recent economic downturn, this trend has continued, with public transport mode share increasing by 8.9 percentage points since 2002. The private transport mode share correspondingly decreased by 8.7 percentage points (table 2.3).

Table 2.3 Percentage shares of journey stages by type of transport, 1993-2012.

	Percentage of journey stages			
Year	Public transport	Private transport	Cycle	Walk
1993	30%	46%	1%	22%
1994	30%	46%	1%	22%
1995	31%	46%	1%	22%
1996	31%	46%	1%	22%
1997	32%	45%	1%	22%
1998	33%	45%	1%	22%
1999	33%	44%	1%	22%
2000	34%	43%	1%	21%
2001	35%	43%	1%	22%
2002	35%	42%	1%	21%
2003	37%	41%	1%	21%
2004	38%	39%	1%	21%
2005	38%	39%	2%	22%
2006	39%	38%	2%	21%
2007	41%	37%	2%	20%
2008	42%	35%	2%	21%
2009	42%	35%	2%	21%
2010	42%	35%	2%	21%
2011	43%	34%	2%	21%
2012	44%	33%	2%	21%

Source: TfL Planning, Strategic Analysis.
Note: Mode shares are calculated from the consistent series for journey stages given in Table 2.1. Totals may not add up to 100 per cent due to rounding.

Figure 2.3 Modal shares of daily journey stages in London, 2012.



Source: TfL Planning, Strategic Analysis.

Trip based mode shares

The decrease of 8.7 percentage points between 2002 and 2012 in the private transport mode share in terms of journey stages is equivalent to a decrease of 8.1 percentage points in terms of trips. Similarly, public transport mode share, which increased by 8.9 percentage points in terms of journey stages, increased by 7.3 percentage points in terms of trips since 2002. Public transport accounted for 36.4 per cent of trips in 2012, up from 35.5 per cent in 2011 and 29.1 per cent in 2002. Over the most recent year, private transport mode share decreased by 0.9 percentage points to 37.5 per cent. Cycle and walk mode shares remained constant, at two per cent and 24 per cent respectively.

Table 2.4 Trip-based mode shares – public and private transport by main mode.

	Percentage of trips			
Year	Public transport	Private transport	Cycle	Walk
1993	24%	50%	1%	25%
1994	25%	49%	1%	25%
1995	25%	49%	1%	24%
1996	26%	49%	1%	24%
1997	26%	48%	1%	24%
1998	27%	48%	1%	24%
1999	27%	48%	1%	24%
2000	28%	47%	1%	24%
2001	28%	46%	1%	24%
2002	29%	46%	1%	24%
2003	30%	44%	1%	24%
2004	31%	43%	1%	24%
2005	31%	43%	2%	25%
2006	31%	43%	2%	24%
2007	32%	43%	2%	23%
2008	34%	40%	2%	24%
2009	34%	40%	2%	24%
2010	34%	39%	2%	24%
2011	36%	38%	2%	24%
2012	36%	37%	2%	24%

Source: TfL Planning, Strategic Analysis.

2.5 Focus on: New population and employment projections arising from the 2011 Census and their implications for future projections of travel demand in London

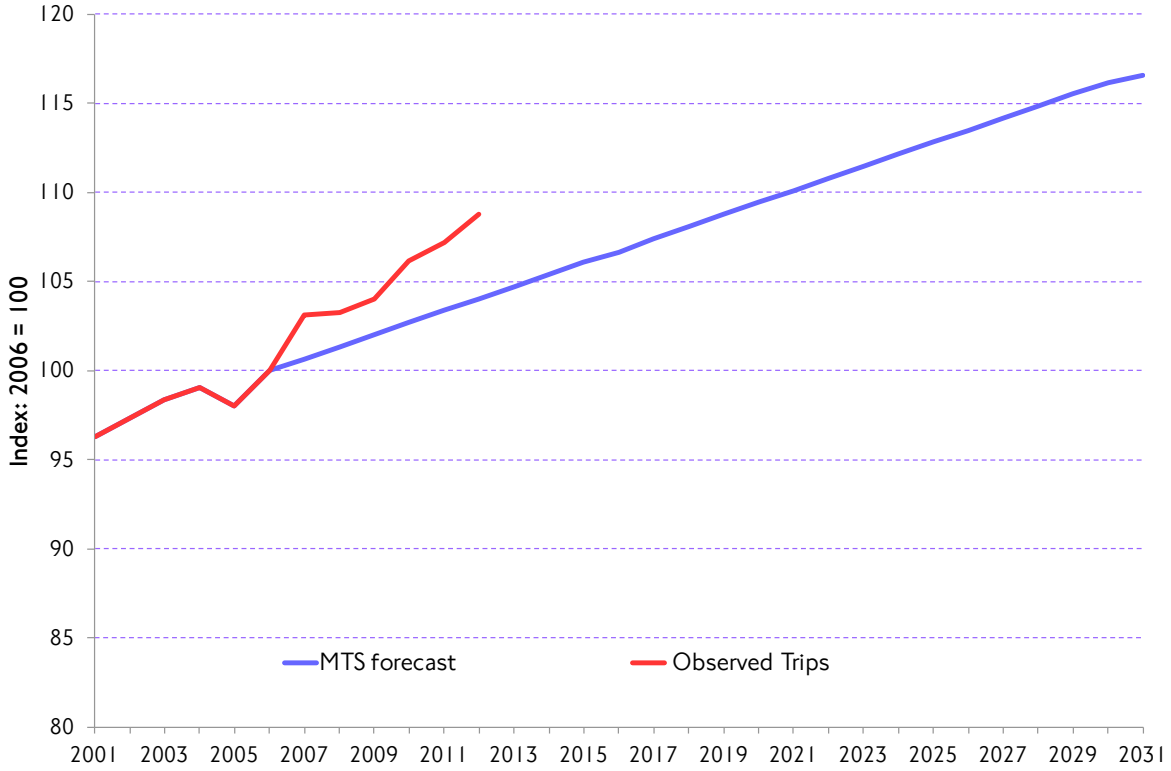
Summary

The observed growth in travel in London over the last decade has primarily been driven by an increase in London's population. Up until 2011, estimates of the resident population were based on data from the 2001 Census, updated with local estimates of births, deaths and net migration each year (the Office for National Statistics 'mid-year population estimates'). The Mayor's 2011 London Plan was underpinned by projections of growth in population and employment prepared in early 2010 by the Greater London Authority (GLA), based on these previous estimates. These were also reflected in the analysis and modelling underpinning the MTS. The release of data from the 2011 Census of population, which showed London's population to be higher than previously recognised, has led to a revision of the base estimates of the current population of London and the projections of future population levels. The GLA has also updated its projections of future employment (jobs) in London. This section provides a summary of these updated projections and an initial assessment of their transport impacts and implications.

How trips in London in 2012 compare with MTS expectation

Figure 2.4 compares the observed growth of travel in London with the forecast growth trend indicated in the Mayor's Transport Strategy. Trips have continued to increase at a faster rate than the MTS forecast, and in 2012 were 5.7 per cent higher than the expected trend. This amounts to an extra 510 million trips per year, or about 1.4 million additional trips on an average day.

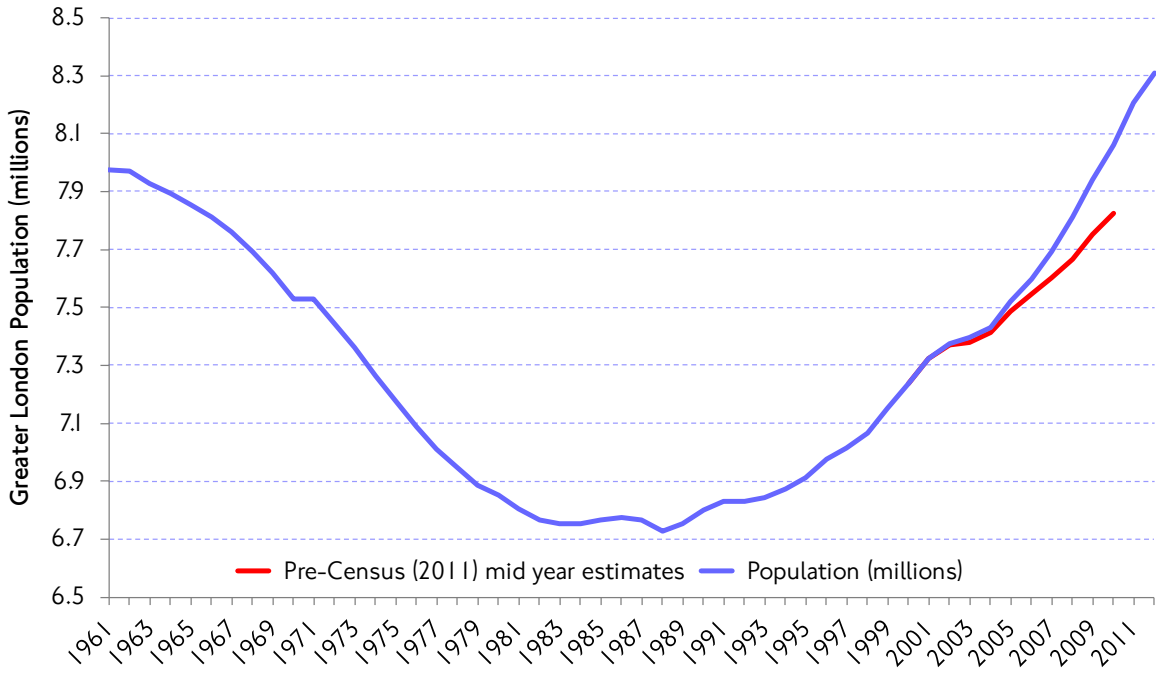
Figure 2.4 Observed trips in London compared with MTS forecast, 2006=100.



Source: TfL Planning, Strategic Analysis.

The driving factor behind the strong increase in travel demand has been strong growth in London's population, which grew by 1.3 per cent in the latest year and is now 13.5 per cent higher than in 2001, at 8.3 million. Notable from figure 2.4 is a temporary pause in the rate of growth mid-decade, thought largely to reflect the economic recession, but the overall trend of strong upward growth is clear.

Figure 2.5 Greater London resident population – with comparison against pre-2011 Census mid-year estimates.



Source: Greater London Authority.

Figure 2.5 shows the trend in London's population over the past 50 years. Of interest is the complete reversal of the population decline that characterised the 1960s and 1970s. This theme is explored further in chapter 7 of this report, and offers particular opportunities to understand contemporary travel demand patterns in that, at various points over this timescale, population numbers have been effectively the same, yet the travel volumes and patterns associated with them have differed.

Looking at the right-hand side of the figure, the increasing divergence between the population estimates on which the MTS and London Plan were based (red line), with the now-revised estimates based on the 2011 Census (blue line), is clear. MTS was based on an expected increase in population of one million (13 per cent) between 2011 and 2031 – equivalent to London absorbing a city about the size of Birmingham. The latest projections mean that, if growth continues at this rate, London's transport networks will have to accommodate an *additional* increase in population of approximately 0.6 million over and above that previously expected by 2031 – equivalent to an additional city the size of Glasgow. Although signifying a vibrant and successful city, such comparisons do illustrate the scale of the travel demand challenges now facing London's transport networks.

The GLA's new projections of London's population

The 2011 Census revealed that London's resident population was about 0.4 million higher than the estimates in the 2011 London Plan (based on estimates rolled forwards from the 2001 Census) – 8.2 million people compared to 7.8 million people. The new information on the trends and structure of the population has also led to expectations of stronger growth to 2041. The population is now forecast to grow faster into the future, reaching 9.84 million by 2031 (up 20 per cent from

2011), and 10.35 million in 2041 (up 26 per cent from 2011) compared to 8.82 million (up 13 per cent) in the London Plan. A key feature of the recent trend is that more people are staying in London rather than moving out (probably due to the impact on the property market of the economic recession over the past six years) and this, combined with continued immigration, will lead to higher than previously expected population levels. A second feature is that of a stronger growth among younger and older people, so growth in the number of people of working age (16-64 years) is less than the growth in the total population.

Table 2.5 Comparison of London-wide population and employment projections.

	2011	2031	2041	2011-31	2011-31
Population, millions					
2011 London Plan	7.80	8.82	n/a	1.02	13%
2013 GLA constrained	8.22	9.55	9.91	1.33	16%
2013 GLA unconstrained	8.22	9.84	10.35	1.62	20%
Employment, millions					
2011 London Plan	4.80	5.45	n/a	0.66	14%
2013 GLA (2041 estimated)	4.90	5.57	5.95	0.68	14%

Source: Greater London Authority.

Table 2.5 shows the updated population and employment projections, and compares them to those used for the London Plan. The GLA has produced two versions of the new population projections. The 'constrained' projection takes account of the expected housing capacity that will be available to accommodate future population growth, whereas the 'unconstrained' projection does not include this constraint.

Spatial and distributional implications of the new population projections

There are also spatial and distributional differences between the new projections and those assumed for the London Plan. Table 2.6 shows the changes in population and employment at the sub-regional level and compares the London Plan projections with the latest figures. The new projections reflect a more even spread of growth across London. Population growth in east London remains highest, however its share of total London growth drops from 49 per cent to 40 per cent. There is much stronger population growth in south and west London.

Table 2.6 Population and employment growth in the London sub-regions.

	Population		Employment	
2011 London Plan	**Change 2011-2031 (millions)**	**Share of total growth**	**Change 2011-2031 (millions)**	**Share of total growth**
South	0.09	8%	0.05	7%
East	0.50	49%	0.15	22%
West	0.11	10%	0.10	15%
North	0.15	14%	0.04	6%
Central	0.18	18%	0.32	49%
Total	1.02	100%	0.65	100%
2013 Projections	**Population (constrained)**		**Employment**	
South	0.23	14%	0.10	14%
East	0.64	40%	0.11	17%
West	0.22	13%	0.12	17%
North	0.21	13%	0.05	7%
Central	0.32	20%	0.30	44%
Total	1.62	100%	0.68	100%

Source: Greater London Authority.

Jobs in London

Table 2.6 shows that projected growth in employment in London has not changed significantly (expected to increase by 14 per cent in both sets of projections). However, the latest set of employment projections are more balanced across the sub-regions, although the central sub-region remains the strongest growing. Nevertheless, there is a notable difference between the projections of working age population and those of employment up to 2031, which could result in increasing levels of out-commuting from London in future.

Further revisions to the forecasts and the implications for the Mayor's strategies

Towards the end of 2013, the GLA plan to produce revised projections, which may differ further from those described above, that will form inputs to the Alterations to the London Plan, which is planned to be released as a draft for consultation in early 2014. It is considered that the policies and proposals within the MTS are defined sufficiently broadly to remain valid and that the revised projections do not lead to a requirement to revise the MTS. However, they do have a number of important implications for the background and context against which the strategy will be implemented.

Transport implications of the new projections

If trip rates do not change, then travel demand will grow at a similar rate to population. On this basis, it is now expected that there will be an additional five million trips per day between 2011 and 2031, compared to the previous projection of four million additional trips from 2007.

The new forecasts have a number of potential wider implications that will need to be considered. In general, the new projections have the effect that levels of population and travel in London previously projected for 2031 will be achieved

considerably earlier than that – in the early 2020s. This provides additional justification for increased investment – not only over the timescale to 2031 covered by the Mayor's Transport Strategy but also beyond. The potential for increased highway congestion gives added impetus to the proposals of the Roads Task Force [3] to tackle congestion. The higher levels of future growth across London create an increased need for consideration of further transport improvements and measures to address the increased growth in travel demand.

2.6 London's economy

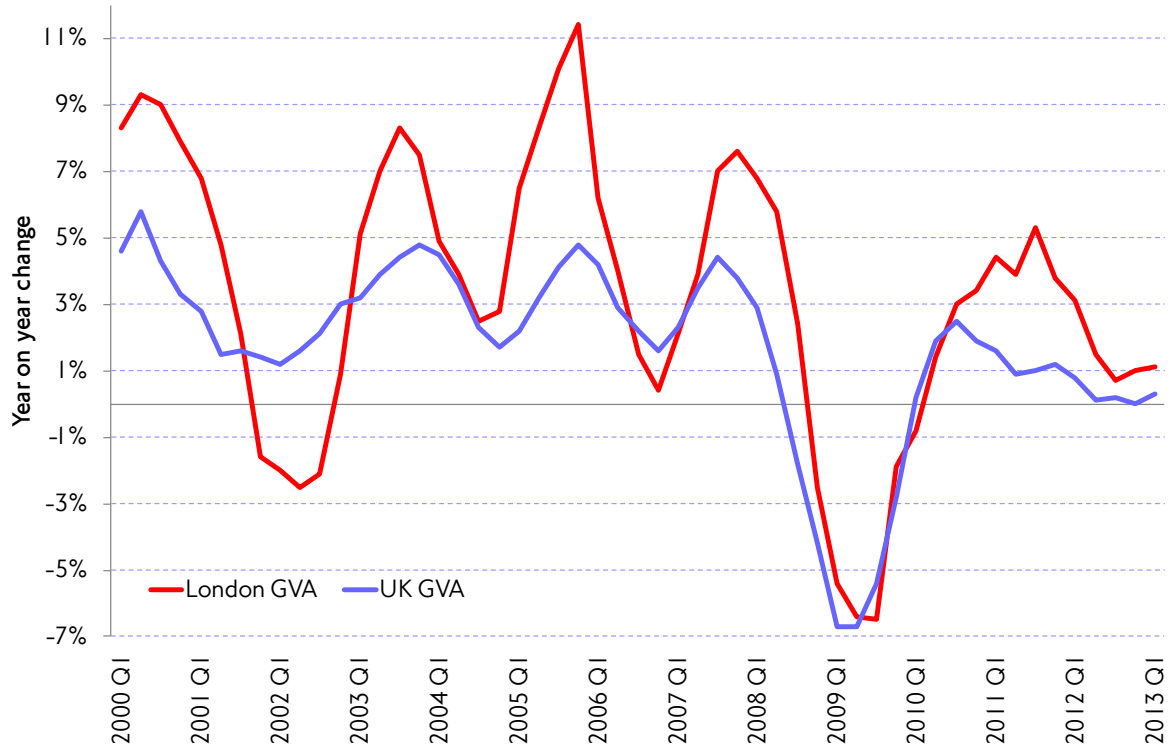
Summary

The UK and London have experienced one of the deepest and longest economic recessions of recent times, although most commentators agree that the indicators are now pointing towards a sustained recovery. Reducing economic output and business and consumer activity feeds through, all other things being equal, to reduced travel demand and this has been seen in what now appears to have been a temporary pause (between 2007 and 2009) in the established strong rates of growth in demand for the principal modes of public transport in London. This section summarises recent economic trends in London.

Economic activity – Gross Value Added

Gross Value Added (GVA) is a measure of the value of goods and services produced in a region. It is a basic indicator of economic output. Figure 2.6 shows the trend for London and UK GVA since 2000. The basic historic pattern is of economic growth, of varying levels, through the middle part of the last decade. This was followed by a recession of unprecedented depth starting in quarter 3 2008, associated primarily with the banking crisis of 2008. The UK emerged from recession (defined as two quarters of negative GVA growth) in quarter 1 2010, following six consecutive quarterly falls in GVA. Since emerging from recession, London has generally been outperforming the UK as a whole in terms of GVA growth – in the four quarters up to quarter 1 2013, London averaged GVA growth of 1.1 per cent per quarter, compared to just 0.6 per cent for the UK overall.

Figure 2.6 Gross Value Added (GVA) – London and UK trends compared. Year-on-year percentage change.

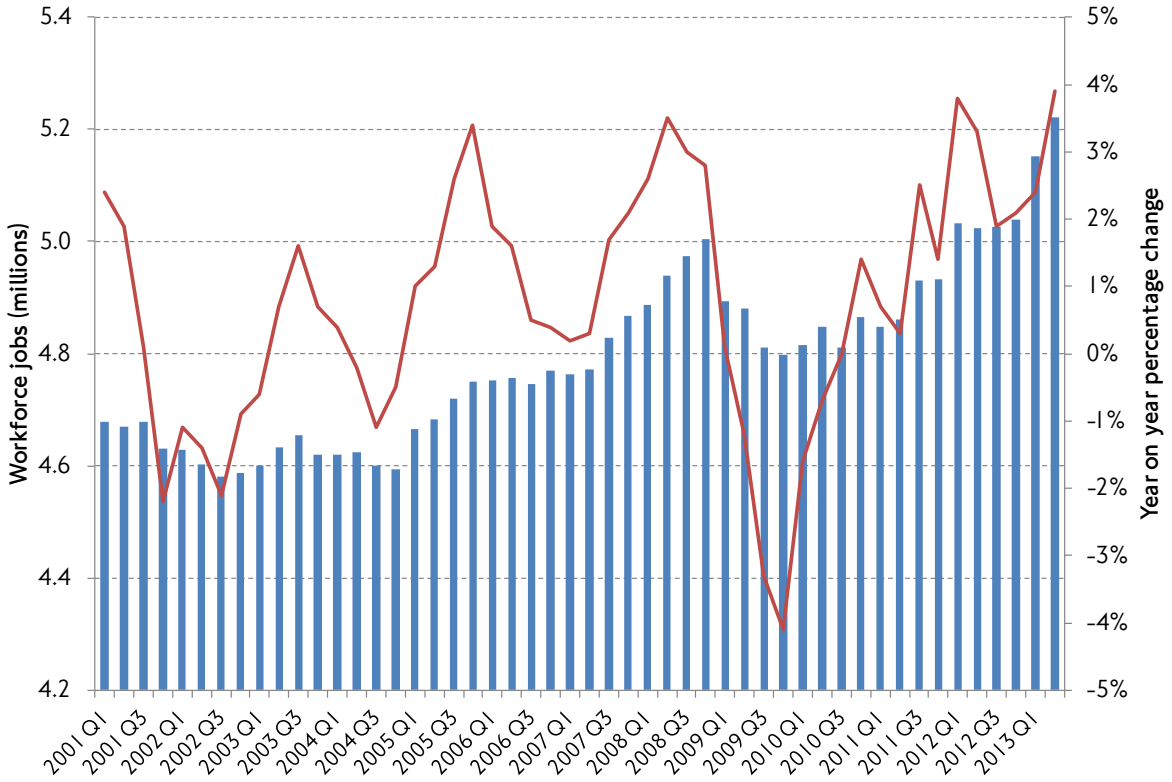


Source: Office for National Statistics, Experian Economics.

Economic activity – London employment

Employment trends in London, as in the UK, have mirrored those of the general economy, with the impact of the recession clearly visible in figure 2.7. Total workforce jobs fell from 5.0 million to 4.8 million (a fall of around 4.1 per cent) between quarter 4 2008 and quarter 4 2009 but have been generally increasing since to beyond pre-recessionary levels, with 5.2 million jobs in quarter 2 2013. The sharpness of the trough in employment in 2009 contrasts with the general stability of travel demand over this period, although in the context of an increasing population.

Figure 2.7 Trends in London workforce jobs and year-on-year percentage change.



Source: ONS, Experian Economics.

Notes and references

(1) See Travel in London report 5, section 2.3. http://www.tfl.gov.uk/assets/downloads/corporate/travel-in-london-report-5.pdf

(2) The Mayor's Vision for Roads and Streets in London. http://www.tfl.gov.uk/corporate/projectsandschemes/28187.aspx

3. Travel trends by mode

3.1 Introduction and content

Chapter 2 of this report looked at trends in aggregate travel demand and mode shares in London. This chapter looks in more specific detail at travel demand trends for each of the principal modes of transport. Chapter 4 of this report then looks at corresponding trends in service supply and operational performance for each of these principal modes. This section covers trends updated to the 2012 calendar year or 2012/13 financial year. The effect of the 2012 Games, which saw record levels of patronage across the public transport networks, can be discerned throughout this chapter, although in the context of the whole year the period of the Games was a relatively small influence on annual patronage totals. Detailed coverage of 2012 Games-time travel patterns can be found in Travel in London report 5 [1].

3.2 Historic travel demand trends for principal modes of transport

Use of public transport in London has grown substantially over recent years, and has continued to do so despite the economic recession. This growth largely reflects increased population, now revealed by the 2011 Census to have been higher than previously assessed, and increased service provision on the public transport networks.

In 2012/13 there were 56.8 per cent more journey-stages by bus and 26.8 per cent more journey stages by Underground than in 2000/01. There has also been dramatic growth on the DLR, with an increase of 160.5 per cent in journey stages since 2000/01, this in part reflecting expansion of this network, and an increase of 61.3 per cent in journey-stages on the Tramlink network, against 2001/02. The London Overground network, created in the latter part of the last decade from parts of the existing National Rail network with some new infrastructure, carried 124.6 million journey stages in 2012/13.

In contrast to the strong growth in population and public transport patronage however, volumes of travel by road have declined. This trend was well-established in central and inner London over most of the last decade, but has also more recently been seen in outer London. Over the long term this trend is thought to reflect a combination of more and improved public transport, travel behavioural change by individuals (such as more non-car owning households) and changes to the road network that have had the effect of removing capacity for general road traffic.

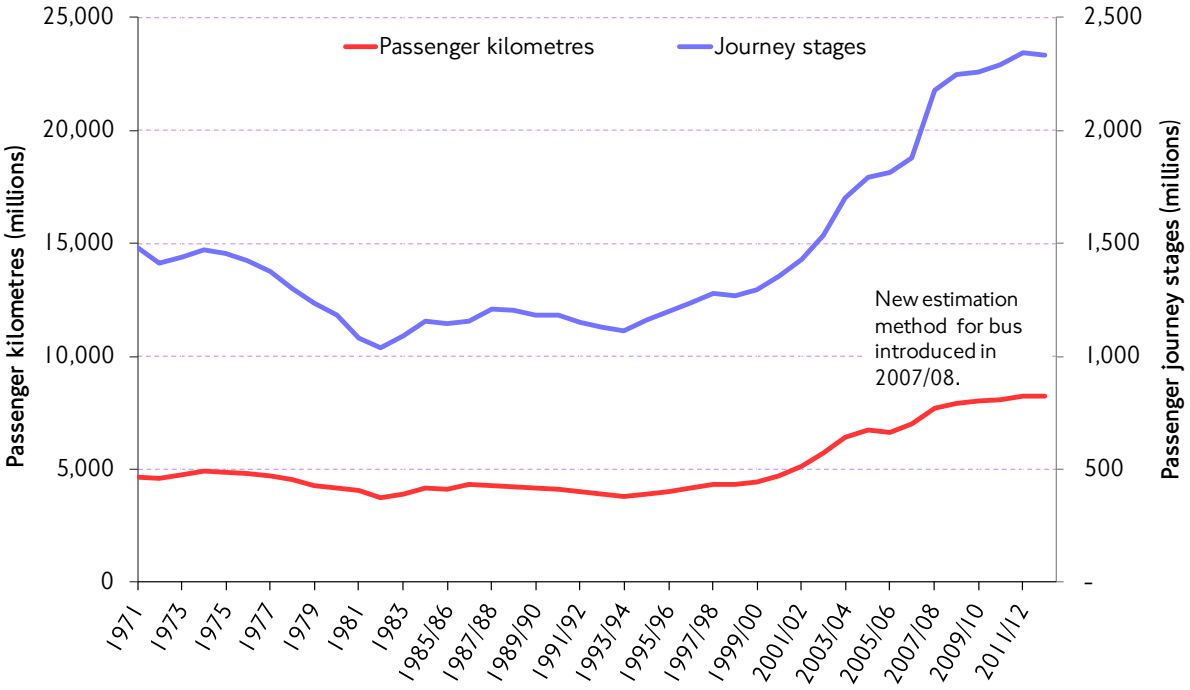
Other significant developments since 2000 have included an estimated 103.2 per cent increase in cycle journey stages in Greater London. This reflects measures by successive mayoral administrations to promote and encourage cycling through the provision of new infrastructure and related initiatives. Although 2012 saw a slowing in the strong pattern of growth of recent years, the dramatic growth in cycling over the last ten years contrasts very strongly with effectively static levels for this mode throughout the 1990s.

3.3 Bus

Figure 3.1 shows the long-term trend for bus patronage in London. The bus has been one of London's transport success stories, with the historic pattern of slowly declining patronage being dramatically reversed in the late 1990s to one of strong

growth. Over the 12 years from 2000/01 to 2012/13, the number of bus journey stages in London increased by 56.8 per cent, and passenger-kilometres grew by 70.5 per cent. The rate of growth has levelled out in more recent years; the most recent year shows little change in passenger kilometres, increasing from 8,219 million in 2011/12 to 8,258 million in 2012/13, while there was a very small drop in bus journey stages, down from 2,344 million to 2,335 million.

Figure 3.1 Passenger kilometres and journey stages travelled by bus.



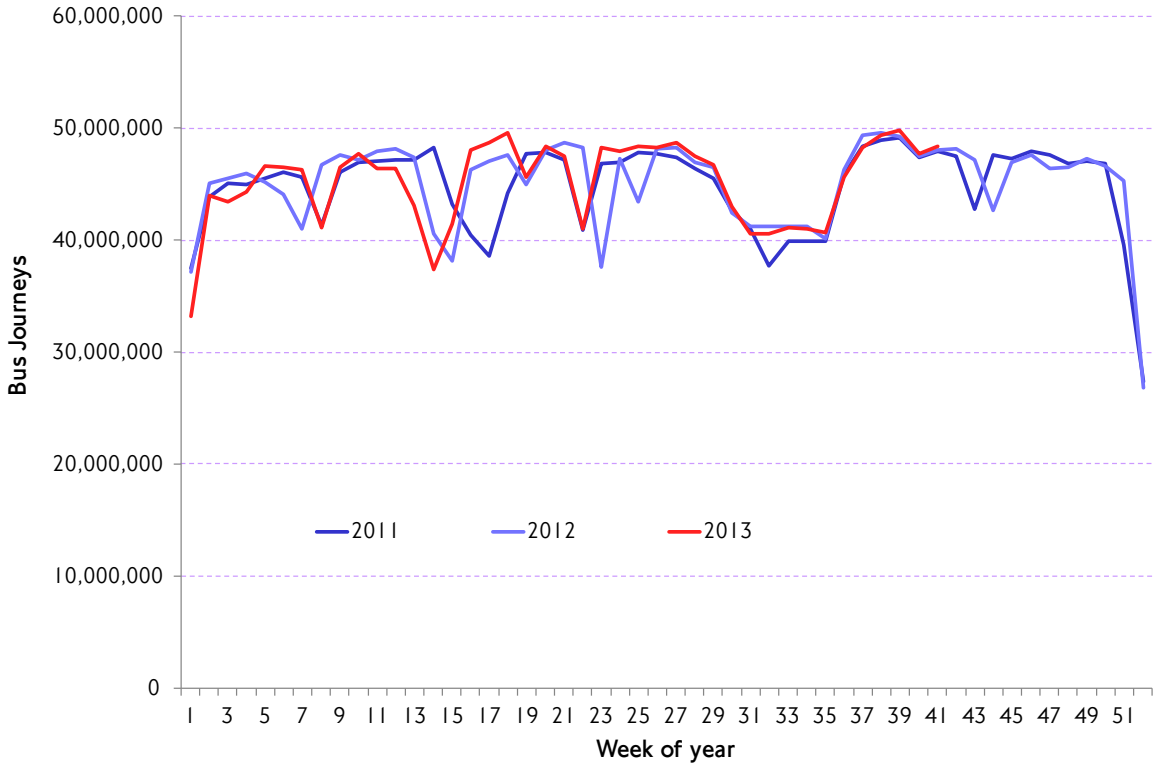
Source: TfL Service Performance data.

This levelling out of the rate of increase in bus patronage corresponds to a slowing of the rate of increase in bus service provision (see section 4.3). The main factors driving bus demand are fares, population and service levels/service quality. In recent years, demand has risen somewhat each year, despite fare increases above the Retail Price Index, due to the continued growth in population, the maintenance of excellent reliability and some year-on-year growth in bus-kilometres operated. When differences in the number and pattern of public holidays between 2011/12 and 2012/13 are taken into account, underlying bus patronage in 2012/13 is estimated to have grown by 0.5 per cent. This is due to 2012/13 having two additional bank holidays over 2011/12, which was also a leap year.

Figure 3.2 shows weekly bus journeys for the last three years, based on the use of Oystercard but uplifted to account for non-Oyster journeys. The overall similarity of bus patronage levels over this entire period is clear, with obvious departures being caused by the different timing of Easter each year and the civil disturbances of summer 2011. The importance of education-related travel is clearly shown in terms of relative reductions of between 10 and 20 per cent in patronage levels during school holiday periods. As described in Travel in London report 5, there was no significant net effect on patronage from the Games in summer 2012, although this net outcome reflected increases in Games-related travel offset by reductions in

'background' patronage, reflecting Games time travel demand management measures.

Figure 3.2 Weekly number of bus journeys. 2011 – 2013 (autumn).



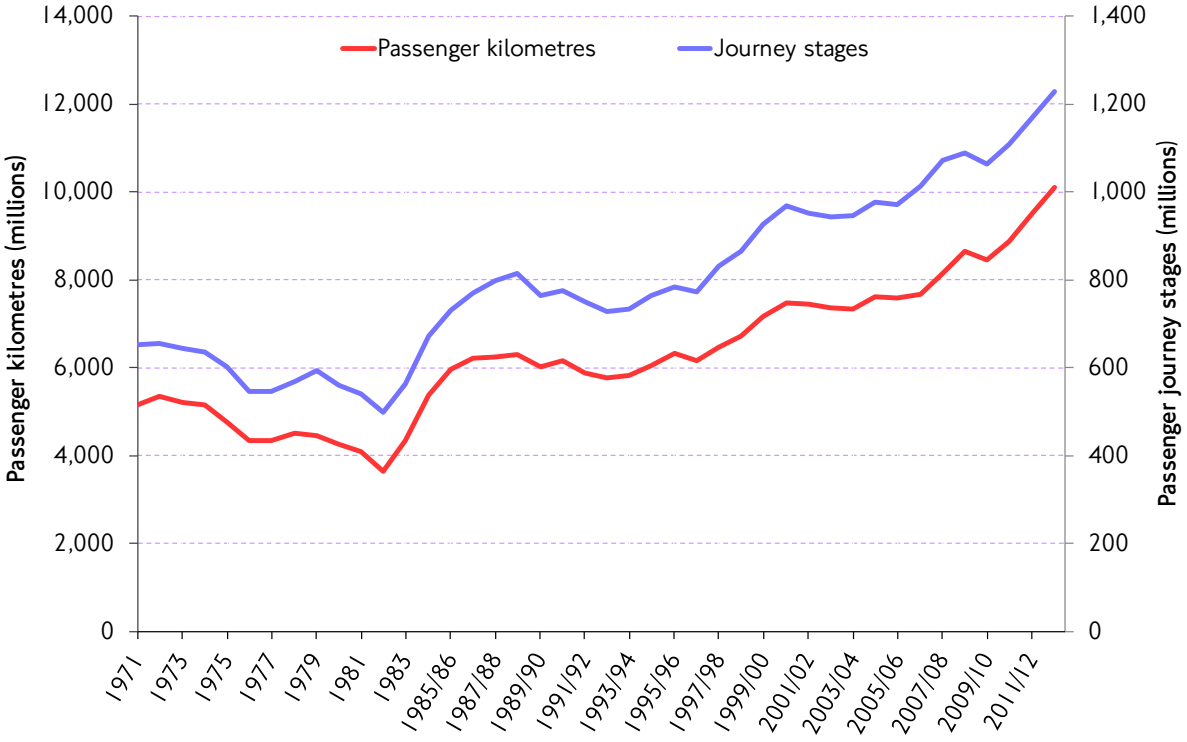
Source: TfL Customer Experience.

3.4 Underground

The number of people using the Underground in 2012/13 was the highest ever (figure 3.3), with 1,229 million passenger journeys (journey stages). Over the past year (2011/12-2012/13), journey stages increased by 5.0 per cent, while passenger kilometres increased by 6.1 per cent. While the 2012 Games were certainly a factor driving this net increase, with sustained 'record' levels of demand during the Games, it is clear from figure 3.4 that it primarily reflects sustained 'background' growth in demand. There was also an increase in train kilometres operated of 4.5 per cent over the year (see section 4.2 of this report), in part reflecting additional services during the 2012 Games.

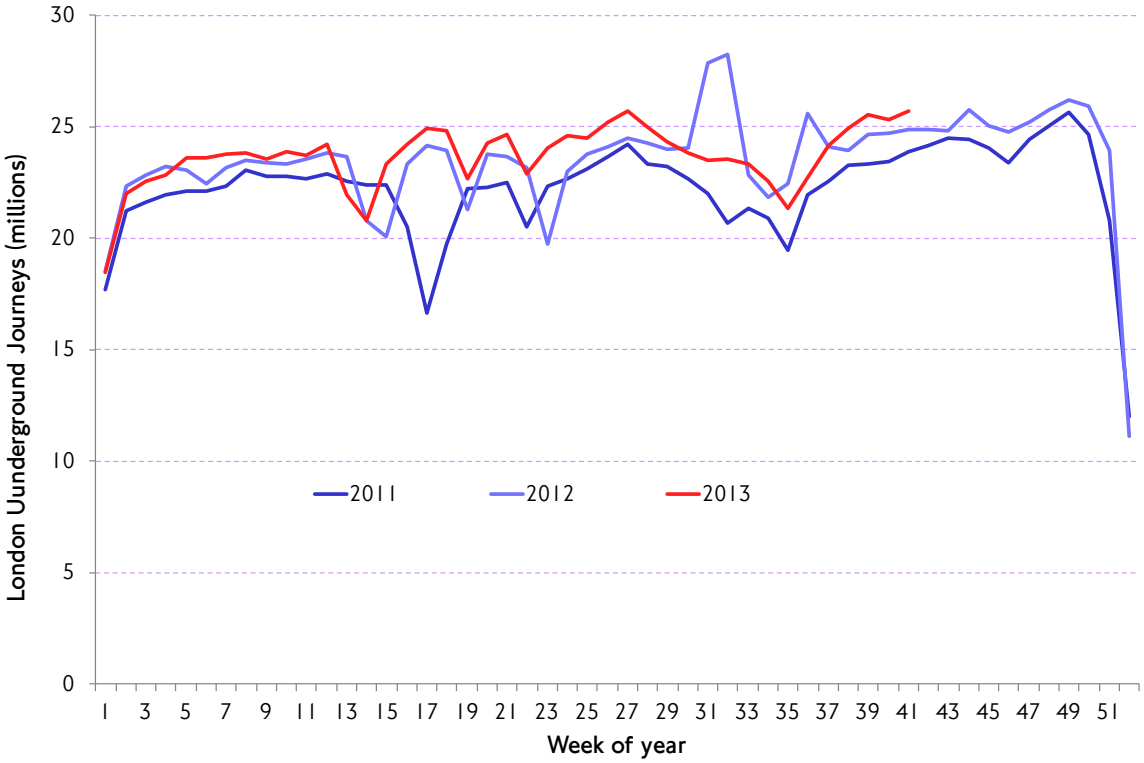
This continued strong growth in Underground patronage contrasts with the flattening trend for bus patronage. It is too early to draw conclusions about the underlying causes of this, but it may relate to differential trends in service supply, with recent strong increases on the Underground, pricing relativities between the two modes, or it could signify that overall growth in travel is mainly occurring in those trips of relatively longer distance.

Figure 3.3 Passenger kilometres and journey stages by Underground.



Source: TfL Service Performance data.

Figure 3.4 Weekly number of Underground journeys, 2011 – 2013 (autumn).



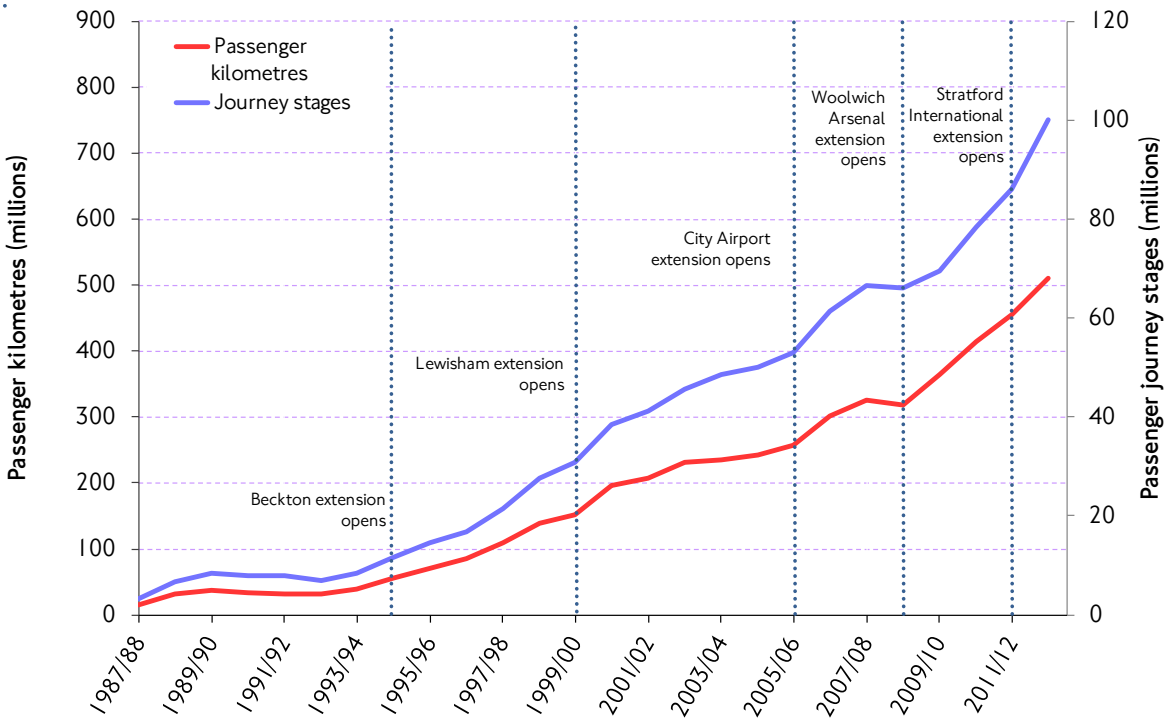
Source: TfL Customer Experience.

3.5 Docklands Light Railway (DLR)

Figure 3.5 shows the trend for travel by DLR since its initial opening in 1987. Patronage has grown steadily over this period as the network has progressively expanded. Principal milestones in the development of the network are shown in the figure to aid interpretation.

In 2012/13 510 million passenger kilometres were travelled on the DLR, equivalent to 100 million journey stages. This is 11.9 per cent higher than 2011/12, a rate of increase higher than the recent trend, the increase partially reflecting particularly substantial additional patronage during the 2012 Games (figure 3.6). Since the late 1990s, DLR patronage has been increasing at a relatively consistent rate – since 2000/01 passenger kilometres have increased by an average of 10 per cent per year, with journey stages increasing by an average of 9.6 per cent per year.

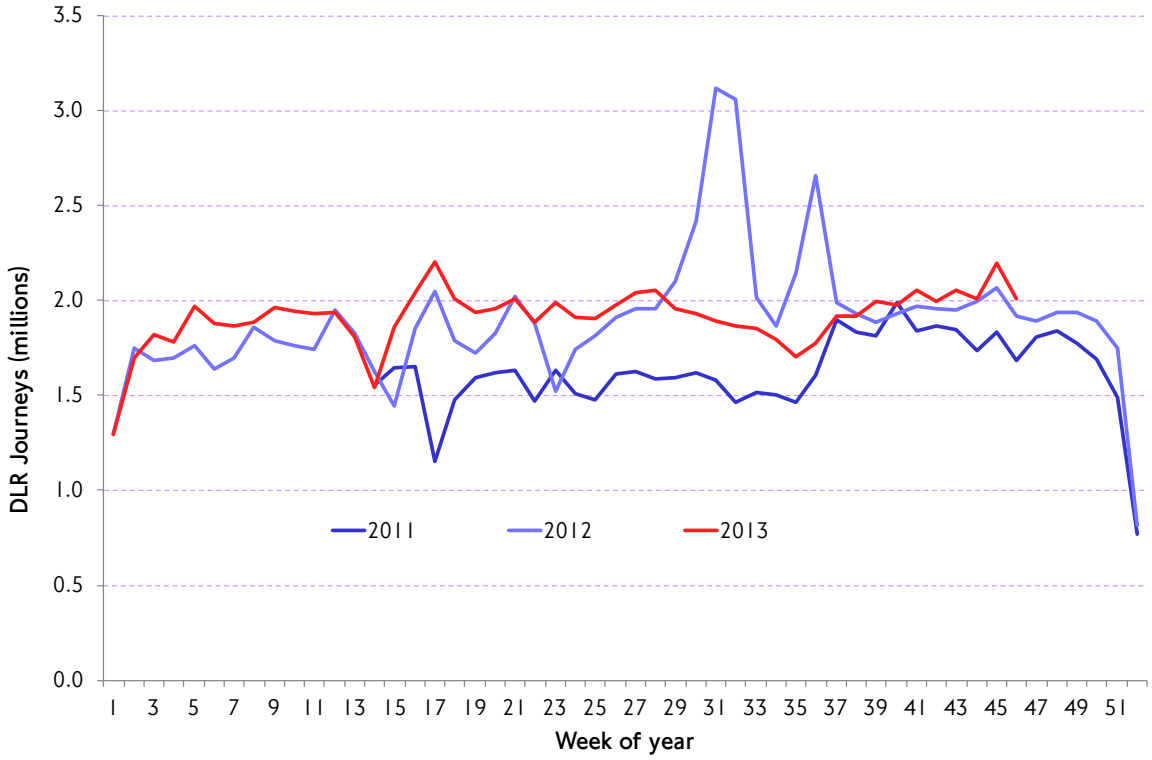
Figure 3.5 Passenger kilometres and journey stages by DLR.



Source: TfL Service Performance data.

As with bus and Underground, it is instructive to view recent growth in DLR patronage on a weekly basis over the last few years (figure 3.6). This clearly shows the relative magnitude of the patronage increase during the period of the 2012 Games, when patronage reached levels almost double those normally expected, alongside a strong trend of 'background' growth.

Figure 3.6 Weekly number of DLR journeys, 2011 – 2013 (autumn).



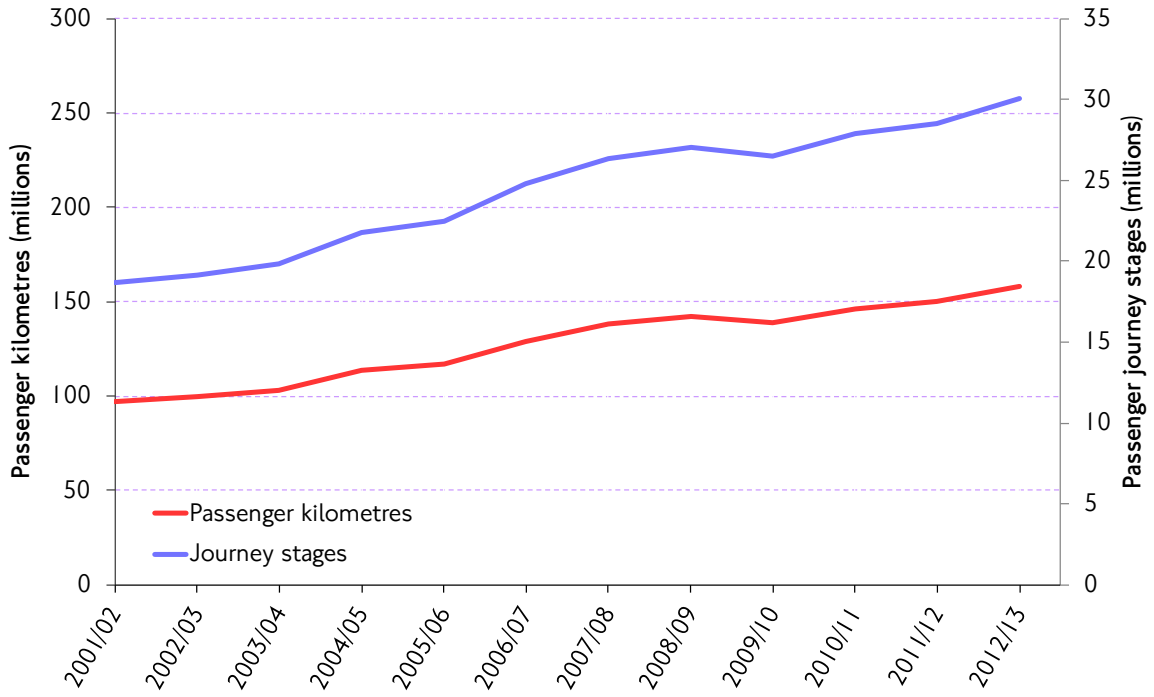
Source: TfL Service Performance data.

3.6 London Tramlink

London Tramlink initially opened in 2000 and the network has been relatively stable since, albeit with a service restructuring in 2006. Figure 3.7 shows steady patronage growth averaging 4.6 per cent for passenger kilometres and 4.5 per cent for journey stages over the period since opening. Aggregate growth since 2001/02 has been 61 per cent for journey stages and 63 per cent for passenger kilometres. Tram kilometres operated have increased by 20 per cent over the period since 2001/02.

In the most recent year there were 5.3 per cent more passenger kilometres and journey stages than in 2011/12, which is the strongest growth in Tramlink patronage since 2007/08.

Figure 3.7 Passenger kilometres and journey stages by London Tramlink.



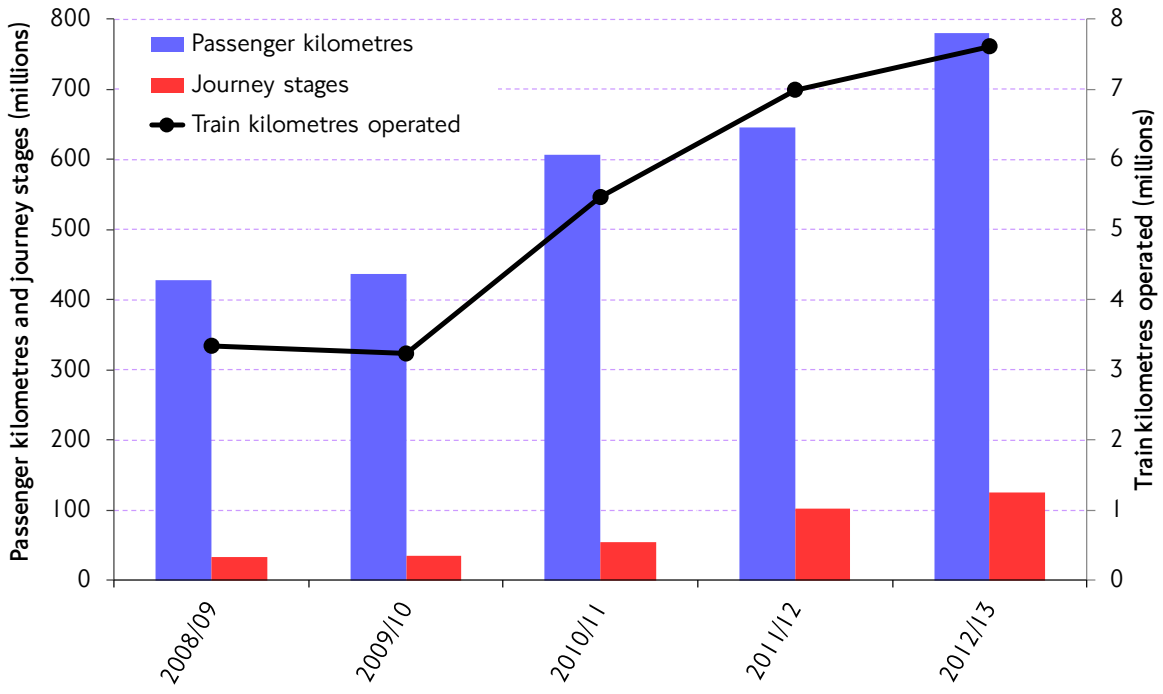
Source: TfL Service Performance data.

3.7 Overground

Since the first full year of operation of the London Overground in 2008/09, passenger kilometres have increased by 82 per cent, with a 275 per cent increase in passenger journey stages and a 128 per cent increase in train kilometres operated. This reflects the comprehensive transformation of the network. In 2011/12 a major infrastructure upgrade project led to the introduction of the May 2011 timetable which provides four peak trains an hour from Stratford to Richmond and four peak trains an hour from Stratford to Willesden, and a 'turn up and go' service of eight trains an hour in the central section. In December 2012 a further extension of the network from Clapham Junction to Highbury & Islington via Surrey Quays opened, completing the orbital route.

In 2012/13, passenger kilometres increased by 21 per cent on the previous year, to 780 million and passenger journey stages increased by 21 per cent to 125 million (figure 3.8). Around 10 per cent of this growth in journeys reflects the opening of the extension from Clapham Junction to Surrey Quays.

Figure 3.8 Passenger kilometres and journey stages by London Overground.



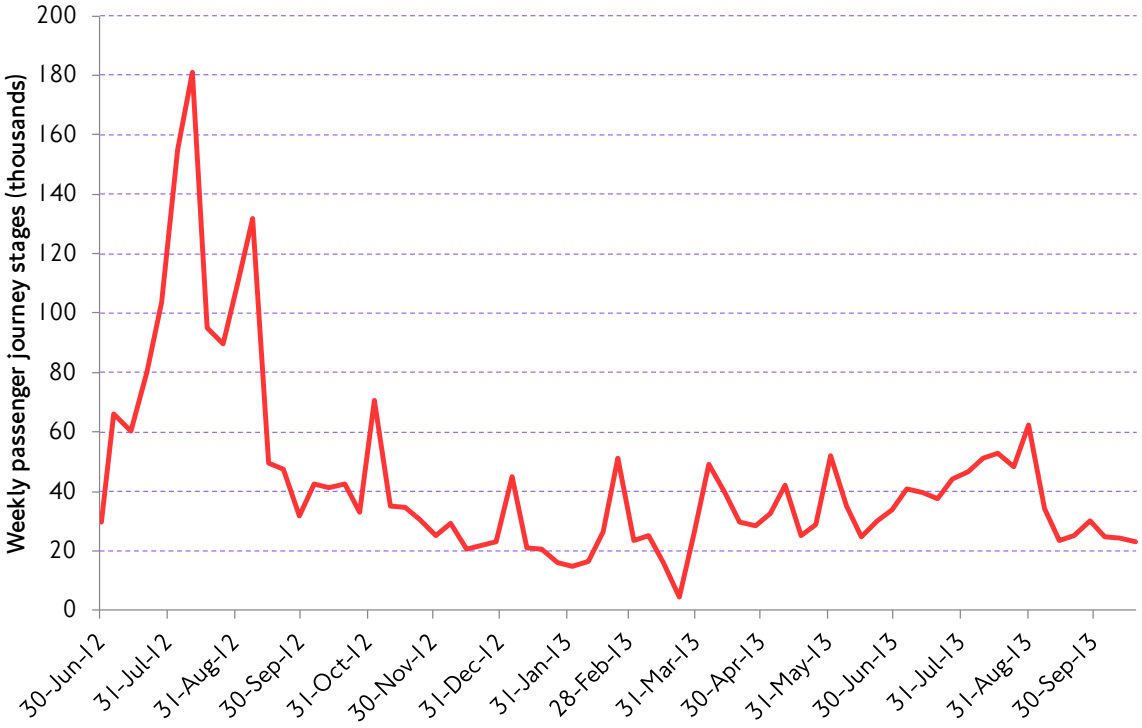
Source: TfL Service Performance data.

3.8 Emirates Air Line

The Emirates Air Line initially opened in June 2012, just prior to the London 2012 Games. During the Games themselves, the geographic position of the Air Line to Games-related tourism and the 'novelty factor' combined to see patronage exceed 180,000 people per week.

Figure 3.9 shows that, following the exceptional conditions of summer 2012, the Emirates Airline has settled into a more regular pattern of usage, typically between 20,000 and 40,000 passengers per week, with more passengers seen during school holidays. In 2012/13, 1.77 million journeys were undertaken on the Emirates Air Line, higher than the 1.57 million journeys forecast in 2011 prior to opening, reflecting 2012 Games demand, however lower than the 2.05 million journeys that was subsequently forecast in January 2013, reflecting steady-state usage.

Figure 3.9 Number of journey stages by Emirates Air Line.



Source: TfL Service Performance data.

3.9 National Rail in London

National Rail travel has grown strongly at the national level over the past decade, with only a brief pause during the recession. This pattern is reflected for travel on services defined by the Office of Rail Regulation (ORR) as 'London and South East' (L&SE). Passenger kilometres and passenger journeys increased for the third year in a row with increases of 3.4 per cent in passenger kilometres and 3.9 per cent in journeys – the number of journeys in 2011/12 being 52.1 per cent higher than 10 years previously (2002/03) – see table 3.1.

Table 3.1 Passenger kilometres and passenger journey stages by National Rail – operators classified by ORR as London and South East operators.

Year	Passenger kilometres (billions)	Year-to-year percentage change	Passenger journeys (millions)	Year-to-year percentage change
1998/99	17.1	..	616	..
1999/00	18.4	7.6	639	3.6
2000/01	19.2	4.3	664	4.0
2001/02	19.3	0.5	663	-0.1
2002/03	19.8	2.6	679	2.4
2003/04	20.1	1.7	690	1.6
2004/05	20.5	1.9	704	2.1
2005/06	20.7	1.1	720	2.2
2006/07	22.2	7.1	769	6.9
2007/08	23.5	6.1	828	7.7
2008/09	24.2	2.9	854	3.1
2009/10	23.8	-1.8	842	-1.4
2010/11	25.0	5.2	918	9.0
2011/12	26.5	5.7	994	8.3
2012/13	27.4	3.4	1,033	3.9

Source: Office of Rail Regulation.

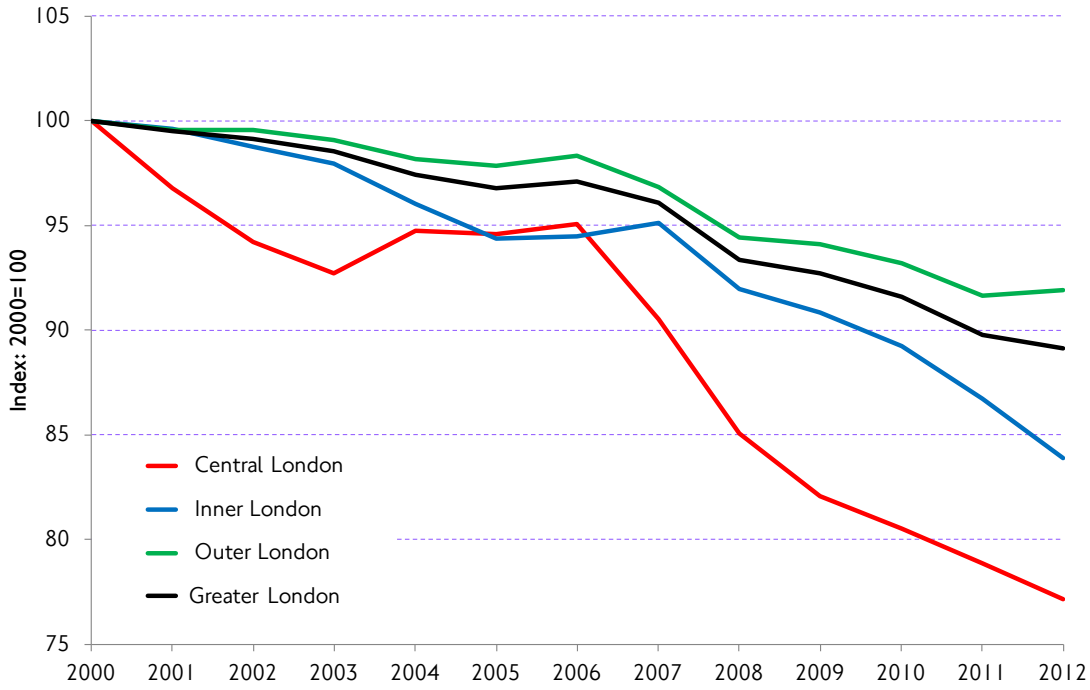
3.10 Road traffic trends in London

Road vehicle traffic in London has been falling over the last decade, with vehicle kilometres in the latest year (2012) 10.9 per cent lower than in 2000, and at their lowest level since 1993. This fall has been particularly prominent in central London (an area larger than the central London Congestion Charging zone), where vehicle kilometres in 2012 were 22.8 per cent below the 2000 level. In inner London, the equivalent fall was 16.1 per cent, while vehicle kilometres in outer London fell by 8.1 per cent. Traffic in outer London only started to fall steadily in the second half of the decade, from 2007 onwards, after a slight increase in 2006, and in 2012 it started to increase again.

In 2012, overall vehicle kilometres in London continued to fall, albeit at a slower rate. Vehicle kilometres were down by 0.7 per cent overall, with the biggest fall in inner London, which was 3.2 per cent down on the previous year. Traffic in central London fell by 2.2 per cent, while traffic in outer London, which accounts for 70 per cent of traffic in London, increased by 0.3 per cent - the first increase in outer London since 2006 (figure 3.10).

The traffic data considered in this section run only to the end of the 2012 calendar year. While it is too early to draw firm conclusions, it is interesting to note at this stage that observed traffic data for 2013 are showing increases in traffic relative to 2012. If sustained, this could signify a break with the now long-established pattern of slowly declining levels of road traffic in London.

Figure 3.10 Trends in road traffic (vehicle kilometres), all motor vehicles in central, inner and outer London. Index: Year 2000=100.



Source: Department for Transport.

In interpreting the trend for central London shown by figure 3.10, it is important to recognise that this reflects a different area and set of conditions to that previously reported by TfL through the Congestion Charging Impacts Monitoring reports. In particular, the DfT series on which the figure is based relies on only a small number of permanent counters in central London, most of which are outside of the Congestion Charging zone (for example on the Inner Ring Road). Furthermore, the area defined as 'central London' in the figure is substantially different to the charging zone. The apparent increase in traffic between 2003 and 2005, does not therefore relate directly to congestion charging effects, although the overall trend for traffic in central London over the period covered by the figure is clear enough.

Table 3.2 London road traffic (billion vehicle kilometres) by central, inner and outer London. All motor vehicles.

Year	Central London	Inner London	Outer London	Greater London	Great Britain
1993	1.3	8.7	20.7	30.7	412.3
1994	1.3	8.8	21.0	31.1	421.5
1995	1.3	8.9	21.0	31.2	429.7
1996	1.3	8.9	21.3	31.5	441.1
1997	1.3	8.9	21.5	31.7	450.3
1998	1.3	8.9	21.7	31.9	458.5
1999	1.3	9.1	22.3	32.7	467.0
2000	1.3	9.0	22.1	32.4	466.2
2001	1.2	9.0	22.0	32.3	472.6
2002	1.2	8.9	22.0	32.1	483.7
2003	1.2	8.8	21.9	31.9	486.7
2004	1.2	8.7	21.7	31.6	493.9
2005	1.2	8.5	21.7	31.4	493.9
2006	1.2	8.5	21.8	31.5	501.1
2007	1.2	8.6	21.4	31.2	505.4
2008	1.1	8.3	20.9	30.3	500.6
2009	1.0	8.2	20.8	30.1	495.8
2010	1.0	8.0	20.6	29.7	487.9
2011	1.0	7.8	20.3	29.1	488.9
2012	1.0	7.6	20.3	28.9	487.1

Source: Department for Transport.

London and Great Britain – traffic trends compared

At the national level, road traffic volumes decreased in 2012 following a slight increase in 2011. Vehicle-kilometres driven nationally are now lower than at any time since 2003 (table 3.3). It is instructive to note that the prevailing trend for road traffic at the national level over the last five years has been downwards, paralleling that seen in London, although probably more directly reflecting a combination of the recession and fuel price increases.

Table 3.3 Index of London road traffic (all motor vehicles, based on vehicle kilometres). Index: Year 2000=100.

Year	Central London	Inner London	Outer London	Greater London - all roads	Great Britain
2000	100.0	100.0	100.0	100.0	100.0
2001	96.7	99.6	99.6	99.5	101.4
2002	94.2	98.8	99.6	99.1	103.8
2003	92.6	98.0	99.1	98.5	104.4
2004	94.7	96.0	98.2	97.4	106.0
2005	94.5	94.4	97.9	96.8	105.9
2006	95.0	94.5	98.3	97.1	107.5
2007	90.6	95.1	96.8	96.1	108.4
2008	85.1	92.0	94.4	93.4	107.4
2009	82.0	90.9	94.1	92.7	106.4
2010	80.5	89.2	93.2	91.6	104.7
2011	78.9	86.7	91.6	89.8	104.9
2012	77.2	83.9	91.9	89.1	104.5

Source: Department for Transport.

3.11 Cycling

This section looks at recent trends in levels of cycling in London, including average daily cycle stages and trips, cycle flows on the TLRN major road network, and the number of cyclists crossing a set of three strategic traffic counting cordons. The latest figures for 2012 appear to represent a slowdown in the recent established pattern of strong growth of cycling in London.

Overall levels of cycling in London

In 2012, there were 582,000 cycle stages in London on an average day, which is a 1.8 per cent increase on 2011. This follows a 5.2 per cent increase in the previous year, with an overall 80.1 per cent increase in cycle stages since 2002 (table 3.4).

Table 3.4 Daily average cycle stages and trips in London.

	Cycle stages		Cycle trips
	Millions	Year on year change %	Millions
2000	0.29	6	0.27
2001	0.32	12	0.30
2002	0.32	1	0.30
2003	0.37	14	0.32
2004	0.38	3	0.33
2005	0.41	9	0.39
2006	0.47	12	0.42
2007	0.47	-	0.42
2008	0.49	5	0.44
2009	0.51	5	0.47
2010	0.54	6	0.49
2011	0.57	5	0.50
2012	0.58	2	0.50

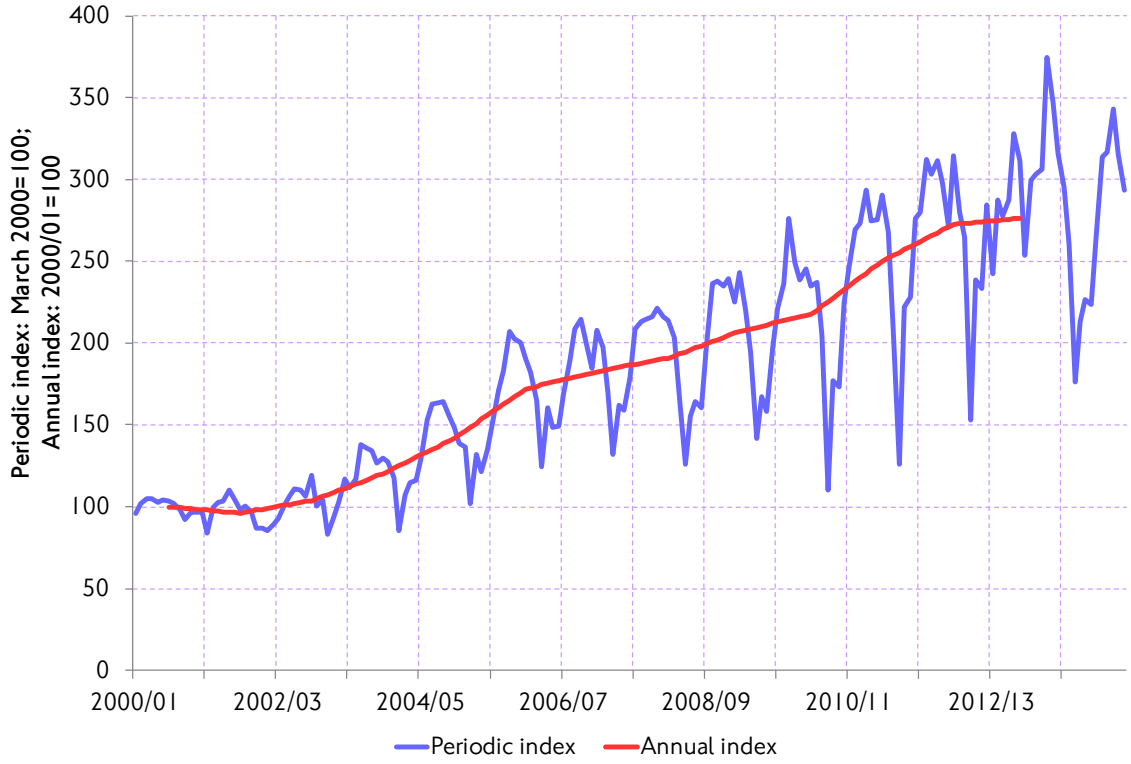
Source: TfL Planning, Strategic Analysis.

Cycle flows on major roads in London

TfL monitors levels of cycling on the TLRN through data collected by automatic cycle counters. Figure 3.11 shows the data as an index with base year 2000/01, calculated as the average daily cycle flows within each four-week reporting period.

Between 2000/01 and 2012/13, the index increased by 176 per cent overall. Following a 15 per cent increase between 2009/10 and 2010/11, the index increased a further 9 per cent in 2011/12 and, in the latest year the index grew by 1.4 per cent. The chart illustrates these seasonal variations in cycling, with peaks and troughs in the series corresponding with summer and the Christmas and New Year holidays respectively.

Figure 3.11 Trends in cycle flows on the TLRN – annualised and periodic indices.



Source: TfL Surface Transport Delivery & Planning.

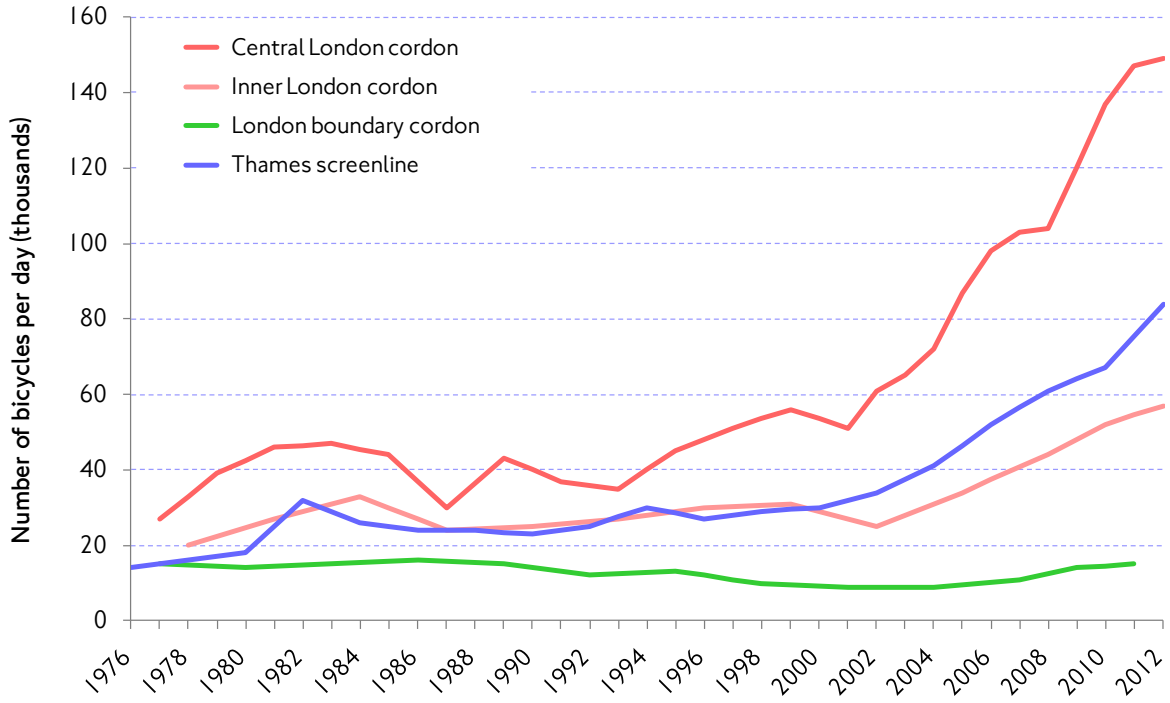
Cycle flows across strategic counting cordons and screenlines in London

Figure 3.12 shows the number of cycles crossing the three strategic counting cordons in London and the Thames screenline between 1976 and 2012. These data are the total number of cycles crossing the cordon in a full weekday (24-hours). Surveys are taken at the same time of year, to ensure there is no seasonal bias.

The long-term trends are clear, with cycling levels at all cordons remaining broadly constant until the year 2000, after which they started to increase. Rates of growth are highest at the Central cordon and on the Thames screenline, with cycle flows at the Thames screenline growing by 25 per cent between 2010 and 2012. Flows across the central cordon surrounding central London (not the same as the congestion charging zone) grew by 15 per cent in 2009 and 14 per cent in 2010, although this growth has slowed down in recent years, with flows increasing by 7 per cent in 2011 and by just 1 per cent in 2012.

Growth has also occurred at the inner and boundary cordons, although the growth started later and at a much lower rate than in central London. Cycle flows at the Inner cordon increased by 10 per cent compared with 2010 – a much higher rate of increase than that suggested by other indicators of cycling in 2012. However, cycle flows across the Central cordon are over twice as high as the Inner and Boundary cordon flows combined.

Figure 3.12 Long-term trends in cycling across strategic cordons and screenlines in London, 24-hour weekdays, both directions.

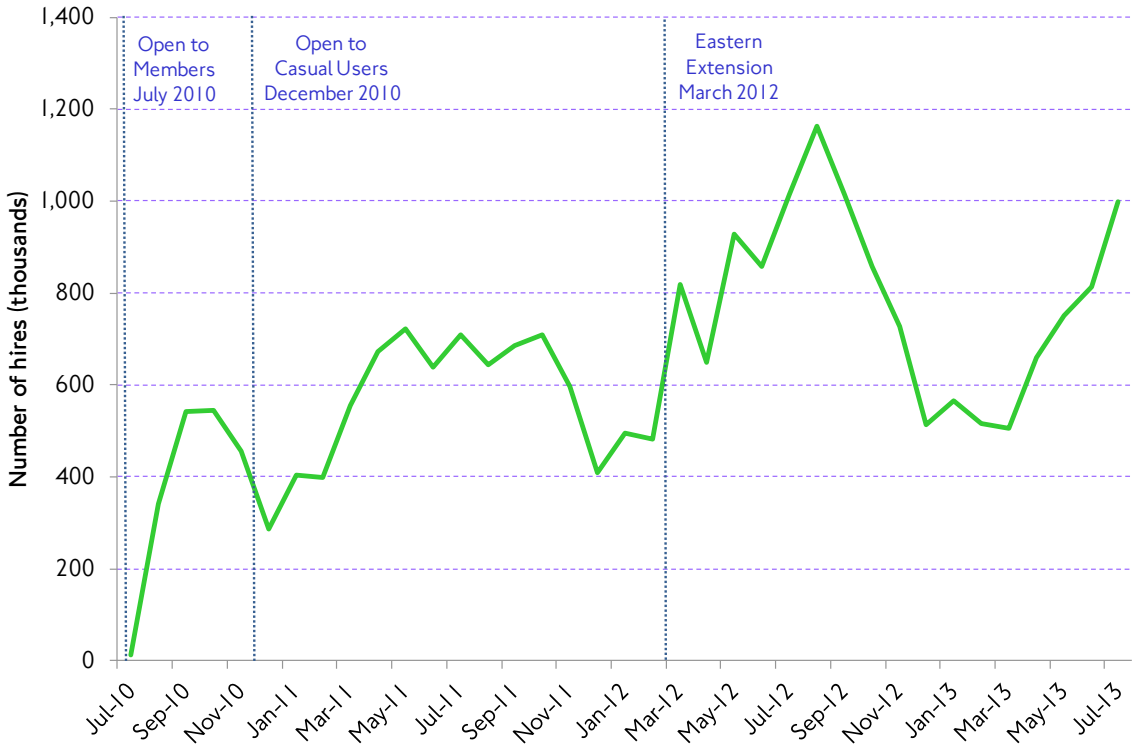


Source: TfL Surface Transport.

Barclays Cycle Hire in central and inner-east London

The Barclays Cycle Hire scheme began in July 2010. Since then, progressive enhancements, including the opening up of the scheme to casual members in December 2010 and an expansion to the east in March 2012 have facilitated steady growth in scheme usage. In the financial year to March 2013, there were a total of 9.5 million cycle hires, up from 7.1 million to March 2012. This relatively large 33 per cent increase year-on-year reflects both the extension of the scheme to east London, and the Games in summer 2012. However, the figure also shows an underlying upwards trend in usage, despite the relatively poor weather in the first half of 2012 and the spring of 2013 (figure 3.13).

Figure 3.13 Trend in monthly cycle hires by type of hire. Barclays Cycle Hire scheme.



Source: TfL Surface Transport.

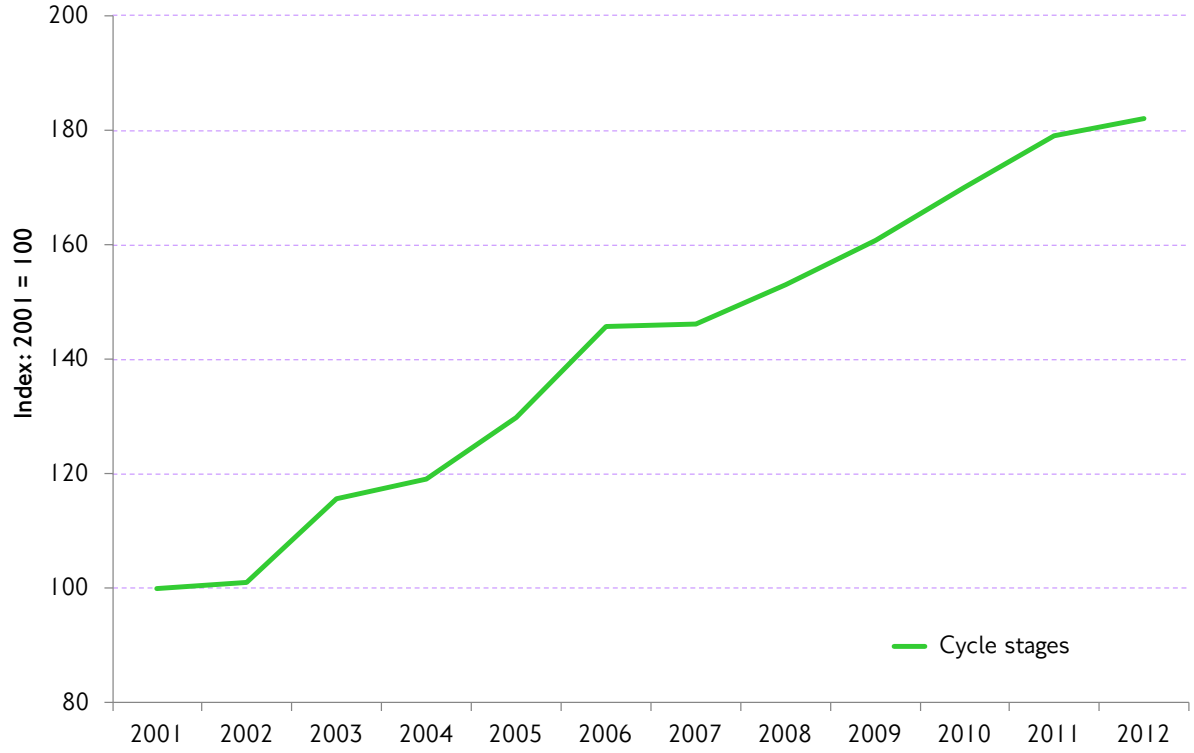
Commentary and interpretation on recent cycling trends in relation to the Mayor's cycling targets for London

The majority of indicators of cycling in London suggest a slowing in 2012 of the recent high rates of growth. The MTS aspiration for cycling is a four-fold increase in the number of cycling journeys by 2026, which would be equivalent to a 5 per cent mode share (at the journey stage level, and according to projected mode shares elsewhere in MTS). Growth in cycling over the most recent two years has been lower than in previous years (figure 3.14).

There are a number of reasons for the slowing in cycling growth. In addition to the weather, which can impact on cycle flows, delivery of new cycling infrastructure slowed in 2012/13 in the run up and during the Games period, following a moratorium on new project construction. Further, the implementation of the Better Junctions cycle safety review has impacted on the pace of delivery of major new cycle programmes, including both the Barclays Cycle Superhighway and Better Junctions programmes.

The Mayor published his Vision for Cycling in March 2013. In it he outlined plans for spending £913m on cycling over the next 10 years. This investment will deliver a step-change in cycling provision that will support the growing numbers of cyclists in London.

Figure 3.14 Growth in the number of cycle journey stages in London.

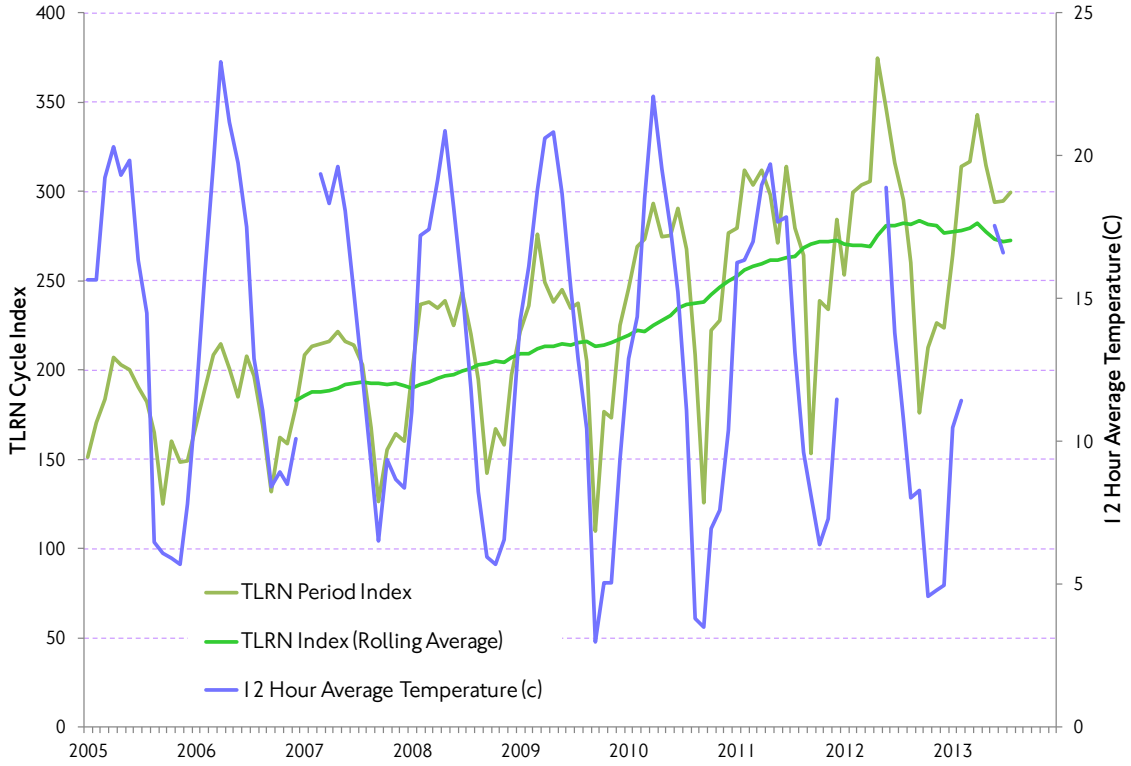


Source: TfL Surface Transport.

3.12 Focus on: Cycling and the weather

The TLRN cycle index (figure 3.11) displays strong seasonal variations in cycle levels, with peaks in summer and troughs in mid-winter. The existence of a peak in summer (when travel demand in general is less than spring and autumn) suggests weather is a key factor in driving cycle demand. Figure 3.15 compares the TLRN cycle index with 12-hour (07:00 to 19:00) average temperatures by (four-week financial) period for the past eight and a half financial years. Daytime conditions are of most interest as this is when the majority of cycle trips take place (more than 75 per cent of cyclists crossing the central cordon do so between 07:00 and 19:00).

Figure 3.15 TLRN cycle index and 12-hour average temperatures.

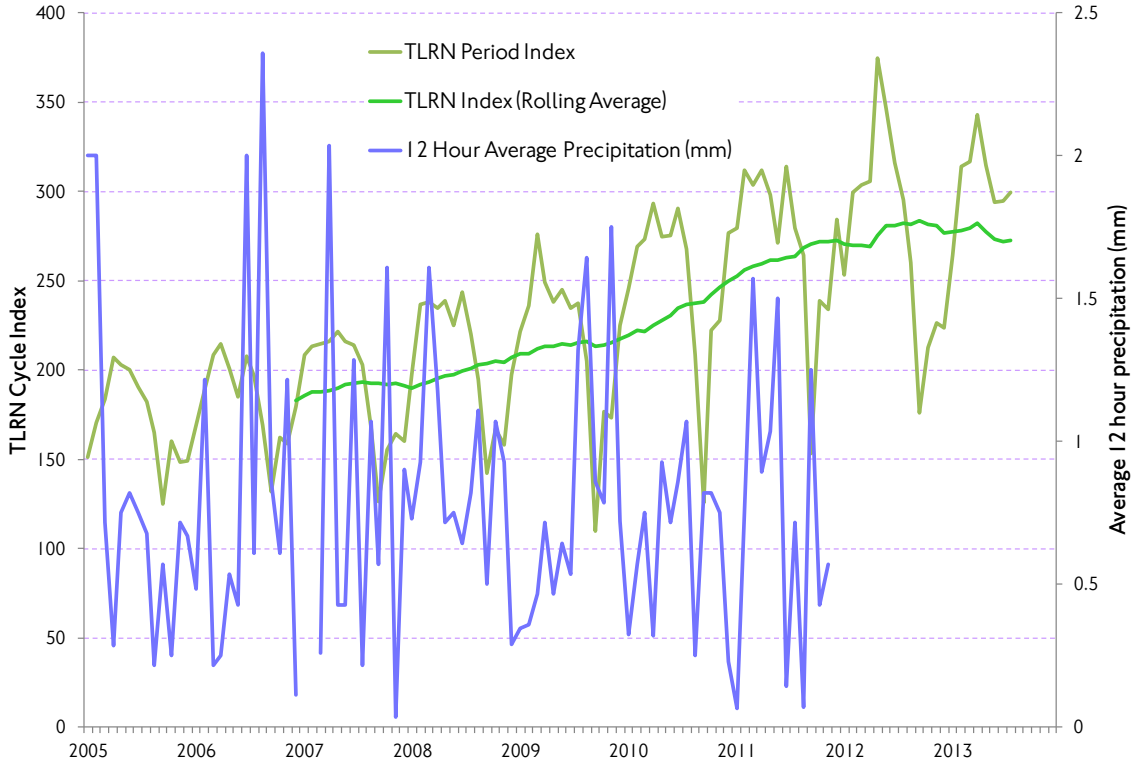


Source: TfL Surface Transport/TfL Planning Strategic Analysis.
Note: Weather data for 2005/06 – 2011/12 based on data from St. James' Park; weather data for 2012/13 – 2013/14 based on data from Regents Park.

Figure 3.15 shows that seasonal variations in cycling levels are closely related to average daytime temperatures, with highest flows in each year corresponding to the warmest months and lowest flows corresponding to the coldest months. Viewing cycle flows over the long-term, it can be seen that while temperature influences seasonal fluctuations, the overall trend in cycle flow has been upwards across the time series despite annual average temperatures remaining broadly stable. In particular, cycle flows increased considerably in summer 2011 despite average temperatures being lower than the three previous years. It should also be noted that both seasonal peaks and seasonal troughs have risen, suggesting that the number of 'year-round' cyclists is increasing,

Figure 3.16 compares the TLRN cycle index with 12-hour (07:00 to 19:00) average rainfall by period for the past eight and a half financial years.

Figure 3.16 TLRN cycle index and 12-hour average precipitation.



Source: TfL Surface Transport/TfL Planning Strategic Analysis.
Note: Weather data for 2005/06 – 2011/12 based on data from St. James' Park; weather data for 2012/13 – 2013/14 based on data from Regents Park.

The relationship between cycle flows and rainfall is less clear. While there are marked drops in cycling during particularly wet periods (for example, winter 2009/10 and winter 2011/12), these often correspond with drops in average temperature, as seen in figures 3.15 and 3.16. Of more interest is the impact of heavy rainfall in warmer periods, for example summer 2011. Here, sharp increases in rainfall correspond with minor decreases in cycling, although not enough to override the general seasonal peak.

There are many reasons why the influence of temperature may differ to that of rainfall. Rainfall tends to be more variable and less predictable than temperature on any given day. Given that most cycle trips are commuting trips and school trips, the decision to cycle is taken early in the day. Rainfall in the afternoon or evening would be unlikely to impact significantly on the decision to return home by bicycle. At a seasonal level, it is usually easy to predict temperature (for example, it will be cold in winter) whereas rainfall doesn't always conform to a particular pattern (for example, the long-term drought in 2010/11 which spanned several seasons). This is particularly important for cyclists whose alternative mode of transport is public transport, as they may choose to buy a monthly season ticket in mid-winter. Further statistical and behavioural research is required to understand these effects more fully.

3.13 Focus on: Walking in London

Introduction

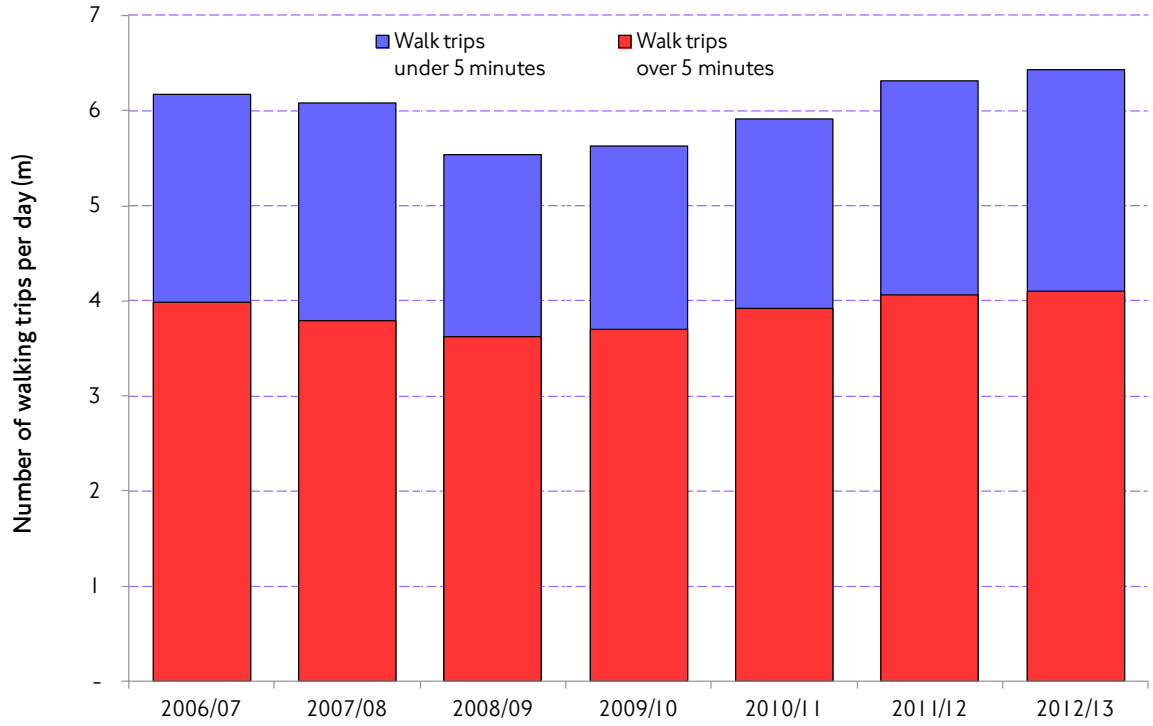
Travel in London report 5 commented on the relative lack of good data describing pedestrian activity in London, and undertook to review data sources with a view to moving towards better estimates. This requirement assumes even greater prominence given the publication in 2013 of the Mayor's Vision for Roads and Streets in London, the outcome of his 'Roads Task Force' (see also chapter 9 of this report), which seeks to improve conditions for pedestrians so as to encourage increased walking as a means of transport. This focus topic summarises new data from an in-depth analysis of walking as recorded by TfL's London Travel Demand Survey (LTDS) over the period 2006/07 to 2012/13.

Walking in London

Walking as a means of travel includes both 'walk all the way trips', which are trips made entirely on foot, and 'walk (journey) stages', where walking is part of a trip made primarily using another mode of transport, for example, walking to a bus stop to catch a bus or Underground station to catch a train. Statistics of general travel and mode shares, for example those given in chapter 2 of this report, conventionally only include the number of 'walk all the way' trips. They do not therefore reflect the full amount of walking in London. A further problem in achieving a complete picture of walking in London is walking by non-residents of Greater London. This component assumes considerable importance in places such as central London, where the visitor and longer-distance daily commuter presence is particularly high, although it is not currently possible to characterise this element in any detail other than to derive rough estimates of gross proportions.

Walk all the way trips in London

Figure 3.17 Number of recorded daily walk all the way trips made by London residents in the GLA area.



Source: Planning Strategic Analysis. LTDS 2006/07-2012/13. Includes London residents only.

According to the LTDS, the number of 'walk all the way' trips by residents in London has been relatively stable over the past seven years, at around 6 million walk trips per day (figure 3.17). There was a drop in the number of walk trips in 2008/09, thought to be a reflection of the economic recession at this time. They stood at 6.43 million per average day in 2012/13 – the highest number so far recorded. Of these, approximately two-thirds are more than five minutes long. There was a 4.3 per cent increase in the total number of walk all the way trips (of all durations) from 2006/07 to 2012/13, with the net increase thought to primarily reflect increased resident population, which is why the mode share of walking, reported in section 2.4 of this report, has remained relatively static over this period.

Walking as part of travel on other modes ('walking stages')

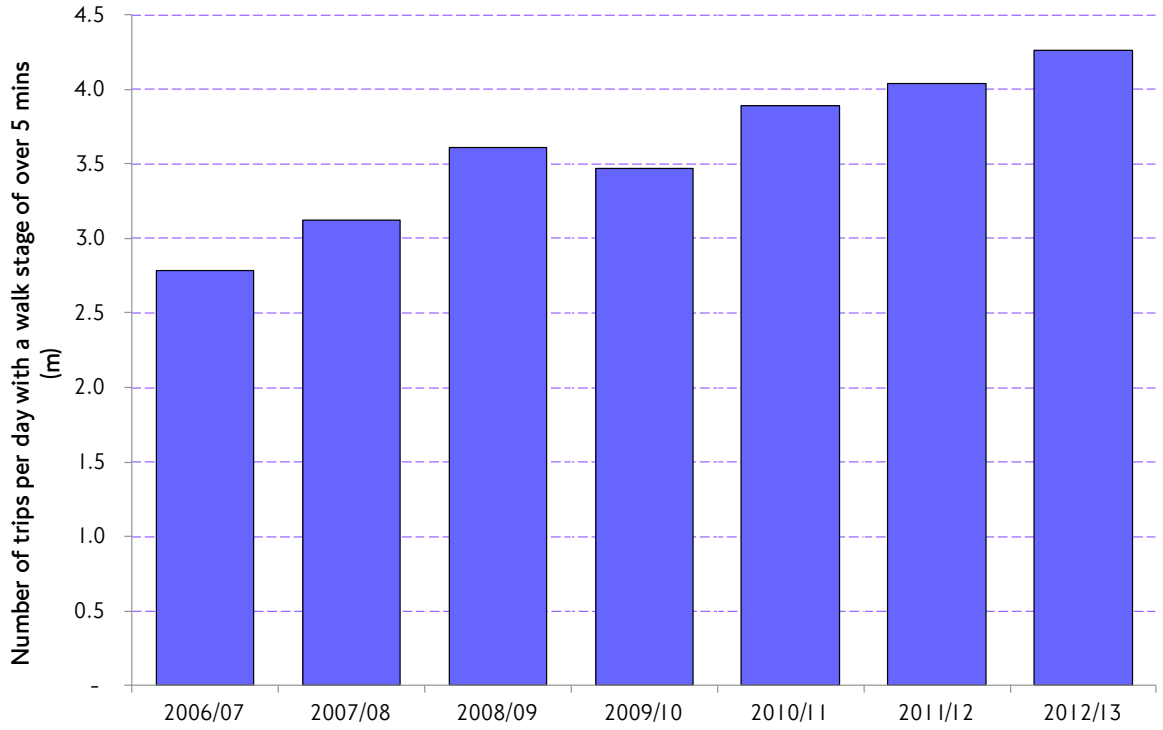
In addition to walk all the way trips, walking often makes up part of a trip made using other transport modes - known as a 'walking (journey) stage'. Many people make very short walk stages as part of longer trips, for example a one-minute walk between bus stops; two minutes to get from a rail station to the bus stop outside. These walks may be considered incidental, as they are deemed to have taken place within the same station or other facility. To set a common and meaningful benchmark for defining 'substantial' walk stages in this analysis, only those of greater than five minutes in duration are considered in the estimates below. Walk stages of this duration are much more reliably captured in travel surveys, and the definition 'greater than five minutes' takes account of the tendency of survey

respondents to 'round up' very short walk stages to five minutes. The LTDS asks respondents to record all walk all the way trips, regardless of their duration.

Prevalence and nature of walk stages

In contrast to walk all the way trips, the number of trips by other modes that involve at least one walk stage of more than five minutes duration has more consistently increased since 2006/07, rising to 4.27 million trips that included a substantial walk stage per day in 2012/13 (figure 3.18). Overall, 30 per cent of all non-walk trips (ie trips made by a main mode other than walking) and over two-thirds of trips by public transport (excluding taxi) include a walk stage of more than five minutes.

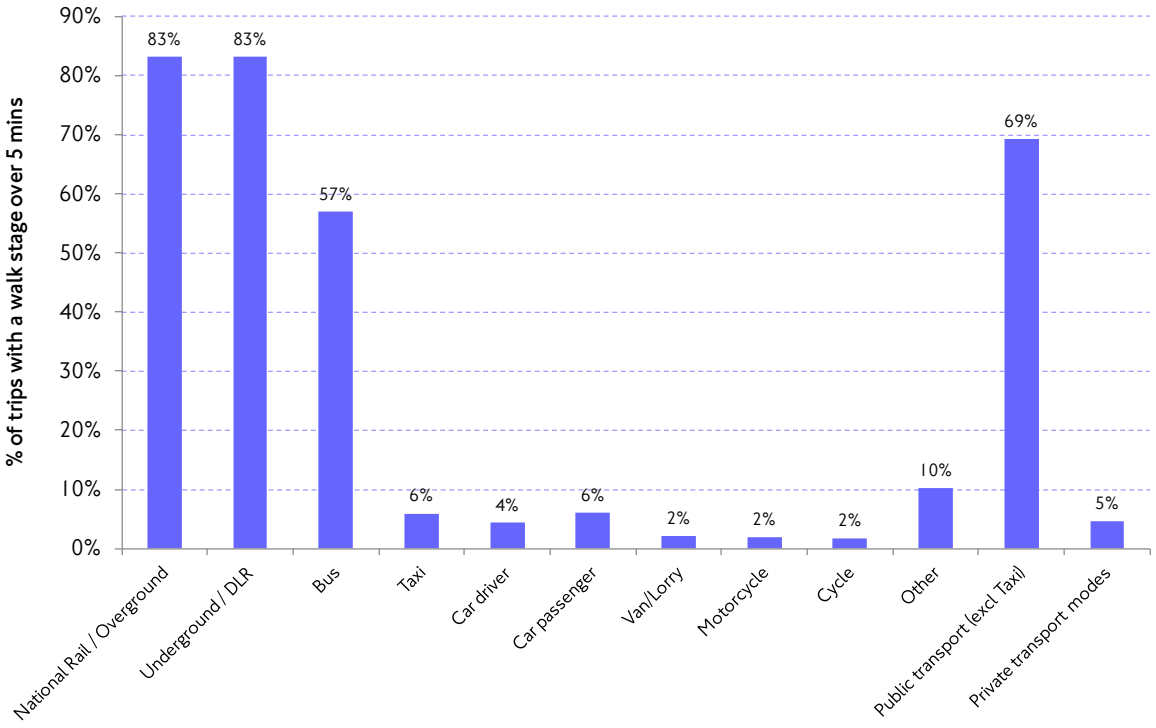
Figure 3.18 Number of trips involving at least one walking stage of more than five minutes (excluding 'walk all the way' trips).



Source: Planning Strategic Analysis. LTDS 2006/07-2012/13. Includes London residents only.

Walk stages of more than five minutes are more likely to be made as part of a main-mode public transport trip, rather than as part of a trip by private motor vehicle. Most trips made using rail, Underground or DLR services included a walk stage of more than 5 minutes (83 per cent), which may typically be a walk between home and the nearest station. More than half (57 per cent) of bus trips involved a substantial walk stage. For the remaining modes, this figure was markedly lower (less than six per cent), with only five per cent of car journeys, for example, preceded or followed by a walk stage of more than 5 minutes (figure 3.19). This is as would be expected, given that cars and bicycles are usually parked in close proximity to the ultimate trip origin or destination.

Figure 3.19 Percentage of trips by main mode involving at least one walk stage of more than five minutes (excluding 'walk all the way' trips).

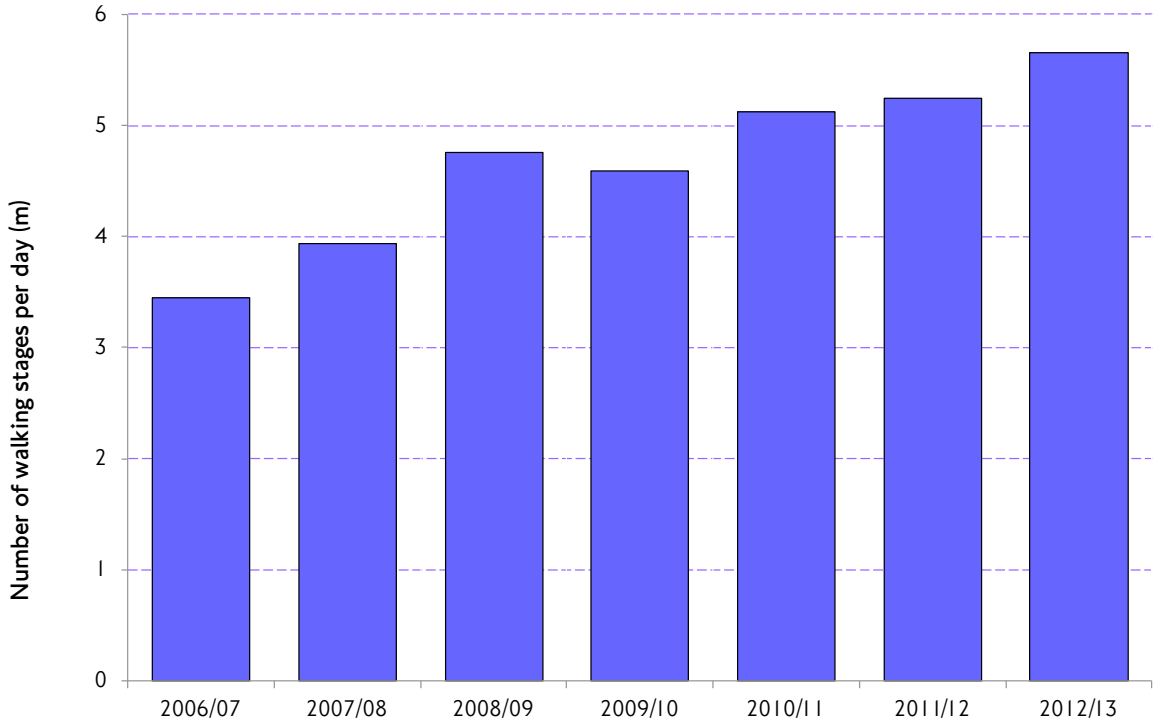


Source: Planning Strategic Analysis. LTDS 2006/07-2012/13. Includes London residents only.

Total number of walk stages

In some cases, more than one walk stage was made as part of a trip by another main mode. In total, just under 5.7 million walking stages were made as part of trips by another main mode in 2012/13. This represents a 64 per cent increase since 2006/07, compared to the 4.3 per cent increase in walk all the way trips over the same period. Average daily numbers of walking stages since 2006/07 are shown in figure 3.20.

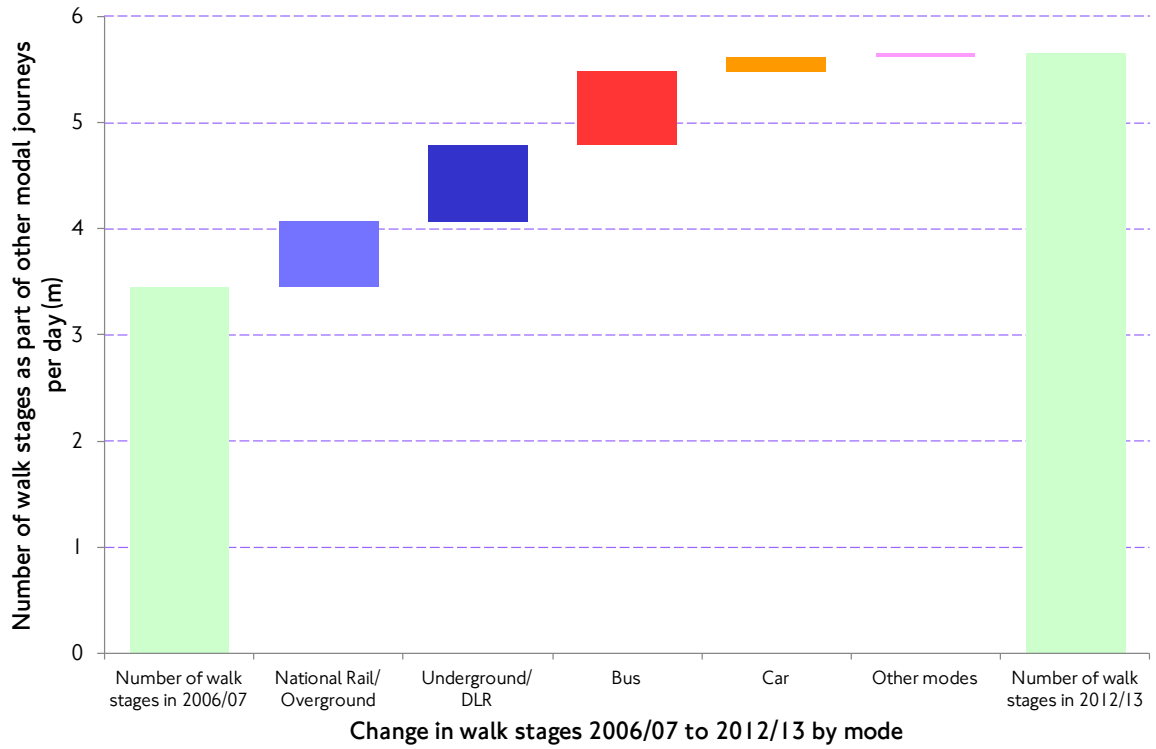
Figure 3.20 Number of walking stages of more than five minutes as part of a trip where another mode was used (excluding 'walk all the way' trips).



Source: Planning Strategic Analysis. LTDS 2006/07-2012/13. Includes London residents only.

The notable increase in walking stages (up 2.2 million over the last seven years) is almost entirely due to an increase in walking stages as part of public transport trips. The increases are relatively evenly distributed between the public transport modes, with 0.6 million of the 2.2 million increase due to walking as part of national rail/Overground trips, and 0.7 million each attributable to walking as part of Underground or bus trips. In contrast, just 0.14 million of the increase is due to the number of car trips (either as a driver or a passenger) that include a walk stage of more than five minutes. The change attributed to each mode is shown in figure 3.21.

Figure 3.21 Change in the number of walk stages of more than five minutes attributable to each mode (excluding walk stages as part of 'walk of the way' trips).



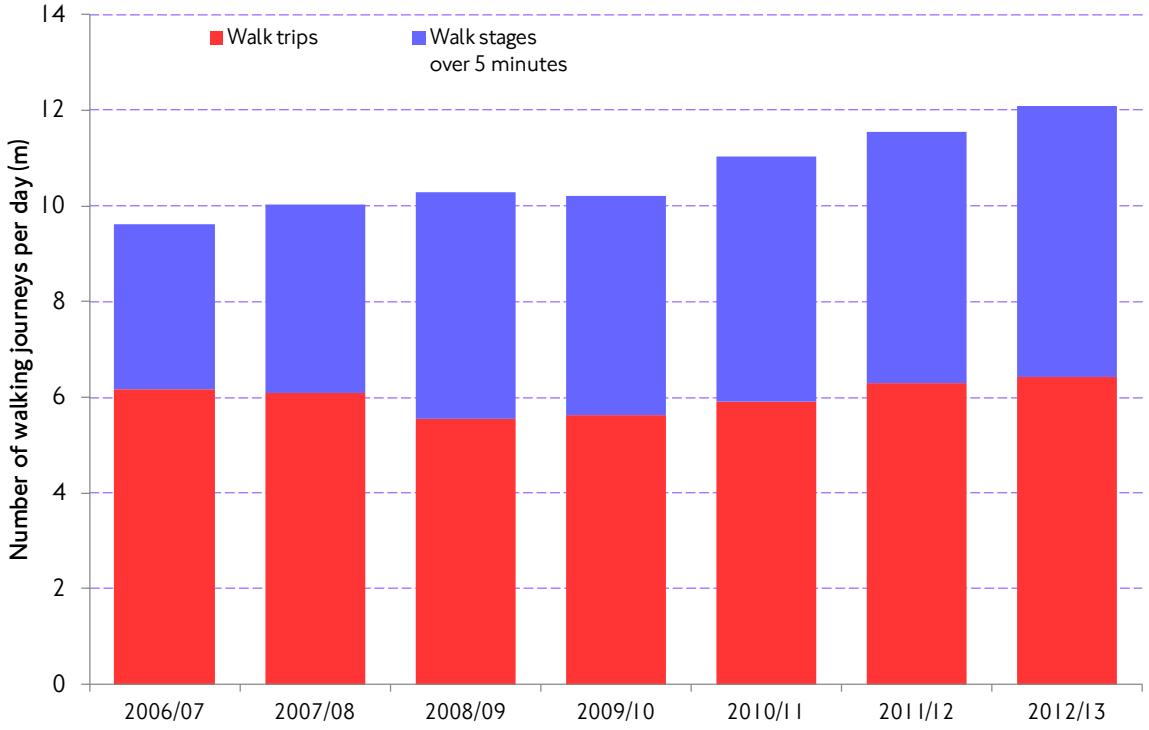
Source: Planning Strategic Analysis. LTDS 2006/07-2012/13. Includes London residents only.

A key point to note is that while travel by public transport has increased, the number of walking stages associated with public transport modes has increased at a greater rate. The increase in the number of public transport trips alone cannot therefore account for the more marked increase in the number of walking stages. As well as the increase in the number of public transport trips, there has been an increase in the proportion of public transport trips that involve a walk stage of more than five minutes. Figure 3.19 shows that 83 per cent of National Rail/Overground/Underground/DLR trips involve a walk stage of over 5 minutes (up from approximately 70 per cent in 2006/07). These two factors – the increase in public transport trips, and the increase in the proportion of public transport trips that involve a substantial walk stage, have contributed to the increase in the number of walk stages made as part of public transport trips.

Total number of walk journeys by residents in London

Combining the number of walk all the way trips and the number of walk stages of more than five minutes made as part of other modal trips provides an estimate of the total number of walk 'journeys' made in London by London residents. As figure 3.22 shows, the total number of recorded walk journeys in 2012/13 stood at 12.1 million – a substantial increase on 2006/07. While the number of walk trips has remained relatively stable at around six million per day, the growing height of the blue part of the bars shows that the increase in walk journeys is almost entirely due to an increase in walk stages made as part of trips by other modes.

Figure 3.22 Number of total walking journeys (walk trips and walk stages).



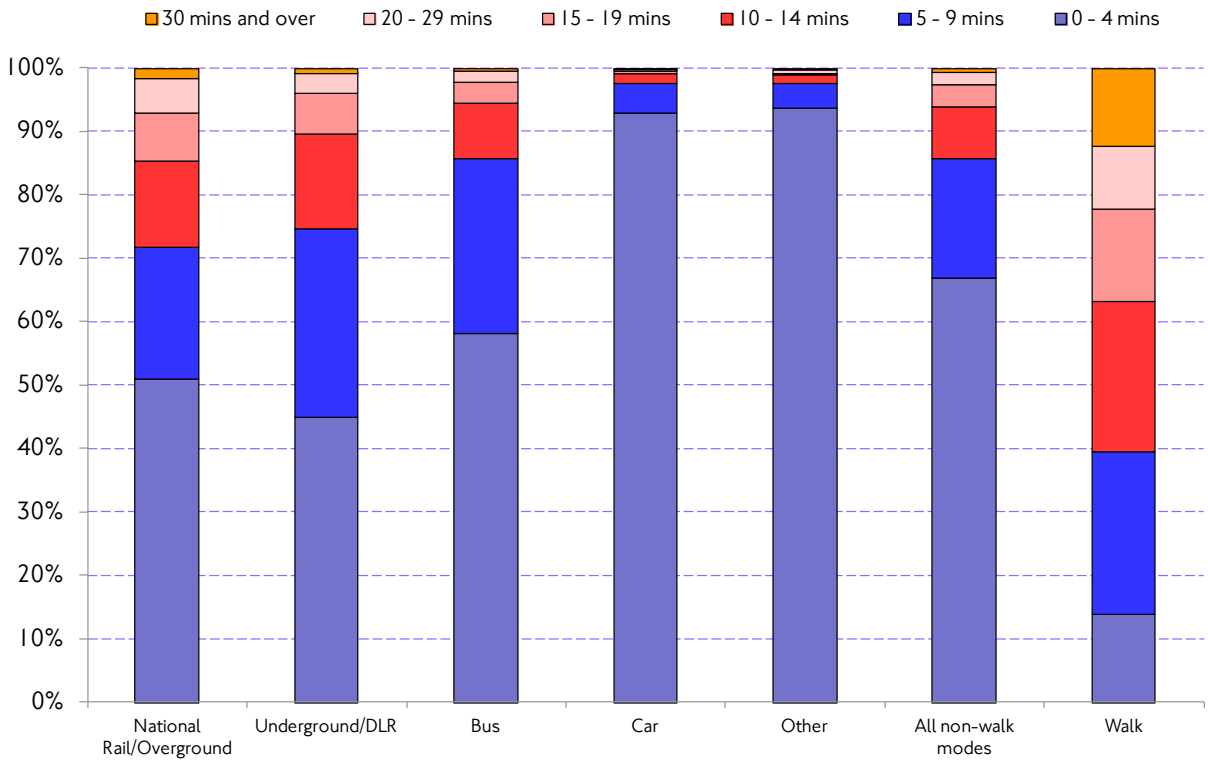
Source: Planning Strategic Analysis. LTDS 2006/07-2012/13. Includes London residents only.

Duration of walk stages

The analysis in this section has looked at 'substantial' walk stages of more than five minutes in duration. Figure 3.23 shows the full distribution of walk stages by duration. It shows that the majority of walk stages are very short. Despite this, the data suggest that the majority of public transport trips involve a walk stage of more than five minutes (figure 3.19). Overall, two-thirds of walk stages made as part of non-walk modes are less than five minutes in duration, and a further 19 per cent less than 10 minutes. However this overall figure hides a number of differences across the different modes. For example, walk stages associated with public transport trips tend to be longer than walk stages as part of a car trip. Around half of all walk stages made as part of public transport trips are less than five minutes long, compared with 93 per cent of walk stages as part of car trips. Within the public transport category, there are further differences: walk stages as part of bus trips tend to be shorter than those associated with rail and underground trips. Fifty-

eight per cent of walk stages as part of bus trips are less than five minutes in duration, compared to 51 per cent of walk stages as part of National Rail/Overground trips, and 45 per cent of walk stages as part of Underground/DLR trips. This is a logical reflection of the more widespread distribution of bus stops compared to railway stations. The full distribution of walk stage durations as part of trips using other modes is shown in figure 3.23.

Figure 3.23 Duration of walk stages as part of trips by other main modes.



Source: Planning Strategic Analysis. LTDS 2010/11-2012/13. Includes London residents only.

The difference in the distributions of walk stage durations is reflected in the average durations of walk stages by mode. Walk stages made as part of National Rail/Overground trips have the highest average duration - 8.1 minutes in 2012/13. For Underground and DLR trips, the average was 7.4 minutes, and for bus trips it was smaller still, at 5.7 minutes. This is still higher than the average duration of a walk stage made as part of a car driver trip, at 3.2 minutes. These figures are all much lower than the equivalent figure for walk all the way trips, where the average stage duration is 18.2 minutes. The duration of walk stages has remained relatively stable over the past five years; however, there were notable increases in average duration of walk stages as part of the three public transport modes between 2007/08 and 2008/09.

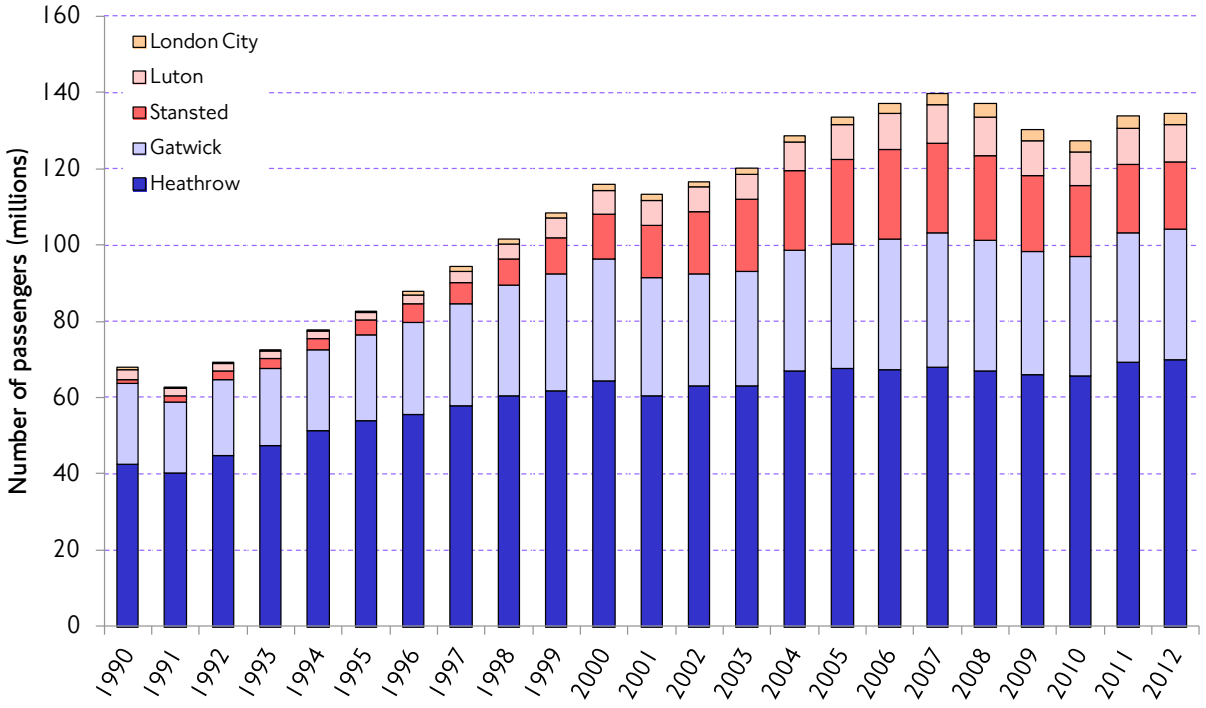
3.14 Other modes

Travel by air

London has five international airports, of which two are among the 10 busiest airports in Europe. Heathrow saw the highest number of passengers in 2012, with 70.0 million passengers, up slightly from 69.4 million in 2011. Heathrow accounted for 52 per cent of London's air passengers, with Gatwick accounting for 25 per cent.

Overall there was a small increase (less than one per cent) in the total number of passengers using London's airports between 2011 and 2012. Looking at the recent trend, the impact of the recession, and recent slow recovery, are clearly evident.

Figure 3.24 Terminal passengers by London area airport.



Source: Civil Aviation Authority.
Note: Terminal passengers are those passengers either joining or leaving an aircraft, including interlining and transfer passengers.

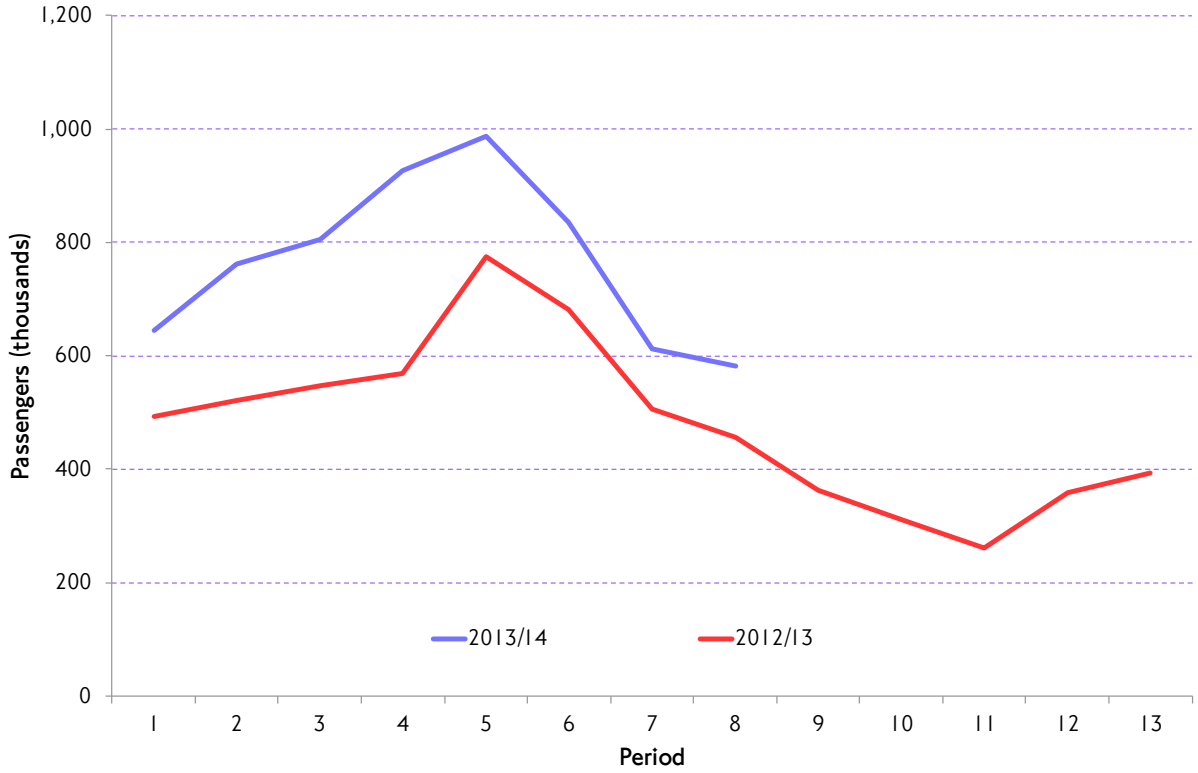
River Services

Patronage on TfL's River Services has seen strong growth in recent years, with a total of 6,270,500 passengers carried in 2012/13.

At the start of 2013/14, a new method of counting passengers was introduced that is intended to give more accurate information based on a full count of boarders and persons alighting at each pier, rather than previous data based partly on boarders and partly on ticket sales. This means that patronage numbers for 2013/14 are not directly comparable with those from previous years.

Figure 3.25 shows data for the whole of 2012/13, based on the previous system of counting, and data from the start of 2013/14 based on the new system. It is not possible to give a precise comparison at present in terms of change over the past year. However, it is estimated (from trials using both methods of counting in parallel) that, like-for-like, there was an approximate 15 per cent increase in passengers in 2013/14 over the previous year, in part reflecting the favourable weather experienced in summer 2013 and the increased number of visitors to London.

Figure 3.25 Passengers using TfL's River Services. Estimates for 2012/13 against first half of 2013/14 (based on new counting method).



Source: TfL River Services.

Licensed London taxis and private hire vehicles

In 2013 there were 25,460 drivers in London licensed to ply for hire – an increase of 0.5 per cent on 2012. There were 22,168 licensed taxis – a decrease of four per cent on 2012, which was the highest recorded level.

The year 2013 also saw a 7.6 per cent decrease in the number of licensed private hire vehicles, alongside a 4.5 per cent increase in licensed private hire drivers.

The year therefore brings an end to a long-term upward trend among licensed vehicles of both types; however the number of licensed drivers continues to rise reflecting the pattern of growth over the past decade. The decrease in the number of both licensed taxis and private hire vehicles in the latest year could be a result of vehicle age limits coming into effect, as the oldest vehicles are taken out of the fleet and not replaced, as well as an increase in the proportion of drivers renting vehicles rather than purchasing.

3.15 Non-travellers in London – what is the socio-demographic basis for non travel?

What is non-travel and why is it important ?

In terms of TfL's LTDS survey a non-traveller is a person who makes no trips on the survey day. This does not mean that they never make any trips, for example they may have been on a days' leave from work or temporarily unwell on the survey day; however, there is a small proportion of the population to whom this may apply, such as the long-term sick. Over the entire population, the LTDS sample should

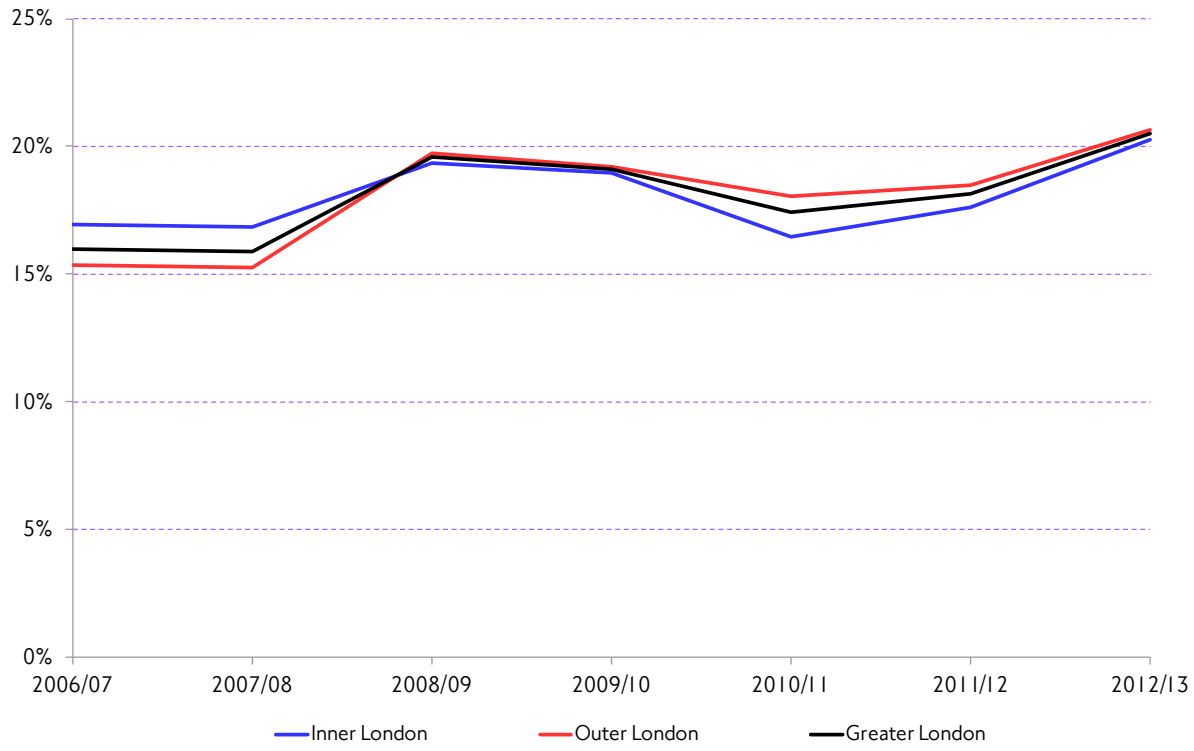
mean that recorded levels of non-travel are typical of Londoners as a whole on an average day.

Non-travel is an increasingly important topic as rising population places further demands on already congested transport networks and where new technologies offer increased opportunities for working or shopping from home. It is therefore of interest to understand more clearly who these non-travellers are. Are particular socio-demographic groups disproportionately reflected, and how does non-travel relate to other aspects of people's lives such as employment status? Is encouraging non-travel 'desirable' as a tool for managing demand on the transport networks? This section explores some insights that are available from LTDS that help shed light on these questions.

Absolute levels of non-travel among London residents

Figure 3.26 shows the absolute level of non-travel indicated by successive LTDS surveys between 2006/07 and the most recent survey in 2012/13.

Figure 3.26 Proportion of people making no trips on survey day (seven-day week).



Source: TfL Planning Strategic Analysis, based on LTDS survey.

The first thing to say is that the levels are perhaps surprisingly high – around one fifth of London's population, approximately 1.5 million people, do not make a recordable trip on the survey day (which may have been a weekend day). This is particularly the case when it is realised that even short trips on foot – a visit to the local shop, for example, are eligible for inclusion in LTDS. The second observation is that this absolute level is broadly consistent between the successive surveys. There is evidence from the figure that the level of non-travel increased during the 'recessionary' years, but the values for 2012/13 would suggest the overall trend has

been upwards over the period covered. Third, there is very little difference in rates of non-travel between residents of inner and outer London, although rates of non-travel in inner London have been more stable than those of residents of outer London.

Who are the non-travellers?

Table 3.5 shows the percentage of people making no trips by age and gender. It looks at the first LTDS survey (2006/07) and the most recent (2012/13) only, to give an idea of change over the review period. This shows relatively high rates of travel among young adults (17-24 years, of both genders), with a particularly notable increase in the non-travel rate for young men between 2006/07 and 2012/13. Unsurprisingly, non-travel rates are lowest for those of working age. Older people, those aged over 60, show the highest rates of non-travel, with around one-quarter of men and one-third of women aged over 65 making no trips at all on the survey day. As an average across all age groups females are more likely to be non-travellers than males, although in certain cases (for example, children) the reverse is true.

Table 3.5 Proportion of people making no trips, by age and gender, 2006/07 and 2012/13.

	Male		Female	
	2006/07	2012/13	2006/07	2012/13
05-16	15.4%	19.4%	14.6%	18.7%
17-24	17.8%	23.1%	19.1%	20.2%
25-44	11.3%	16.9%	13.5%	18.6%
45-59	14.1%	15.4%	14.4%	19.0%
60-64	10.0%	21.5%	20.3%	28.0%
65+	23.3%	26.5%	31.8%	36.7%
All	14.5%	19.1%	17.4%	21.8%

Source: TfL Planning Strategic Analysis, based on LTDS survey.

Table 3.6 shows the relationship between ethnicity, gender and non-travel. It is seen that black, Asian and minority ethnic groups are more likely to be non-travellers than those in the white ethnic group, with people from black backgrounds most likely to be non-travellers. The most pronounced gender split is for those of Asian backgrounds, with women from this group being around one-third more likely than men to be non-travellers.

Table 3.6 Proportion of people making no trips, by ethnicity and gender, 2006/07 and 2012/13.

	Male		Female	
	2006/07	2012/13	2006/07	2012/13
White	18.3%	23.5%	19.5%	23.7%
Mixed, Other and Chinese	23.6%	31.6%	23.0%	31.5%
Asian	21.8%	25.4%	30.2%	33.5%
Black	27.7%	30.2%	28.7%	32.0%

Source: TfL Planning Strategic Analysis, based on LTDS survey.

It might be expected that working status is a major factor affecting the amount of travel that people make, and table 3.7 shows this to be the case. Retired people and those not working (not necessarily 'unemployed' in the economic sense) have

the highest rates of non-travel. Rates of non-travel for full and part-time workers are broadly comparable. If these values were generalised to the whole population, people in full or part time work would not travel, typically, once every eight days. The prevailing trend for levels of non-travel to have increased between 2006/07 and 2012/13 is evident from this table – values for all groups having increased over the review period.

Table 3.7 Proportion of people making no trips, by working status, 2006/07 and 2012/13.

	2006/07	2012/13
Full time worker	10.7%	14.0%
Part time worker	10.8%	15.5%
Student	16.1%	23.2%
Not working	22.8%	30.6%
Retired	27.0%	32.4%

Source: TfL Planning Strategic Analysis, based on LTDS survey.

Table 3.8 shows a relationship, albeit a relatively weak one, between household car ownership and non-travel. People in households with two or more cars are least likely to be non-travellers, as might be expected, since increased car ownership is related to higher levels of mobility in general. Non-car owners show the highest levels of non-travel, but in London this is more likely to reflect personal circumstances that do not warrant the possession of a car, as opposed to limitations on potential travel.

Table 3.8 Proportion of people making no trips, by car ownership, 2006/07 and 2012/13.

	2006/07	2012/13
No cars	19.2%	23.8%
One car	15.3%	18.8%
Two or more cars	12.6%	18.6%

Source: TfL Planning Strategic Analysis, based on LTDS survey.

Summary

Not travelling reflects a wide range of personal socio-economic circumstances. In a city such as London, with widespread availability of all forms of transport, non-travel is unlikely to reflect a lack of transport opportunities, although evidence elsewhere in this report demonstrates the benefits of further extending connectivity and transport provision in London. Non-travel is therefore most likely to be a reflection of either physical ability or a reflection of reduced 'need to travel', broadly related to economic utility and seen as a negative thing. For example, unemployed people clearly have less reason to travel than employed people, yet they also derive less benefit from the social and economic opportunities that London has to offer. Retired people, on the other hand, may simply choose to travel less, or may be constrained from doing so by a wide range of physical and social factors. There is no clear evidence, from this analysis and similar analyses elsewhere in this report (see especially chapter 7) at least, of higher levels of non-travel corresponding to improved technologies enabling home working or shopping,

although further exploiting this possibility could profitably be pursued through a 'follow-on' survey of LTDS respondents in the coming year.

3.16 Comparison of recent travel trends in London with equivalent trends at the national scale

It is instructive to compare key trends in personal travel in Greater London with those at the national scale. London is of course different in many respects from other parts of the country. In particular, London is characterised by a high density of population and employment, and has an extensive public transport network – characteristics that are reflected in few other places nationally. This section looks at several key indicators of personal travel, comparing recent trends in London with those at the national scale, and drawing out trends and developments that are specific to London.

The DfT's National Travel Survey

The DfT's National Travel Survey (NTS) is an established household survey that is designed to monitor long-term trends in personal travel and to inform the development of policy. Data collection consists of a face-to-face interview and a one-week self-completion written travel diary. Approximately 20,000 individuals, in 8,000 households, participate in the NTS each year. The NTS includes a sample of London households, as a component of the national picture (London accounts for 12.5 per cent of the national 'in-scope' population for NTS). Full details of the survey can be found at: https://www.gov.uk/government/organisations/department-for-transport/series/national-travel-survey-statistics.

Summarising the results from the 2012 NTS, the DfT identifies several key travel behaviour trends at the national scale [2]. These are used as the basis for this brief comparison of equivalent trends in London, alongside other trends from NTS that make particularly informative comparisons with London. Note that the units of measurement and other aspects of survey methodology differ between the two surveys. This should be borne in mind when interpreting material below.

Person trip rates and trip length

The NTS shows a long-term trend of slowly falling person trip rates dating from 1995/96, accompanied by similar small falls in the average distance travelled per person. In 2006, the average number of trips per person per year, on a national basis, was 1,037, falling to 954 in 2012 (a decrease of 8 per cent). Average (annual) distance travelled per person fell from 7,133 miles to 6,691 miles over the same period.

In London, person trip rates have been fluctuated over the same period, dipping during the recession years but since recovering, although still below pre-recession levels – 2.65 trips per person per day in 2006/07 compared to 2.51 in 2012/13. Average daily travel distance by Londoners has been relatively stable, at around 15 kilometres per person per day.

Average distance travelled and time spent travelling

At the national scale, NTS finds a trend of recent slow increases to the average trip length, up from 6.9 miles in 2006 to 7 miles in 2012. Total time per person spent travelling has been broadly stable, but average time per trip has increased by 2 per cent, up from an average of 22.2 minutes in 2006 to 22.7 minutes in 2012.

In London the average time per trip has reduced slightly in recent years, down from 27.7 minutes in 2006/07 to 27.1 minutes in 2012/13.

Trends in driving licence holding and vehicle availability

Recent NTS surveys find a continuation of the long-term trend towards higher rates of driving licence holding nationally, however there are distinct gender differences. Between 2006 and 2012, the proportion of women holding full driving licences nationally increased from 63 per cent to 66 per cent, while for men the proportion holding full driving licences fell from 81 per cent to 80 per cent. In London, 72 per cent of men in both 2006/07 and 2012/13 held a full driving licence, while the proportion of women in London holding a full driving licence decreased marginally from 56 per cent in 2012/13 to 54 per cent in 2006/07.

At the national scale, the proportion of households in Great Britain who do not have access to a car has remained stable at around 25 per cent since 2006, while the proportion of households who have access to two or more cars remained at 32 per cent.

Non-car-owning households are much more prevalent in London. In London, a slow shift has seen the proportion of households without access to a car increase from 41.8 per cent in 2006/07 to 43.2 per cent in 2012/12, while the proportion of households with access to two or more cars has shown a modest reduction, falling from 15.4 per cent in 2006/07 to 15.1 per cent in 2012/13.

Mode share – inner and outer London

Table 3.9 compares mode share, based on total trips, at the national level with the equivalent for London, showing inner (including central) and outer London separately.

Table 3.9 Mode share for Great Britain and London, based on number of trips.

Source	NTS 2012	LTDS 12/13		
	Great Britain	Inner London	Outer London	Greater London
Walk	22.3	38.3	26.3	31.2
Bicycle	1.7	3.9	1.6	2.5
Car / van driver	42.1	13.7	31.5	24.2
Car / van passenger	22.3	7.0	15.2	11.9
Bus	6.4	17.7	12.0	14.3
Rail (including DLR and Underground)	2.8	17.0	11.7	13.8
Other	2.4	2.3	1.8	2.0

Source: TfL Planning Strategic Analysis, LTDS survey and DfT National Travel Survey.

The NTS found that, nationally, 64 per cent of all trips were made by car (as a driver or a passenger), which compares to 47 per cent for outer London and just 21 per cent for inner London. Walking is far more prevalent in inner London, accounting for 38.3 per cent of trips,

compared to outer London and Great Britain, which show mode shares of 26.3 per cent and 22.3 per cent respectively.

Table 3.10 compares mode share, based on total distance travelled, at the national level with the equivalent for London, showing inner (including central) and outer London separately.

Table 3.10 Mode share for Great Britain and London, based on distance travelled.

Source	NTS 2012	LTDS 2012/13		
	Great Britain	Inner London	Outer London	Greater London
Walk	2.7	4.4	2.4	3.1
Bicycle	0.8	2.5	0.8	1.4
Car / van driver	50.3	20.1	37.2	31.1
Car / van passenger	27.6	14.0	20.3	18.1
Bus	5.5	12.7	8.2	9.8
Rail (including DLR and Underground)	9.4	43.1	28.8	33.9
Other	3.7	3.2	2.3	2.6

Source: TfL Planning Strategic Analysis, LTDS survey and DfT National Travel Survey.

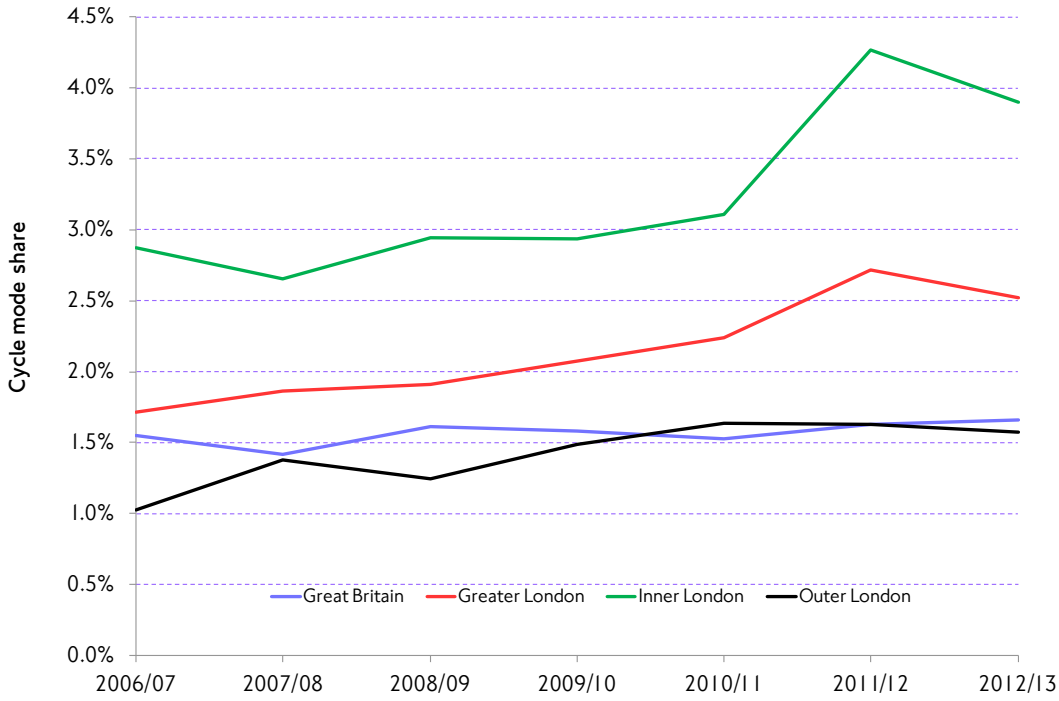
Table 3.10 shows that car travel again forms the largest mode share at the national level when presented in terms of distance travelled. In 2012, 78 per cent of total distance travelled in Great Britain was by car, compared to 58 per cent in outer London and 34 per cent in inner London. Rail (including DLR and Underground) dominates distance travelled in inner London, with a 43.1 per cent mode share, compared to just 9.4 per cent for Great Britain.

Cycling

While the mode share for cycling has remained relatively flat at the national scale, there has been strong growth in London, where the mode share has increased in recent years.

Figure 3.27 shows that cycling has grown strongly in London, particularly inner London, as described in section 3.11 of this report. In contrast, at the national level, cycling has not grown since 2008/09. Figure 3.26 shows that the mode share for cycling at the national level has remained relatively stable at around 1.5 per cent since 2006, which is around the same mode share as outer London, albeit outer London has increased from a lower mode share of around 1 per cent in 2006/07. Inner London not only has a far higher mode share for cycling but it has also seen a greater proportion of growth, with an increase in cycling mode share from 2.9 per cent in 2006/07 to 4.3 per cent in 2011/12, before dropping slightly to 3.9 per cent in 2012/13.

Figure 3.27 Cycling mode share for Great Britain and London for the years (2006/07 to 2012/13).



Source: TfL Planning Strategic Analysis, LTDS survey and DfT National Travel Survey.

3.17 Reference statistics: Travel demand in London

Table 3.11 brings together indicators of transport patronage across the principal modes of transport, covering the most recent three years. The percentage change over the most recent year is also shown.

Table 3.11 Summary of key indicators of travel demand for principal travel modes in London.

Mode and indicator	Units	2010 or 2010/11	2011 or 2011/12	2012 or 2012/13	Difference (%) 2012 or 2012/13 vs. previous year
Public transport					
Total PT passenger kilometres	Millions per year	18,124	18,989	19,805	4.3
Total PT journey stages	Millions per year	3,556	3,732	3,819	2.3
Bus passenger kilometres	Millions per year	8,082	8,219	8,258	0.5
Bus journey stages	Millions per year	2,289	2,344	2,335	-0.4
Underground passenger km	Millions per year	8,875	9,519	10,099	6.1
Underground journey stages	Millions per year	1,107	1,171	1,229	5.0
DLR passenger kilometres	Millions per year	414	456	510	11.9
DLR journey stages	Millions per year	78	86	100	16.3
London Tramlink passenger kilometres.	Millions per year	146	150	158	5.3
London Tramlink journey stages	Millions per year	28	29	30	5.3
Overground passenger kms	Millions per year	606	645	780	21.0
Overground journey stages	Millions per year	53.5	102.6	124.6	21.5
National Rail pass. kms (L&SE)	Millions per year	25,037	26,462	27,357	3.4
National Rail journeys (L&SE)	Millions per year	918	994	1,033	3.9

Road traffic					
Motor vehicle kms – GLA	Billions per year	29.7	29.1	28.9	-0.7
Motor vehicle kms – central	Billions per year	1.0	1.0	1.0	-2.2
Motor vehicle kms – inner	Billions per year	8.0	7.8	7.6	-3.2
Motor vehicle kms – outer	Billions per year	20.6	20.3	20.3	0.3
Central London cordon	'000 motor vehicles	1,133	1,161	1,144	-1.5
Inner London cordon	'000 motor vehicles	1,945	n/a	1,898	-2.4
Outer London cordon	'000 motor vehicles	n/a	2,560	n/a	n/a
Thames screenline	'000 motor vehicles	772	n/a	811	5.1
Cycling					
Cycle flows on TLRN	Cycles counted (index 2000/01=100)	250.1	272.6	276.4	1.4
Cycles – central cordon	Cycles counted thousand	137	147	149	1.4
Cycles – inner cordon	Cycles counted thousand	52	n/a	57	9.6
Cycles – outer cordon	Cycles counted thousand	n/a	15	n/a	n/a
Cycles – Thames screenline	Cycles counted thousand	67	n/a	84	25.4
Other modes					
Airport terminal passengers	Millions	127.2	133.6	134.4	0.6
River Thames passengers	Passengers (thousand)	4,142	4,357	4,160	-4.5
Licensed taxis	Vehicles (thousand)	22.6	23.1	22.2	-4.0
Licensed taxi drivers	Number (thousand)	25.1	25.3	25.5	0.5
Licensed private hire	Vehicles (thousand)	50.7	54.0	49.9	-7.6
Licensed private hire	Drivers (thousand)	61.2	64.1	67.0	4.5

Source: TfL Group Planning, Strategic Analysis.

Notes and references

(1) See Travel in London report 5, chapter 10. http://www.tfl.gov.uk/assets/downloads/corporate/travel-in-london-report-5.pdf

(2) https://www.gov.uk/government/publications/national-travel-survey-2012

4. Performance of the transport networks

4.1 Introduction and content

This chapter reviews aspects of service supply and the operational performance provided by London's transport networks, updating the range of indicators introduced in previous Travel in London reports, and following on from the trends in travel demand on the different transport modes described in the previous chapter. It provides a summary of the performance of the TfL operated mass public transport networks, together with National Rail in London – in terms of indicators of service provision and operational reliability. It then looks at the performance of London's road network – in terms of measures such as traffic speeds, journey times and journey time reliability.

As with the travel trends discussed in the previous chapter, the London 2012 Games will have influenced many of the indicators considered in this chapter, although the focus here is on comparisons at the annual level. Detailed coverage of Games-time travel patterns and operational performance can be found in the fifth Travel in London report [1].

Best ever levels of public transport operational performance

Over recent years TfL has provided more public transport services, and operated them more reliably, than ever before. Table 4.1 summarises key measures of service provision and operational performance, comparing values at the start of the last decade (nominally 2000/01), with those for the most recent three years. Clear and sometimes dramatic improvements are evident over the decade, as are the generally high levels of service and operational excellence now being sustained – particularly during the most recent (2012 Games) year.

Table 4.1 Key indicators of public transport service provision and performance since 2000/01. Summary of typical values.

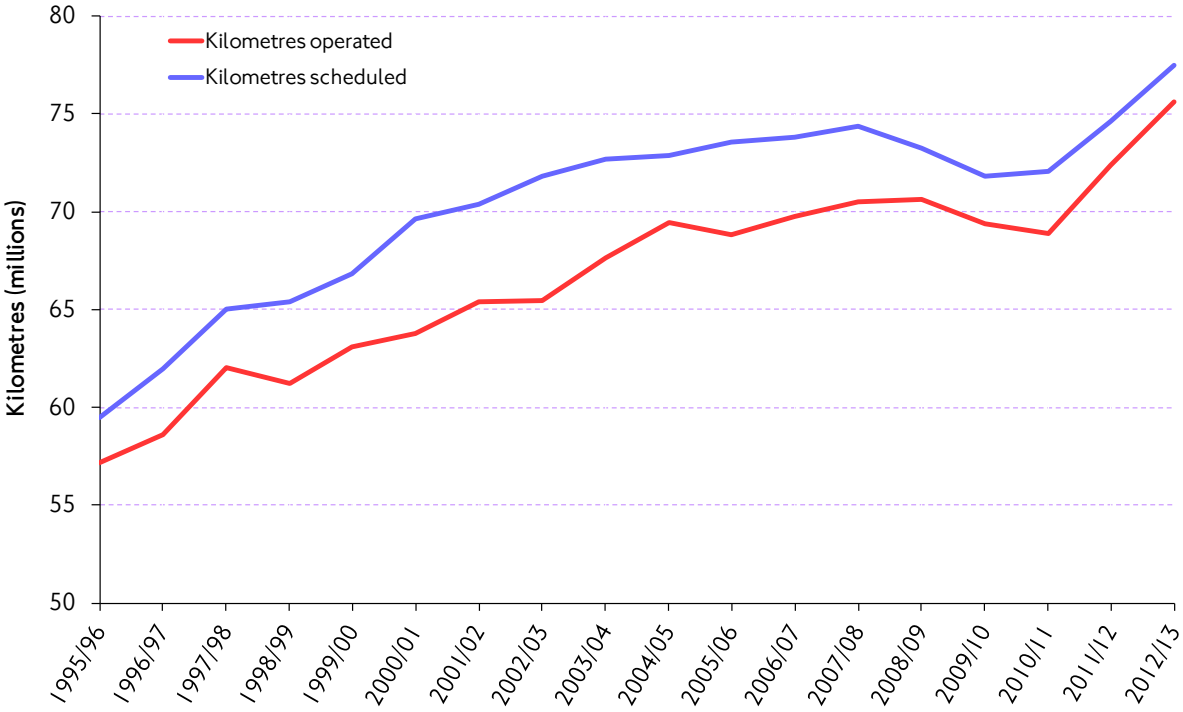
Mode	Measure	Start of decade	2010/11	2011/12	2012/13
Service provision					
Buses	Kilometres operated	365 million	486 million	490 million	490 million
London Underground	Kilometres operated	64 million	69 million	72 million	76 million
DLR	Kilometres operated	2.9 million	4.7 million	4.9 million	5.7 million
London Tramlink	Kilometres operated	2.4 million	2.7 million	2.7 million	2.9 million
London Overground	Kilometres operated	n/a	5.5 million	7.0 million	7.6 million
Service performance					
Buses	Excess wait time	2.2 minutes	1.0 minutes	1.0 minutes	1.0 minutes
London Underground	Excess journey time	8.6 min	6.5 min	5.8 min	5.3 min
DLR	Reliability	96%	97%	98%	99%
London Tramlink	Reliability	99%	99%	99%	97%
National Rail	ORR L&SE PPM	78%	91%	92%	91%
London Overground	ORR PPM	n/a	95%	97%	97%

Source: TfL Planning, Strategic Analysis.

4.2 Underground

London Underground (LU) has substantially increased its service offering over the last decade – in the context of a largely static physical network. This reflects the success of the Tube upgrade programme, providing the ability to increase both capacity and service reliability. Service changes have also increased off-peak service levels in response to rising demand. Train kilometres scheduled in 2012/13 were 11 per cent higher than in 2000/01, while train kilometres operated were 19 per cent higher (this denoting a more substantial improvement in operational reliability). The year 2012/13 saw four per cent more train kilometres scheduled, as well as four per cent more train kilometres operated, than in 2011/12.

Figure 4.1 London Underground: train kilometres scheduled and train kilometres operated.



Source: London Underground.

Figure 4.1 shows two other significant features. First is that the three years 2008/09 to 2010/11 saw small falls in both measures (note the origin point of the graph). This largely reflects the impact of the Tube upgrade plan itself, in the form of planned closures of parts of the network at the weekends. The second feature is that the gap between the service scheduled and that actually operated has tended to narrow – denoting a more reliable service (table 4.2). In 2012/13, 97.6 per cent of scheduled train kilometres were operated.

Underground reliability can also be expressed in terms of passenger-focused measures such as average journey time and excess journey time. This is the additional time that passengers have to wait over and above that implied by the schedule as a result of unreliability in the service. Excess journey time has reduced by more than a third since the start of the last decade, and by a further 9.5 per cent in the latest year, to an average of 5.3 minutes – this feeding through to substantial reliability benefits for Tube users.

Table 4.2 London Underground – service reliability and journey times.

Year	Train kilometres scheduled (millions)	Percentage of scheduled kilometres operated	Average actual journey time (minutes)	Average generalised (weighted) journey time (minutes)	Excess journey time (weighted) (minutes)	Excess as % of generalised journey time
2000/01	69.6	91.6	28.6	45.7	8.6	18.9
2001/02	70.4	92.9	28.3	45.2	8.1	18.0
2002/03	71.8	91.1	29.1	46.7	9.7	20.7
2003/04	72.7	93.1	27.9	44.3	7.4	16.8
2004/05	72.9	95.3	27.7	44.0	7.2	16.4
2005/06	73.6	93.6	27.8	44.3	7.5	16.9
2006/07	73.8	94.5	28.0	44.7	8.1	18.0
2007/08	74.4	94.8	27.8	44.5	7.8	17.4
2008/09	73.2	96.4	27.5	43.9	6.6	15.1
2009/10	71.8	96.6	27.7	44.1	6.4	14.5
2010/11	72.1	95.6	28.0	44.6	6.5	14.6
2011/12	74.6	97.0	27.5	45.1	5.8	13.3
2012/13	77.5	97.6	26.8	43.6	5.3	12.1

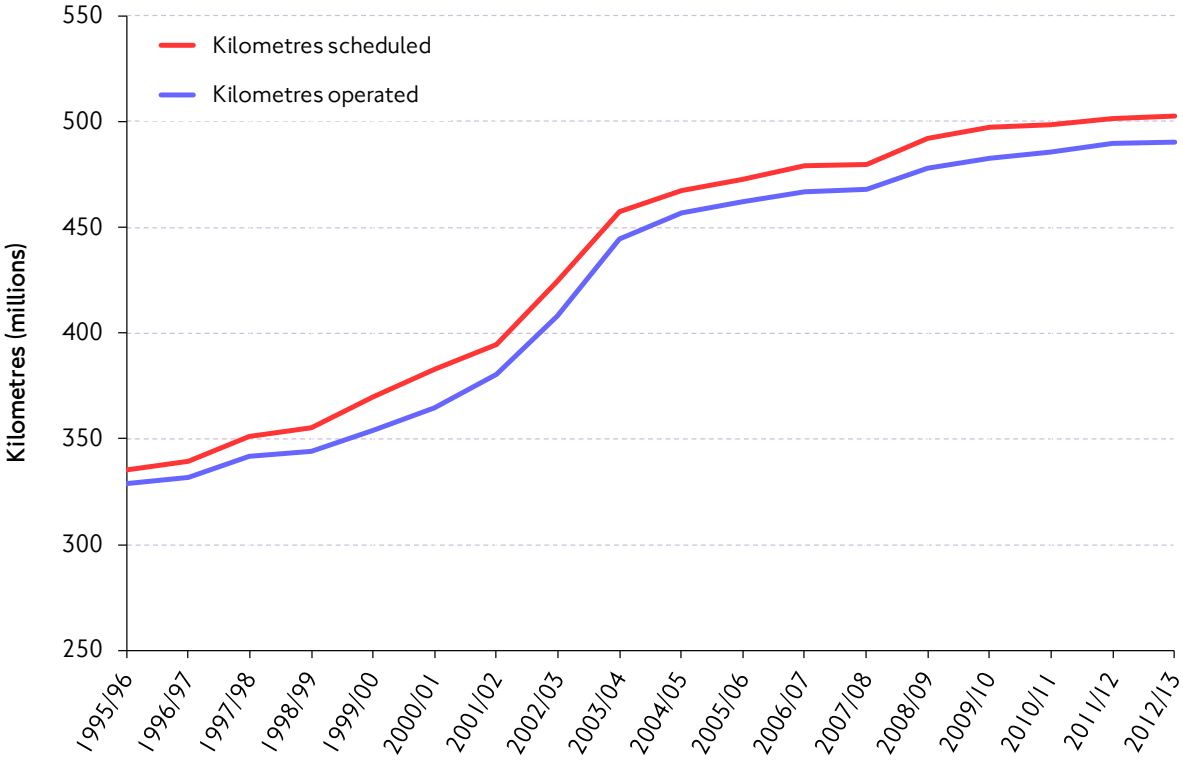
Source: London Underground.
1. Excess journey time is the difference between actual journey time and that expected if services run to time, and weighted to reflect how customers value time.

4.3 Bus

Bus service supply

The bus is one of London's transport success stories, having substantially increased both service provision and patronage since the start of the last decade. Buses in London carried 2.3 billion people in 2012/13, and operated 490.5 million bus-kilometres (97.6 per cent of the scheduled service), matching performance in 2011/12 (figure 4.2).

Figure 4.2 Bus service provision – scheduled and operated bus kilometres.



Source: London Buses.

Bus service performance

Table 4.3 shows measures of bus service reliability. The percentage of timetabled services 'on time' for low frequency bus routes increased again. However, the average actual waiting time has increased to 5.9 minutes. This can be attributed to an expansion of monitoring in the latest year to cover the period 05:00 – 24:00 continuously. Scheduled levels of service are lower at times of day not previously monitored such as late evenings and Sunday mornings. Despite these changes, monitored actual wait times are still 13 per cent below those of 2000/01 and excess wait time has remained at the historic low of one minute.

Table 4.3 Indicators of bus service reliability.

Year	Kilometres scheduled (millions)	Percentage of scheduled kilometres			High frequency services[1]		Low frequency services[2]
		Operated	Lost due to traffic congestion[4]	Lost due to other causes[5]	Average wait time (minutes)		Percentage of timetabled services on time[3]
					Actual	Excess	
2000/01	383	95.3	2.1	2.6	6.8	2.2	67.7
2001/02	395	96.4	2.0	1.6	6.6	2.0	69.4
2002/03	425	96.1	2.6	1.3	6.4	1.8	70.5
2003/04	457	97.2	1.7	1.1	5.8	1.4	74.6
2004/05	467	97.7	1.6	0.8	5.6	1.1	77.1
2005/06	473	97.7	1.7	0.6	5.6	1.1	77.2
2006/07	479	97.5	1.9	0.6	5.5	1.1	78.1
2007/08	480	97.5	2.0	0.5	5.5	1.1	79.1
2008/09	492	97.0	2.3	0.7	5.5	1.1	80.8
2009/10	497	97.1	2.3	0.6	5.5	1.1	80.5
2010/11	499	97.4	2.1	0.5	5.4	1.0	81.4
2011/12	502	97.6	1.9	0.5	5.4	1.0	83.2
2012/13	503	97.6	1.7	0.7	5.9	1.0	83.6

Source: London Buses.
1. High frequency services are those operating with a scheduled frequency of 5 or more buses an hour.
2. Low frequency services are those operating with a scheduled frequency of fewer than 5 buses an hour.
3. Buses are defined as 'on time' if departing between two and a half minutes before and 5 minutes after their scheduled departure times.
4. Also includes other lost kilometres outside the control of the operator.
5. Includes all lost kilometres within the control of the operator.
6. Results for High Frequency routes from 2012/13 reflect the move to a greatly expanded QSI system for monitoring of this group of routes

4.4 Docklands Light Railway (DLR)

Since 2000/01 the DLR has increased the number of kilometres operated from 2.9 million to 5.7 million, an increase of 97 per cent (table 4.4) – reflecting both network expansion and enhanced service levels. The year 2012/13 saw the percentage of trains on time reach record levels, at 98.8 per cent. The percentage of scheduled services operated was the highest since 2007/08, at 98.5 per cent. This reflected the move towards three-car trains on the whole network in the year prior to the 2012 Games, and exceptional levels of service provision and operational excellence during the Games themselves.

Table 4.4 DLR service provision and reliability.

Year	Kilometres operated (millions)	Percentage of scheduled services operated	Percentage of trains on time
2000/01	2.9	98.2	96.3
2001/02	2.9	98.3	96.6
2002/03	3.2	98.1	96.3
2003/04	3.4	98.2	96.6
2004/05	3.3	98.5	97.1
2005/06	3.6	98.7	97.3
2006/07	4.3	99.2	97.8
2007/08	4.4	99.1	97.3
2008/09	3.9	98.4	94.6
2009/10	4.6	97.2	94.8
2010/11	4.7	97.5	97.4
2011/12	4.9	97.7	97.5
2012/13	5.7	98.5	98.8

Source: Docklands Light Railway.

4.5 London Tramlink

London Tramlink performance in 2012/13 was slightly down relative to the previous year, although against the backdrop of an increase of more than eight per cent in scheduled kilometres. London Tramlink continues to deliver a very high level of reliability with 97.3 per cent of scheduled services being operated in 2012/13 – the 12th year that this measure has been above 97 per cent (table 4.5).

Table 4.5 London Tramlink service reliability.

Year	Scheduled kilometres (millions)	Operated kilometres (millions) [1]	Percentage of scheduled service operated
2001/02	2.44	2.41	99.1
2002/03	2.49	2.46	98.9
2003/04	2.50	2.48	99.0
2004/05	2.49	2.42	97.2
2005/06	2.50	2.44	97.4
2006/07	2.57	2.54	98.7
2007/08	2.60	2.57	99.0
2008/09	2.70	2.66	98.5
2009/10	2.62	2.60	99.2
2010/11	2.72	2.70	99.2
2011/12	2.74	2.71	98.9
2012/13	2.98	2.90	97.3

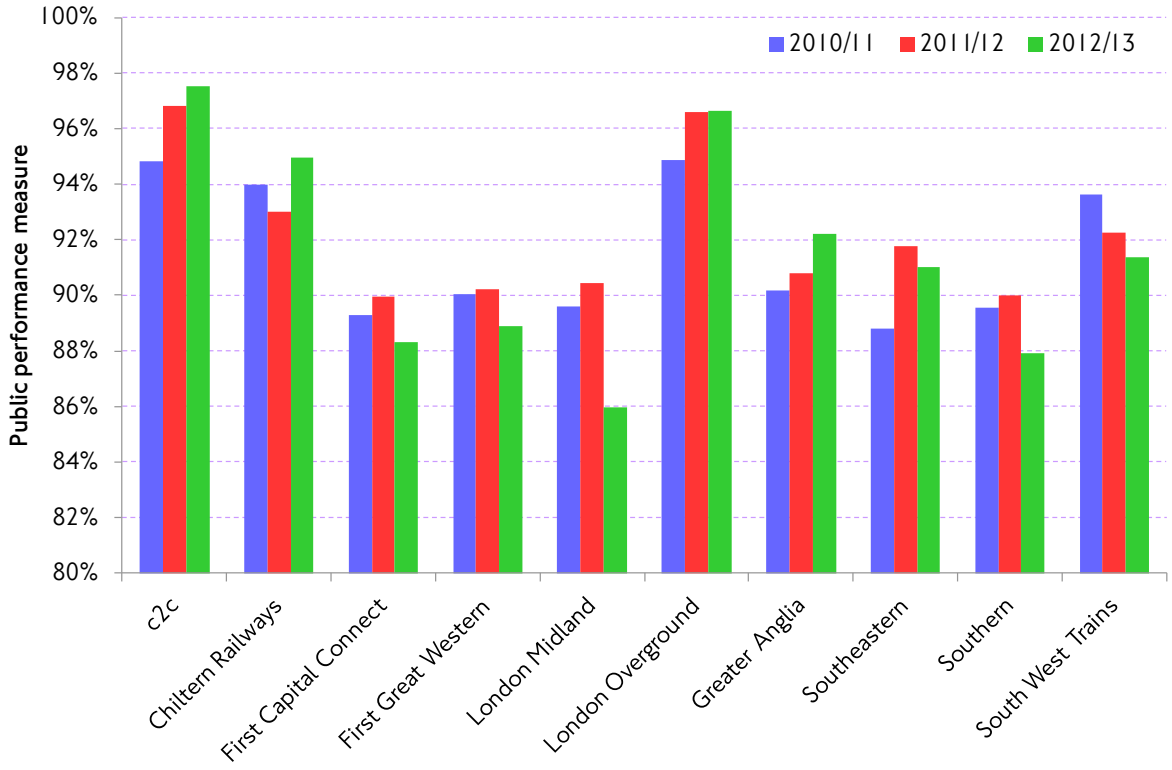
Source: London Tramlink.
1. Operated kilometres exclude replacement bus services operated during period of track repair works.

4.6 National Rail and London Overground

This section looks at the performance of National Rail services in London, including TfL's London Overground network. The reliability of National Rail services is measured through the Public Performance Measure, which combines figures for punctuality and reliability into a single measure [2]. The PPM is therefore the percentage of trains 'on time' compared to the number planned. A train is defined as 'on time' if it arrives no later than five minutes after the planned destination arrival time for services defined by the Office of Rail Regulation (ORR) as 'London and South East' (L&SE) and regional operators, or not later than 10 minutes for long-distance operators.

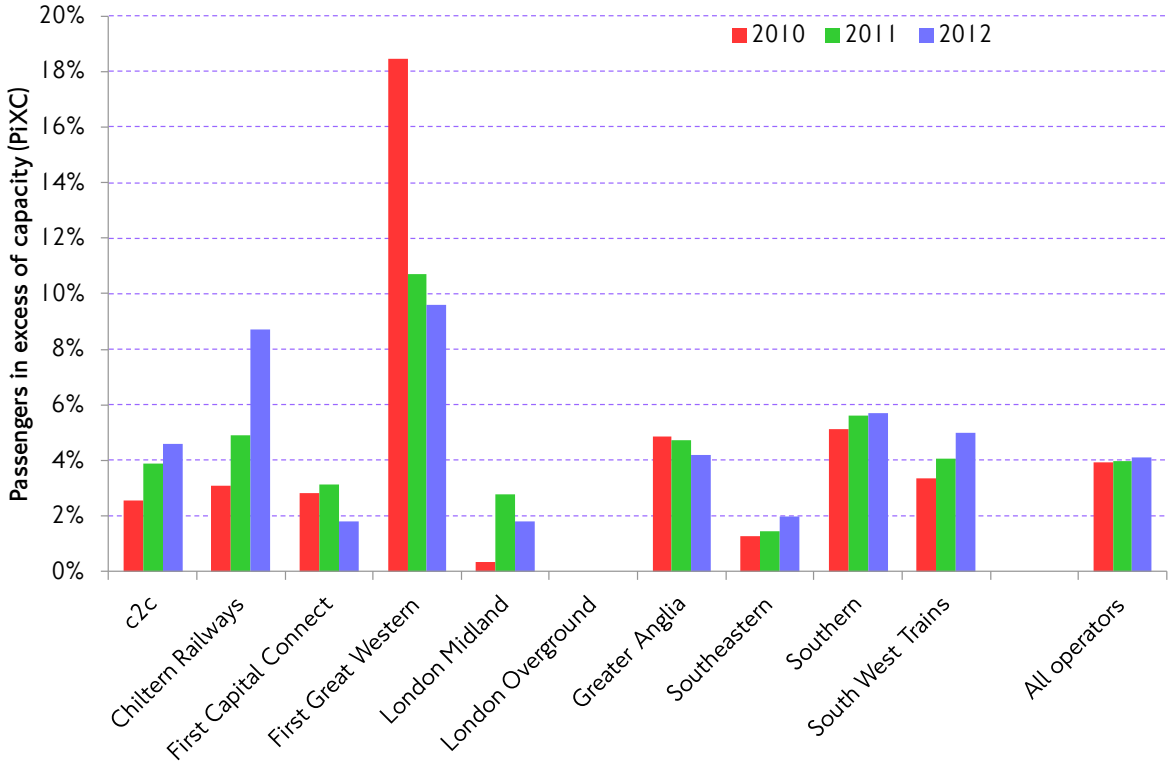
Figure 4.3 shows PPM measures for all services operated by L&SE operators over the last three years. The general trend over the most recent year was mixed – services of some operators showing an improvement, balanced by others whose PPM measure had fallen. The most notable change was for services operated by London Midland (medium-distance services from London Euston). The score for this operator fell to 86 per cent for 2012/13, against values for the preceding two years that were already towards the low end of the operators considered. London Overground was the second best performing operator for PPM, with scores of 96.6 for the most recent two years, just behind c2c (services from London Fenchurch Street), which further increased its position as the best performing L&SE operator on this measure.

Figure 4.3 National Rail – public performance measure for London and South East Operators (moving annual average as at quarter four each year).



Source: Office of Rail Regulation.

Figure 4.4 Passengers in excess of capacity (PiXC) for National Rail operators in London during the weekday morning peak.



Source: Office of Rail Regulation.

Crowding on National Rail is monitored using the DfT's 'PiXC' (Passengers in Excess of Capacity) measure. This compares planned capacity on services arriving in or departing from central London against actual demand, with PiXC being the difference between the two. Figure 4.4 shows PiXC results (for the morning peak period only) for the last three years by train operator. The trend in 2012 was mixed, although the PiXC value across all operators (combined) has remained broadly stable at around four per cent for the last three years.

In the context of continuing strong growth in demand for rail services, significant changes in PiXC values for individual operators are usually associated with the acquisition of new rolling stock and/or the provision of new services. Although London Overground is notable for having PiXC values of zero for each of the last three years, this only relates to the Euston-Watford services (other parts of the Overground network are not measured for PiXC, as it is a measure most applicable to 'radial' commuter routes), and this line itself benefited from new rolling stock, offering higher capacities, in 2010. However, the Overground network as a whole is experiencing rapid growth and levels of crowding, while not currently severe, will be a concern in the future.

First Great Western services into London Paddington have the highest morning peak PiXC values for the third consecutive year, although these have improved since 2010, reflecting the introduction of additional rolling stock. The three-year PiXC trend for both Chiltern and South West Trains are indicative of growing overcrowding on these services, although both operators continue to develop

initiatives to alleviate this (such as the forthcoming introduction of ten-car trains on some South West Trains suburban services).

4.7 Public transport reliability

This section brings together and summarises key reliability statistics for the principal public transport modes in London, including National Rail, as (collectively) one of the strategic outcome indicators for MTS. Values for each mode are shown separately in table 4.6 below, Values for the most recent year are either at, or close to, their long-term historic highs, indicating that high levels of performance on the public transport networks are being sustained.

Table 4.6 Summary of key reliability indicators for the principal public transport modes.

Mode	Units/measure	2010/11	2011/12	2012/13	Trend
Underground	Standardised journey time (minutes)	44.6	45.1	43.6	Improving
Underground	Excess waiting time (minutes)	6.5	5.8	5.3	Improving
London Buses	Excess waiting time for high-frequency routes (minutes)	1.0	1.0	1.0	Stable at excellent level
London Buses	Low frequency routes – percentage of buses on time	81.4	83.2	83.6	Improving
DLR	Percentage of trains that ran to time	97.4	97.5	98.8	Recent high
London Tramlink	Percentage of scheduled services operated	99.2	98.9	97.3	Recent decline
National Rail	ORR's PPM measure for L&SE operators (all services, average for year)	91.0	91.7	91.0	Stable
London Overground	ORR's PPM measure (all services)	94.8	96.6	96.6	Continued high performance

Source: TfL Planning, Strategic Analysis.

4.8 Public transport capacity

For MTS monitoring purposes TfL produces an annual indicator of the total capacity provided by the public transport networks. This is calculated from established 'planning capacities' for the vehicles used for the different types of services, multiplied by the kilometres operated by each. The modes included in this indicator are: Underground, buses, DLR and London Tramlink, with values for each mode given separately (table 4.7).

Over the most recent year Underground capacity increased by 2.6 per cent following line upgrades and increased off-peak service levels. London Tramlink capacity also increased, while bus capacity remained stable. There was a 25.7 per cent increase on DLR, reflecting the continued roll out of three-car operation to the network and the augmented service during the Games in summer 2012.

Table 4.7 Total yearly capacity provided by the principal public transport modes. Million place-kilometres.

Mode	2009/10	2010/11	2011/12	2012/13	Percentage change 2011/12 to 2012/13
Underground[1]	63,099	62,446	65,177	66,888	2.6
Bus	29,311	29,751	29,804	29,626	-0.6
DLR	2,027	2,338	2,635	3,311	25.7
London Tramlink	544	564	566	606	7.0

Source: TfL Planning, Strategic Analysis.
Notes: 1.Values for Underground have been revised to reflect published London Underground assumptions for standing capacity. The absolute values given in the table reflect these revised assumptions, and are internally consistent. They do differ, however, from equivalent values published in previous Travel in London reports, although the percentage changes between years are the same.

4.9 Performance of the road network

Measures of road network performance

There are three basic measures of road network performance, each having its own characteristics:

- **Average traffic speed** is the simplest measure, but tells us nothing about how actual network performance compares to what might be 'expected' for the network. This would clearly vary, for example, between major and minor or residential roads.
- **Excess delay** is the conventional measure used to describe traffic congestion, and compares the actual travel rate (expressed as minutes per kilometre) for a given journey against the travel rate for the same journey under uncongested conditions (typically and for practical purposes taken as the early hours of the morning).
- **Journey time reliability** is the MTS indicator for traffic smoothing, which quantifies the variability of actual journeys around a nominal average. The measure is independent of both absolute average speed and delay. This measure is described more fully in section 4.5 of Travel in London report 3 [3].

Summary of long-term trends for traffic speeds and delays in London

Previous Travel in London reports described the long-term trends towards slower average traffic speeds and increased congestion (delay) in London. They have also described the relationship of these trends to levels of traffic demand, which have been falling for much of the last decade, and interventions - such as urban realm improvements - that have reduced the effective capacity of London's road network for general motorised traffic [4].

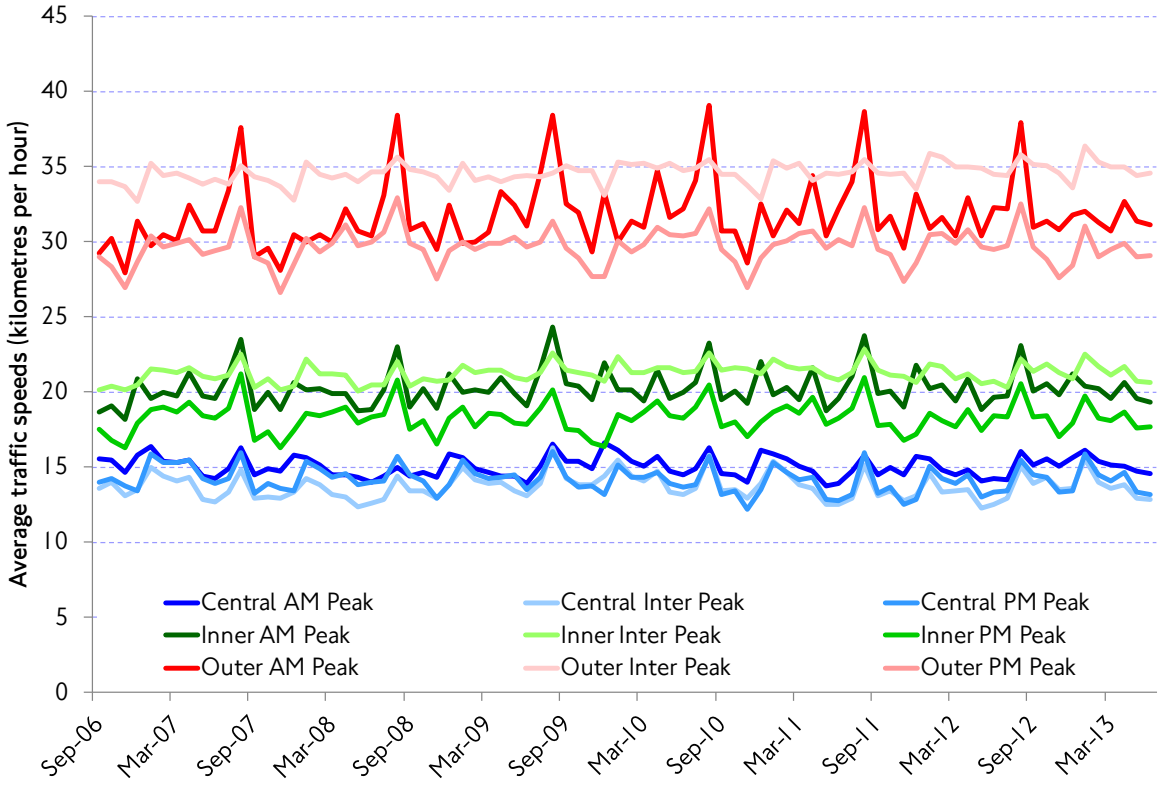
The clarity of this relationship, visible in the data up to 2006/07, has more recently been obscured as newer Trafficmaster GPS data, which replaced the traditional 'moving car observer' method of recording speeds and delays, has shown a notable lack of 'directional' trend at the aggregate level since first becoming available in late 2006. This is in spite of continued reductions to traffic volumes, and a wide range of interventions by TfL and delivery partners intended to improve the operation of

the road network. The following sections update key indicators of road network performance for the latest year.

Average traffic speeds

Figure 4.5 shows the trend in average traffic speeds by functional sector of London since these data first became available in late 2006. Values are summarised in table 4.8. Looking first at the figure, there are clear and expected patterns associated with seasonality and the fluctuations in traffic demand on the network over the course of each year. There are also clear and expected differences in the prevailing average speeds for each of central, inner and outer London. The overall trend, however, is one of marked stability over the six-year period, which is in contrast to the prevailing trends towards slower average speeds over the first half of the last decade.

Figure 4.5 Average traffic speeds (kilometres an hour) by functional sector of London. Working weekdays by time period. TfL's 'network of interest'.



Source: TfL Surface Transport.

Table 4.8 Average traffic speeds (kilometres per hour) by functional sector of London. Working weekdays, by time period. TfL's 'network of interest'.

Area and time period	2007 speed (kph)	2008 speed (kph)	2009 speed (kph)	2010 speed (kph)	2011 speed (kph)	2012 speed (kph)
Central AM peak	15.2	14.7	15.1	15.2	14.9	15.0
Central inter-peak	13.6	13.3	14.2	14.0	13.6	13.6
Central PM peak	14.5	14.3	14.3	14.0	13.8	14.1
Inner AM peak	20.2	20.0	20.7	20.5	20.4	20.3
Inner inter-peak	21.1	21.0	21.4	21.6	21.4	21.2
Inner PM peak	18.4	18.4	18.1	18.5	18.4	18.3
Outer AM peak	31.0	31.6	32.3	32.2	32.4	32.0
Outer inter-peak	34.2	34.5	34.4	34.7	34.7	35.0
Outer PM peak	29.4	30.0	29.5	29.8	29.8	29.8

Source: TfL Surface Transport, based on data from Trafficmaster.
1. Value derived by weighting geographic components by proportion of traffic flow within zone.

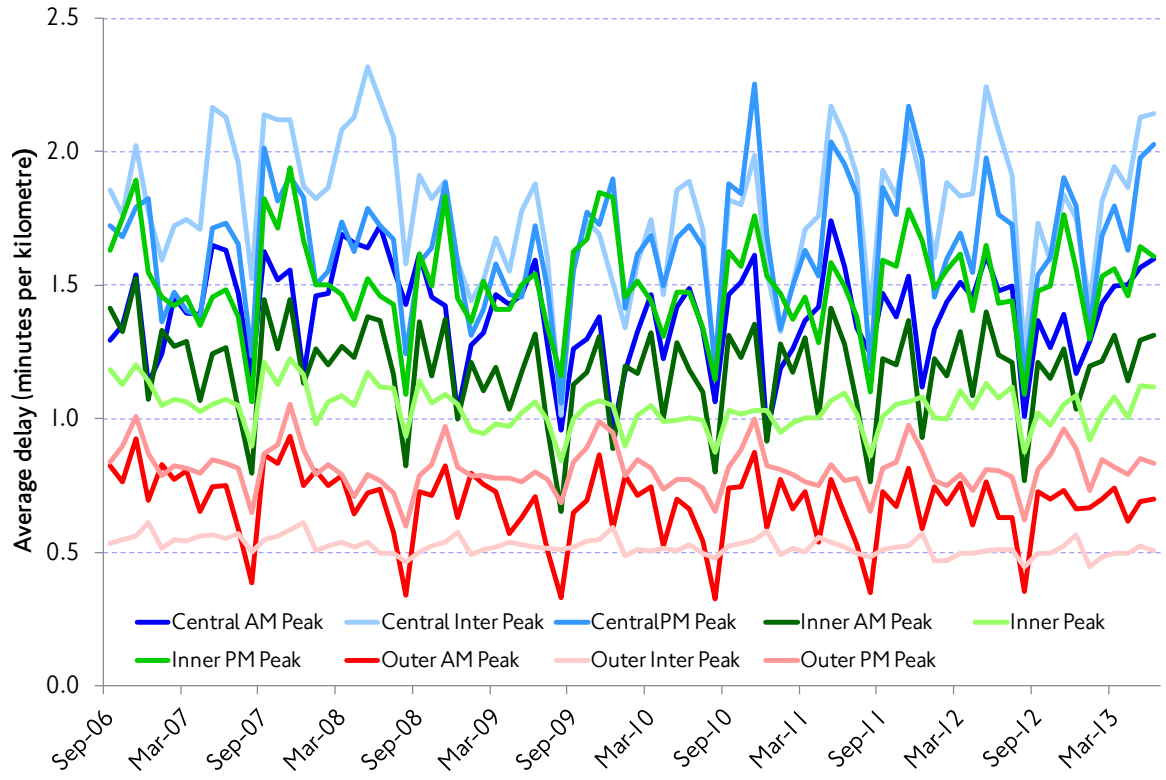
Vehicle delay (congestion)

Figure 4.6 shows the trend for congestion (delay), corresponding directly to the speed data in figure 4.5 above. Trafficmaster delay values are calculated against a variable 'uncongested' night-time speed, which is that actually measured on a day-by-day basis, rather than a static nominal 'night-time' speed, as was the case with previous moving car observer data. Furthermore, Trafficmaster 'uncongested' speeds relate to the period from 22.00 to 06.00 – a period which, in many parts of London, sees substantial volumes of traffic. This contrasts with previous practice where uncongested speeds measured by (infrequent) moving car surveys related to the period 02.00 to 05.00.

As well as the expected seasonal and geographical patterns shared with the speed data, figure 4.6 illustrates large differences in the degree of variability of traffic congestion by both area and time period. So, inter-peak congestion in outer London remains remarkably stable from month-to-month at about 0.5 minutes per kilometre, whereas morning peak congestion here may vary by up to 100 per cent from month to month. In inner London the degree of variation in peak-period congestion is also roughly twice that of inter-peak congestion. In central London the pattern is reversed – inter-peak congestion being the most variable and this coinciding with the period of highest traffic demand on the network. This pattern is characteristic of networks where traffic demand routinely approaches the carrying capacity of the network. Congestion, as a measure of network instability, increases at a greater rate, and journey times are therefore more variable, the closer that traffic demand is to the carrying capacity of the network.

Although figure 4.6 shows strong variability within area at the 'seasonal' level, annual average values are again remarkably stable, as can be seen from table 4.9. There was a tendency towards lower average delay values in 2008 and 2009 relative to 2007, but annual averages since have again been stable.

Figure 4.6 Average vehicle delay (minutes per kilometre) by functional sector of London. Working weekdays, by time period. TfL's 'network of interest'.



Source: TfL Surface Transport.

Table 4.9 Average vehicle delay (minutes per kilometre) by functional sector of London. Working weekdays, by time period. TfL's 'network of interest'.

Area and time period	2007 delay (min/km)	2008 delay (min/km)	2009 delay (min/km)	2010 delay (min/km)	2011 delay (min/km)	2012 delay (min/km)
Central AM peak	1.4	1.5	1.3	1.3	1.4	1.4
Central inter-peak	1.9	1.9	1.6	1.7	1.8	1.8
Central PM peak	1.6	1.6	1.5	1.7	1.7	1.6
Inner AM peak	1.2	1.2	1.1	1.2	1.2	1.2
Inner inter-peak	1.1	1.1	1.0	1.0	1.0	1.0
Inner PM peak	1.5	1.5	1.5	1.5	1.5	1.5
Outer AM peak	0.7	0.7	0.7	0.7	0.7	0.7
Outer inter-peak	0.6	0.5	0.5	0.5	0.5	0.5
Outer PM peak	0.8	0.8	0.8	0.8	0.8	0.8

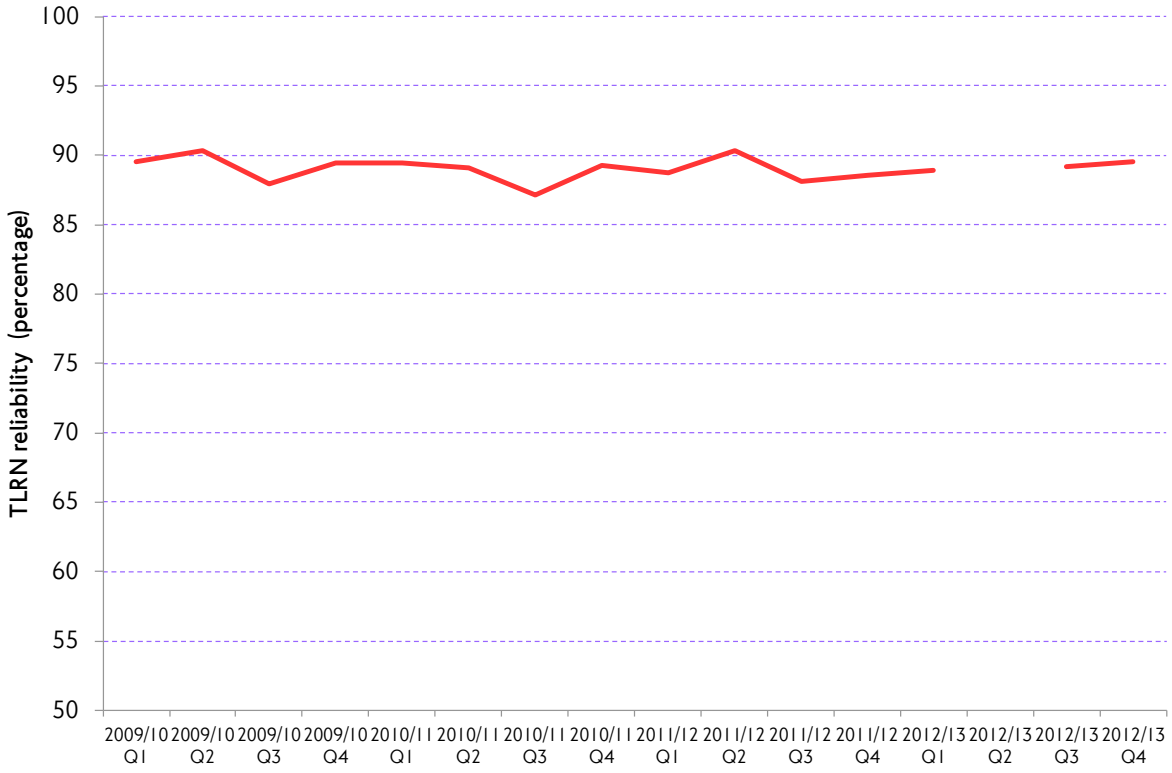
Source: TfL Surface Transport, based on data from Trafficmaster.
1. Value derived by weighting geographic components by proportion of traffic flow within zone.

Smoothing traffic flow and journey time reliability

TfL's assessment of road network performance for MTS is primarily based on the concept of journey time reliability. This considers the relationship of actual measured journeys (using automatic number plate recognition (ANPR) cameras) to a nominal average journey time that is representative of journeys by road in London. This is measured quarterly on a road corridor basis, covering most of the TLRN major road network in London, and is aggregated to a London wide index for the purpose of MTS assessment (figure 4.7).

Against a current working target of 89.5 per cent of road journeys in London to be achieved within five minutes of the nominal 30 minute average journey time, recorded performance since the start of this measure in 2009 has consistently been between 88 and 90 per cent. Seasonal factors are evident in the graphic but there is no evidence yet, over the four years of data available, of a clear 'directional' trend in this indicator. Note that, due to the widespread alterations made to the operation of the major road network in London during the 2012 Games, a comparable value for this period is not available.

Figure 4.7 Journey time reliability on the TLRN. Percentage of journeys completed within an allowable 'excess' of a normalised average journey time.



Source: TfL Surface Transport.

4.10 Focus on: Understanding the contribution of causal factors to journey time unreliability on the major road network

In view of the relatively stable trend for journey time reliability, research has been undertaken to examine the effect of quantifiable influencing factors. The research has used a regression-model-based approach to determine the significance of each of the hypothesised causative influences. These factors are categorised as follows:

- **Physical bottlenecks (capacity).** For the purpose of this analysis this is assumed to be constant, despite the impact of improvements to junctions and roadways throughout London.
- **Traffic incidents.** Data from the London Streets Traffic Control Centre is available on a daily basis showing the severity and duration of events that cause disruption on the road network.
- **Traffic control devices.** Impacts of traffic control devices have been updated and reviewed throughout the time period.
- **Special events.** Across the large London network, it is expected that 'special events' will be confined to a small area and have minimal impact on city-wide journey time reliability.
- **Fluctuations in normal traffic.** Traffic flow data has been collected at approximately 50 sites across the network. These are assumed to be representative for the purposes of this analysis.

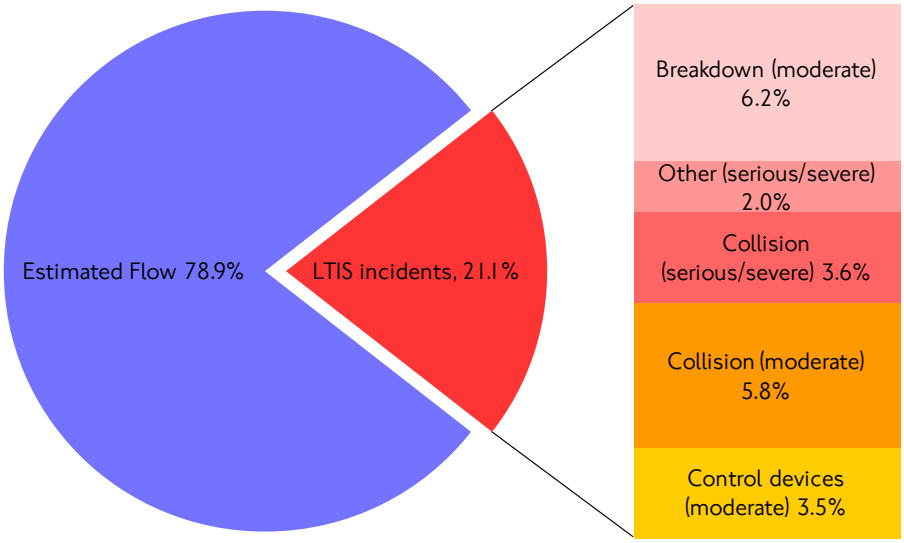
Method summary

Journey time reliability is measured across all monitored links of the TLRN network from journey time data derived from ANPR number plate reading cameras. The data is available by link on a daily basis. The average weekly AM peak journey time reliability weighted by vehicle kilometres across the four year period in London is 88.8 per cent. The analysis involved a step-wise linear regression approach to determine the impact that each factor has on journey time reliability. Journey time reliability data was only available for weekdays and the analysis has focused on the AM peak period.

For modelling purposes, the journey time reliability was converted to an 'unreliability level' (the difference from 100 per cent reliability). The regression was run on weekly average figures rather than daily figures to remove bias from different days of the week. The traffic flow data have been indexed against the average across the period to provide a London-wide traffic flow index, which indicates the level of traffic for a given AM peak period. There is evidence to suggest that the impact of flow is exponential rather than linear, therefore the flow factor was transformed to an exponential derivative for more accurate representation in the linear regression modelling.

Incident data was collected and refined down to match the time period and dates required by other data sets in the model. The data has been separated into two categories, 'moderate' events and 'serious and severe' events. By multiplying the explanatory factors variables by the modelled coefficients from the regression, it is possible to determine the average overall influence of each factor on the TLRN reliability in the weekday AM peak (figure 4.8).

Figure 4.8 The proportional contribution of explanatory factors to the loss of journey time reliability in the weekday AM peak.



Source: TfL Surface Transport.

The analysis shows that 'normal' traffic levels and traffic variability accounts for about four-fifths of unreliability on the network. The remaining 21 per cent is spread relatively evenly over the incident types that have been modelled. The figure shows only the influence of factors that have been measured. For example, at the moment the model does not include planned or unplanned road works. Road works are difficult to represent in a model such as this. Typically many road works, because they have management plans in place, and occur outside of traffic sensitive times, do not disrupt traffic. Of the few that do, their impacts depending on their size and duration are often diffused widely across the network as drivers change their routeings to adapt to diversions in place.

4.11 Reference statistics: Performance of the transport networks

Table 4.10 Indicators of public transport service provision and performance by mode.

Service and indicator	Units	2010 or 2010/11	2011 or 2011/12	2012 or 2012/13	Trend
Underground					
Level of service scheduled	Million train kms	72.1	74.6	77.5	Strong improvement
Level of service operated	% of schedule	95.6	97.0	97.6	Strong improvement
Service reliability	Standardised journey time	44.6	45.1	43.6	Recent improvement
Service reliability	Excess journey time	6.5	5.8	5.3	Strong improvement
Bus					
Level of service scheduled	Million bus kms	498.5	501.6	502.6	Steady improvement
Level of service operated	Per cent	97.4	97.6	97.6	Consistently excellent
Service reliability	Excess waiting time	1.0	1.0	1.0	Consistently excellent
DLR					
Level of service operated	Million train kms	4.7	4.9	5.7	Strong improvement
Level of service operated	% of schedule	97.5	97.7	98.5	Consistently excellent
Service reliability	% of trains on time	97.4	97.5	98.8	Consistently excellent
London Tramlink					
Level of service scheduled	Million train kms	2.72	2.74	2.98	Strong improvement
Level of service operated	% of schedule	99.2	98.9	97.3	Recent decline
National Rail					
Service reliability – all L&SE operators	ORR PPM (% peak only)	86.9	88.1	86.9	Stable
Service reliability – all L&SE operators	ORR PPM (% all services)	91.0	91.7	91.0	Stable
Service reliability – London Overground	ORR PPM (% all services)	94.8	96.6	96.6	Consistently excellent

Source: TfL Group Planning, Strategic Analysis.

Notes and references

(1) See Travel in London report 5, chapter 10. http://www.tfl.gov.uk/assets/downloads/corporate/travel-in-london-report-5.pdf

(2) http://www.networkrail.co.uk/about/performance/

(3) See Travel in London report 3, section 4.5. http://www.tfl.gov.uk/assets/downloads/travel-in-london-report-3.pdf

(4) See Travel in London report 4, section 4.13. http://www.tfl.gov.uk/assets/downloads/travel-in-london-report-4.pdf

Monitoring and assessing progress with the implementation of the Mayor's Transport Strategy

5. Implementing the Mayor's strategy: Key trends, highlights and issues

5.1 Introduction and content

Chapters 2 to 4 of this report looked at recent trends for travel demand and operational performance across the TfL modes and compared these, where appropriate, with MTS expectations. These earlier chapters therefore quantify the changing context and background to the MTS, in terms of aggregate travel demand and transport supply. Demand for travel across London's transport networks is growing rapidly – some way ahead of the original MTS expectation from higher than expected population growth – creating additional demand pressures and bringing forward 'crunch points' where new and improved infrastructure is required. Meanwhile, TfL is achieving 'best ever' levels and quality of service across the public transport networks, reflecting a whole host of initiatives and culminating in transport's role in facilitating the highly successful London 2012 Games.

This chapter looks at progress across the wider range of MTS goals, covering: safety and personal security, transport accessibility (connectivity), improving transport opportunities for all Londoners, aspects of the environment and climate change, customer satisfaction with the transport system and aspects of TfL's wider organisational performance. The emphasis is on giving a broad evidence-based assessment of trends, but focusing on topics of particular contemporary interest each year.

Chapter 6, which follows, then provides a summary update and review of progress towards MTS strategic goals, as monitored by the 24 formal strategic outcome indicators for the strategy and as informed by the wider commentary and body of data in this report.

5.2 Road safety

Summary

Recent years have seen substantial reductions in the number of casualties from road traffic collisions in London. This section updates progress against casualty reduction benchmarks and focuses on the analytical approaches TfL is using to address those areas of particular concern.

Strategic frameworks

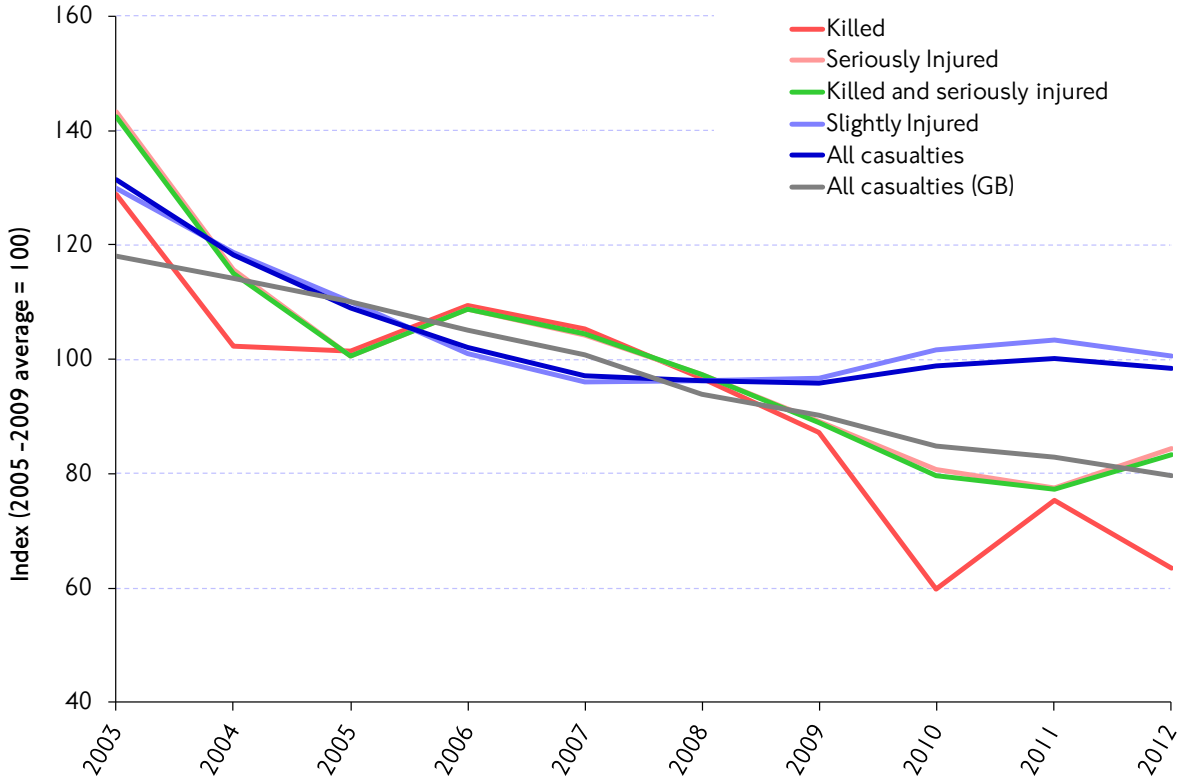
In May 2011 the Government published a new national Strategic Framework for Road Safety (SFRS) [1]. This set out policies that are intended to continue to reduce deaths and injuries on the roads. It contains forecasts of expected casualty reductions at the national level against a 2005-2009 average (the new baseline for assessing progress). However, the framework does not set new formal targets at the national level for road casualty reduction.

In June 2013, TfL published its Road Safety Action Plan for London (Safe Streets for London) [2]. This plan seeks to develop the road safety elements of the MTS and covers the period up to and including 2020. It provides an overview of, and framework for, London's future approach to road safety, including the development of detailed implementation plans and other actions to address London's key road safety challenges. The plan aims to reduce the number of people killed or seriously injured on London's roads by 40 per cent by 2020, and identifies 56 key measures that will help improve road safety.

Casualty trends

Figure 5.1, indexed to the Government's 2005-2009 baseline for measuring progress, shows the long-term trend of casualty reduction in London since 2003, while table 5.1 summarises casualty statistics in 2012 compared to 2011 and the 2005-09 baseline.

Figure 5.1 Long term trend for road traffic casualties in London, by severity of injury. Index values relative to 2005-2009 average baseline.



Source: TfL Delivery Planning, Surface Transport.

Casualties in 2012

In 2012 a total of 28,780 personal injury casualties were reported in London. Of these, 134 were fatally injured, 2,884 were seriously injured and 25,762 were slightly injured. Compared to 2011:

- Fatalities fell by 16 per cent in 2012, from 159 to 134, the second lowest since records began. The number of fatalities fell in all vulnerable user groups, including pedestrians, cyclists and motorcyclists.
- There was a nine per cent year-on-year increase in all serious casualties (2,646 compared to 2,884).
- Slight casualties decreased by 2.6 per cent (25,762 compared to 26,452).
- Overall casualties (all injury severities) in 2012 decreased by 1.6 per cent compared with 2011 (28,780 compared to 29,257).

A number of factors may underlie this increase in KSI casualties. Record rainfall in spring 2012 caused a marked rise in collisions on wet road surfaces, with more than half of these collisions resulting in a vulnerable road user being injured. The continuing growth in population, especially of younger people, may also have been a factor.

Table 5.1 Road collision casualties in Greater London in 2012 compared with 2005-2009 average and 2011.

Casualty severity	User group	Casualty numbers			Percentage change in 2012 over	
		2005-2009 average	2011	2012	2011	2005-2009 average
Fatal	Pedestrians	96.0	77	69	*-10%*	*-28%*
	Pedal cyclists	16.6	16	14	*-13%*	*-16%*
	Powered two-wheeler	43.4	30	27	*-10%*	*-38%*
	Car occupants	49.4	32	19	*-41%*	*-62%*
	Bus or coach occupants	2.4	1	2	*+100%*	*-17%*
	Other vehicle occupants	3.2	3	3	*0%*	*-6%*
	Total	**211.0**	**159**	**134**	***-16%***	***-36%***
Fatal and serious	Pedestrians	1,216.4	980	1,123	*+15%*	*-8%*
	Pedal cyclists	420.6	571	671	*+18%*	*+60%*
	Powered two-wheeler	791.2	599	629	*+5%*	*-21%*
	Car occupants	949.0	499	448	*-10%*	*-53%*
	Bus or coach occupants	139.6	86	94	*+9%*	*-33%*
	Other vehicle occupants	109.8	70	53	*-24%*	*-52%*
	Total	**3,626.6**	**2,805**	**3,018**	***+8%***	***-17%***
	Children (under 16yrs)	**330.2**	**230**	**270**	***+17%***	***-18%***
Slight	Pedestrians	4,214.0	4,466	4,143	*-7%*	*-2%*
	Pedal cyclists	2,718.2	3,926	3,942	*0%*	*+45%*
	Powered two-wheeler	3,806.4	4,077	4,022	*-1%*	*+6%*
	Car occupants	12,426.8	11,293	11,217	*-1%*	*-10%*
	Bus or coach occupants	1,429.8	1,384	1,232	*-11%*	*-14%*
	Other vehicle occupants	1,004.8	1,306	1,206	*-8%*	*+20%*
	Total	**25,600.0**	**26,452**	**25,762**	***-3%***	***+1%***
All severities	Pedestrians	5,430.4	5,446	5,266	*-3%*	*-3%*
	Pedal cyclists	3,138.8	4,497	4,613	*+3%*	*+47%*
	Powered two-wheeler	4,597.6	4,676	4,651	*-1%*	*+1%*
	Car occupants	13,375.8	11,792	11,665	*-1%*	*-13%*
	Bus or coach occupants	1,569.4	1,470	1,326	*-10%*	*-16%*
	Other vehicle occupants	1,114.6	1,376	1,259	*-9%*	*+13%*
	Total	**29,226.6**	**29,257**	**28,780**	***-2%***	***-2%***

Source: TfL Delivery Planning, Surface Transport.

Table 5.1 shows casualties on London's roads both for 2011 and 2012, compared against the 2005-2009 baseline. Changes in collisions and casualties during 2012

should be considered in the context of long-term casualty trends in London, as year-on-year fluctuations are not always indicative of long-term trends.

In 2012 against the 2005-09 baseline:

- Fatalities were 36 per cent below the 2005-09 average.
- All KSI casualties were 17 per cent below the 2005-2009 average.
- Child KSIs were 18 per cent below the 2005-2009 average.
- 'Slight' casualties were 1 per cent above the 2005-2009 average.
- Pedestrian KSIs were 8 per cent below the 2005-2009 average.
- Powered two-wheeler user KSIs were 21 per cent below the 2005-2009 average.

Pedal cyclist KSIs were 60 per cent above the 2005-2009 average, however this should be seen in the context of a considerable increase in cycling in recent years.

5.3 Focus on: Vulnerable road users and casualty risk

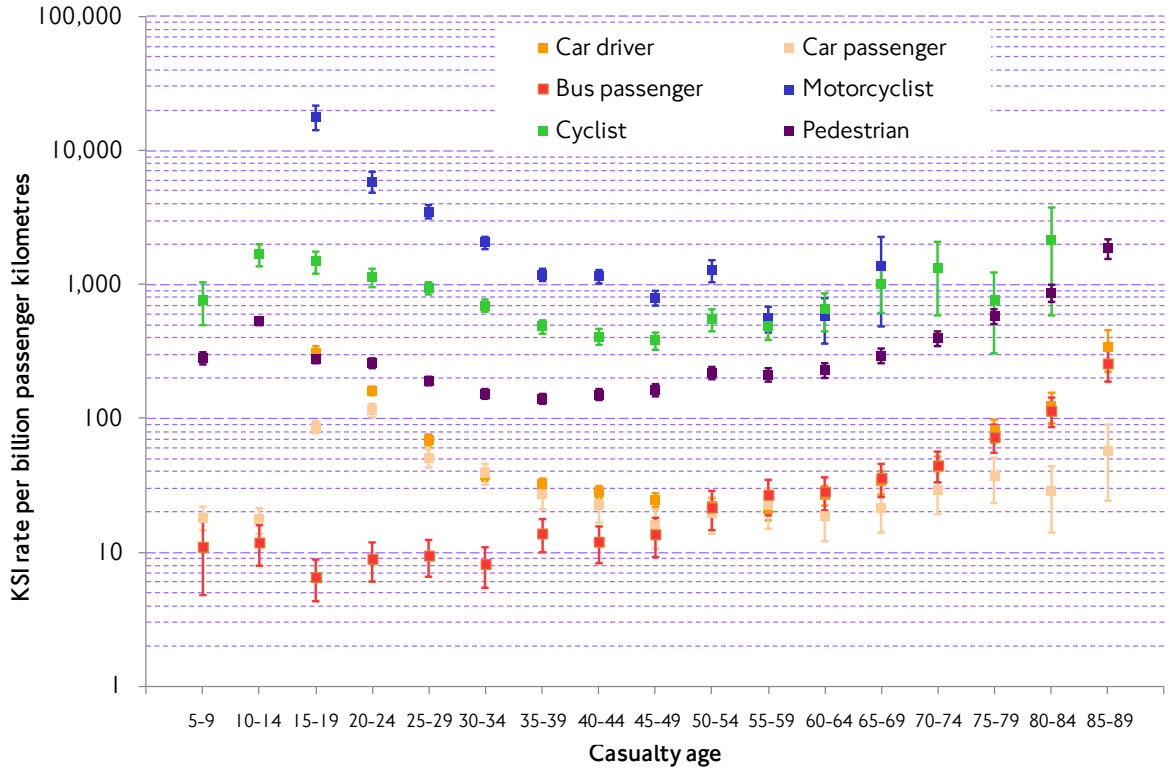
In 2012, vulnerable road users (those walking, cycling and riding a motorcycle) accounted for the majority (80 per cent) of KSI casualties, with car occupants accounting for most of the remainder (a further 15 per cent of all KSI casualties). While this indicates which road user groups are experiencing greatest levels of injury, raw casualty numbers do not account for the exposure to risk in terms of the numbers or lengths of journeys undertaken by each road user group, or the time spent travelling.

Setting KSI casualty figures alongside other data, for example, trips, population, journeys, and time and distance travelled using different modes provides greater insight. Looking at KSI casualties associated with walking, cycling and riding a motorcycle alongside the number of journeys by each of these modes shows that vulnerable road users are over-represented in the casualty figures.

- Walking accounted for 21 per cent of daily journeys, but 37 per cent of KSI casualties in London in 2012.
- Pedal cycles accounted for two per cent of daily journeys, but 22 per cent of KSI casualties in London in 2012.
- Motorcycles accounted for one per cent of daily journeys, but 21 per cent of KSI casualties in London in 2012.

Figure 5.2 shows a breakdown of casualties by age and relative exposure to risk (defined as casualties divided by distance travelled). The risk value shows the risk of being killed or seriously injured per billion passenger-kilometres. The size of each bar represents the 90 per cent confidence interval for the risk value for each age group by road user type. The graph is plotted according to a logarithmic scale.

Figure 5.2 Casualty rate per billion vehicle kilometres by age for each mode.



Source: TfL Delivery Planning, Surface Transport.

This analysis can be developed to identify the most beneficial interventions and to focus resources. The need to improve the safety of pedestrians, cyclists and motorcyclists has been identified; however, it is also important to improve road safety by reducing the casualty numbers and risk experienced by all Londoners. TfL has therefore identified the following groups for whom safety can be most improved through road safety interventions:

Pedestrians

- Pedestrians aged 75 or over owing to relatively higher levels of risk;
- pedestrians aged under 20 owing to relatively higher levels of risk;
- pedestrians aged 20-29 owing to high casualty numbers.

Cyclists

- Child and teenage cyclists owing to relatively higher levels of risk;
- cyclists aged 20-39 owing to high casualty numbers.

Motorcyclists

- Motorcyclists aged under 30 owing to relatively higher levels of risk and casualty numbers.

Drivers and passengers

- Older drivers owing to relatively higher levels of risk;
- car passengers aged 20-29 owing to relatively higher levels of risk and casualty numbers;

- bus passengers aged over 60 owing to relatively higher levels of risk;
- BAME groups, particularly pedestrians, cyclists and motorcyclists, owing to higher relative risk than non-BAME groups.

Improving safety for these groups may involve interventions to change the behaviours of other road users who are putting these groups at risk, improving the safety of the infrastructure and changing the behaviour of the groups themselves through education or enforcement.

5.4 Passenger safety on the public transport networks

Overall, particularly when viewed in the context of rising service levels and patronage, London's public transport networks continue to offer a safe travelling environment, with notable improvements to passenger safety over more recent years.

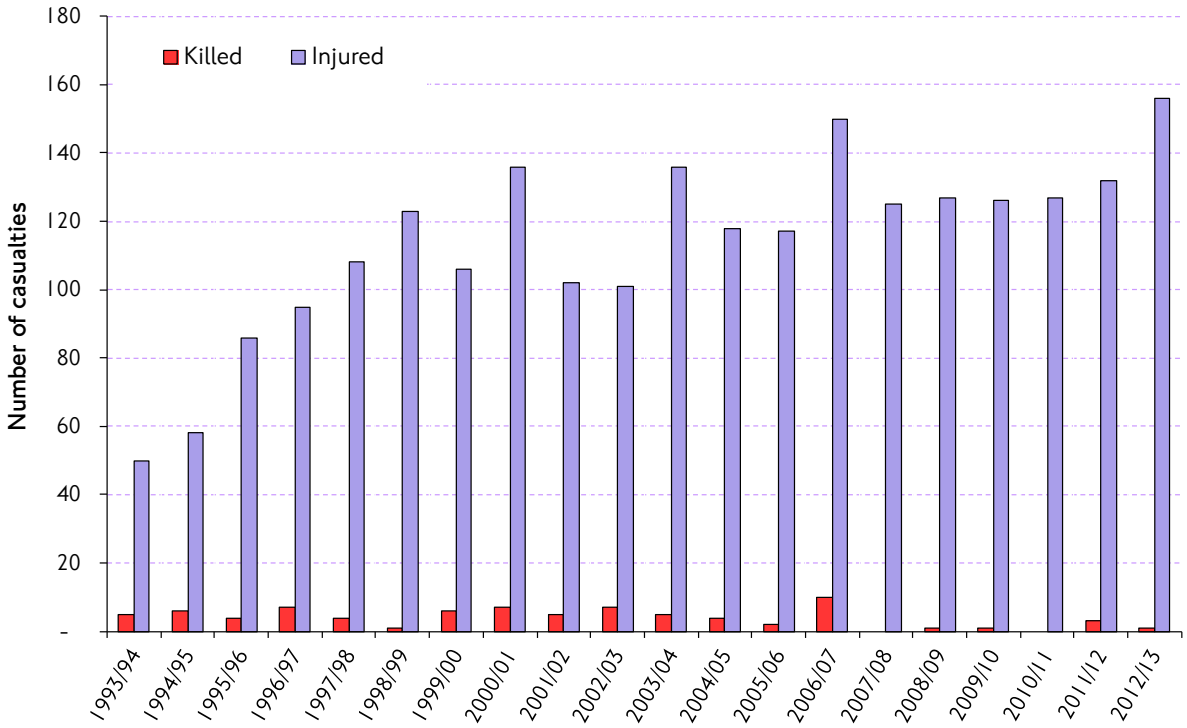
London Underground

On the Underground, passenger injuries in 2012/13 were higher than recent years, with one fatality and 156 other major injuries. At the same time passenger numbers on the Tube reached new levels, with over 1.2 billion passenger journeys made, a five per cent increase on 2011/12. The fatality involved an incident on the Metropolitan line at Finchley Road (figure 5.3). The Office of Rail Regulation concluded this was not an industry caused fatality.

Buses and coaches

In 2012, 92 bus users sustained major injuries in London, with two fatalities. The fatalities resulted from separate incidents, one of which was a 69 year old male falling forward after sudden braking due to another vehicle. The other fatality was a 75 year old male, who fell down the stairs as the bus moved away. These casualty numbers exclude pedestrian and other vehicle users who might have been injured in collisions involving buses or coaches – these are included in the statistics described in section 5.2. Figure 5.4 shows a consistent trend of improvement in bus or coach passenger injuries over the last decade, despite an increase in the latest year. The number of people killed or sustaining major injuries whilst using the buses in 2012 stood at roughly half of the typical values at the start of the decade. This also reflects an approximate 65 per cent increase in bus or coach patronage, and therefore also represents a substantial reduction in risk per passenger.

Figure 5.3 Number of people killed or injured while travelling on London Underground.



Source: Transport for London. Excludes suicides and victims of assault and terrorist activity.

Figure 5.4 Number of people killed or sustaining major injuries while travelling on buses or coaches in London.

Source: Transport for London. Excludes suicides and victims of assault and terrorist activity.

5.5 Crime and antisocial behaviour on the public transport networks

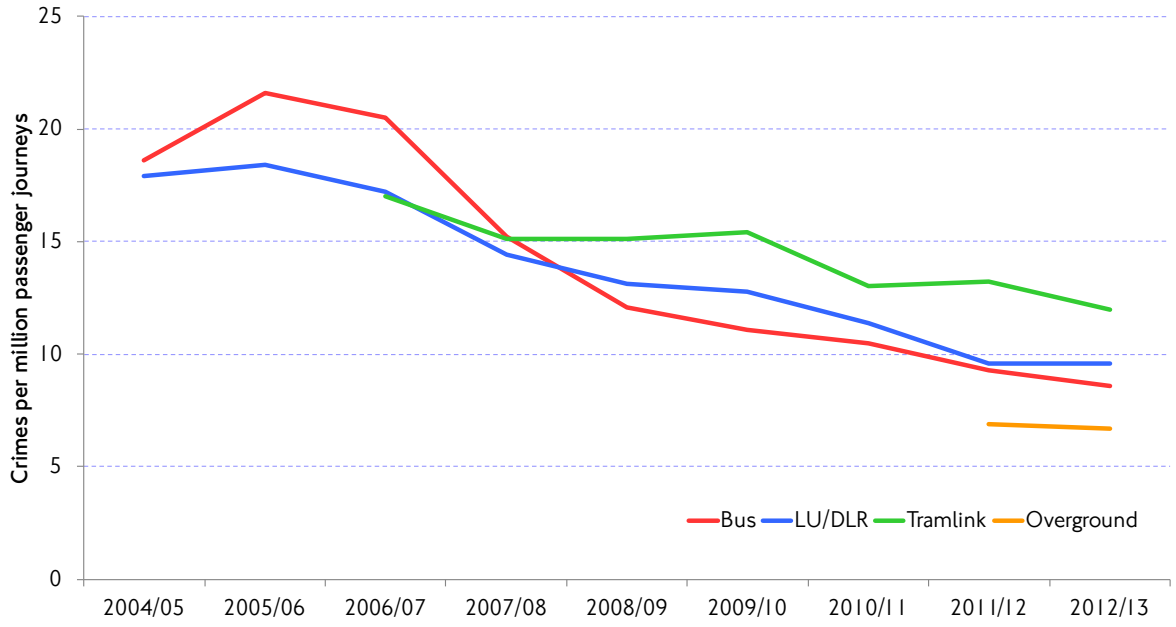
Summary

Levels of crime on TfL's transport system have continued to fall in 2012/13 – down by 2.3 per cent on 2011/12. The rate of crime for TfL's public transport system has fallen to 8.9 crimes per million passenger journeys, down from 9.4 in 2011/12. The risk of becoming a victim of crime while travelling on TfL's transport system is now at its lowest recorded level.

Trend for recorded crime on London's public transport networks

Progress during 2012/13 was broadly consistent with recent trends (figure 5.5). There were 8.6 reported crimes per million customer journeys on the bus network, down from 9.3 in the previous year (a reduction of 7.5 per cent). There were also reductions of reported crime on Tramlink and London Overground over the previous year, these falling by 9.1 per cent and 2.9 per cent respectively. On the Underground and DLR networks, there were 9.6 reported crimes per million customer journeys during 2012/13, the same level as 2011/12. However this follows successive reductions in previous years.

Figure 5.5 Crime on TfL's public transport networks. Rate per million passenger journeys.



Source: TfL Enforcement and On-street Operations.

5.6 Access to jobs and services (transport connectivity)

Background

The key role of London's transport system is to provide access to jobs, services and other opportunities so that London can function efficiently and its economy can continue to grow. The efficacy of London's transport networks, particularly the public transport networks, was amply demonstrated during the 2012 London Games, when unprecedented numbers of visitors were accommodated while the rest of London was kept functioning and 'open for business'. However, on a day-to-day level, it is known that the availability of transport can still act as a constraint on,

for example, the ability of people to reach suitable employment opportunities. Furthermore, as London's population continues to grow, new and improved transport links to cater for this growth and greater connectivity assume crucial importance.

The MTS therefore provides for both large-scale 'step change' improvements, such as Crossrail (expected to open in late 2018) alongside numerous smaller scale or incremental improvements (for example, the introduction of new rolling stock on the Underground under the Tube upgrade programme or the better alignment of local bus services with local needs). A variety of tools are available to TfL to help ensure that this investment is directed appropriately.

This section looks at how TfL measures strategic connectivity, and looks at relative change across London between 2007 and 2016 and, reflecting Crossrail, with expected conditions in 2031 (the end of the period fully covered by the MTS).

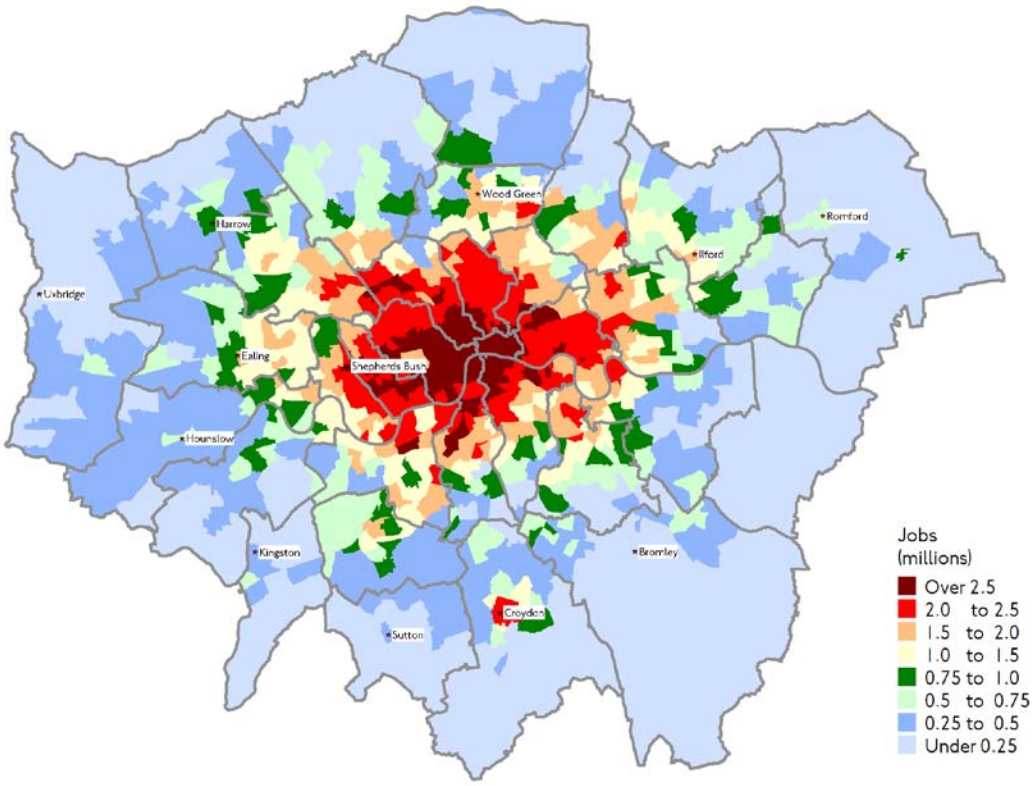
Accessibility to jobs

Good transport links are essential for moving people between their homes and workplaces – as well as other places that provide essential or discretionary services. One measure that can be used to quantify the development of the transport networks is the number of jobs (whether filled or currently vacant) that are potentially available within a given travel time from a particular residential location. The basis for assessing this is a travel time contour of 45 minutes by the principal public transport modes, expressed as an aggregate measure across Greater London.

Figure 5.6 shows these results for 2012. The map should be interpreted in terms of, from any one point, the number of jobs that are potentially reachable in 45 minutes. Given the nature of TfL's transport models used to derive this measure and the evolutionary pace of change in the transport networks, it is not always possible or appropriate to update this indicator each year. Furthermore, the changing number of jobs from year-to-year will also have an impact. As might be expected, the map reflects the concentric pattern of employment density and also the primarily radial orientation of the public transport networks. Typically, for people living in outer London, between 0.25 and 0.5 million jobs are potentially available from their home location within 45 minutes travel time. However, this rises to typically around 2.5 million jobs potentially available to a resident of central London.

Table 5.2 shows the available time-series for this indicator, and shows steady progress in terms of increased access to employment in London.

Figure 5.6 Number of jobs available by mass public transport within 45 minutes travel time, 2012.



Source: TfL Planning Strategic Analysis.

Table 5.2 Number of jobs available by mass public transport within 45 minutes travel time, 2012. London-wide average of small-area scores.

Year	Number of jobs available within 45 minutes travel time
2006	937,900
2009	959,400
2011	980,200
2012	989,450

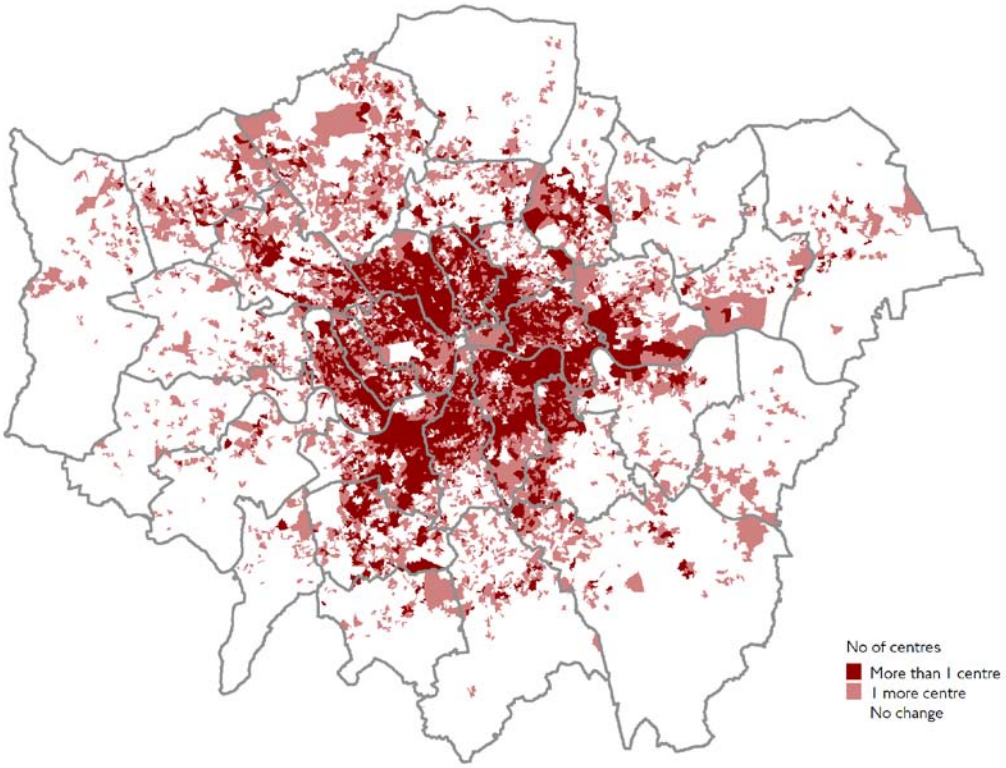
Source: TfL Planning Strategic Analysis.

Accessibility to town centres

Town centres are important as they contain concentrations of services and opportunities that are commonly accessed from both the local area and further afield. In looking at accessibility (connectivity) to town centres in London, it is most informative to exclude central London itself, as this can obscure the more local effects that are of primary interest to many Londoners. Therefore, the following analysis looks at connectivity to 'metropolitan' and 'major' town centres only, of which there are 12 of the former and 35 of the latter in London.

Figures 5.7 to 5.9 look at how connectivity to these town centres is expected to change, given current strategic transport plans and investment, over the entire period of the MTS (2007 to 2031). Figure 5.7 looks at the period between 2007 (the approximate date of the MTS) and 2016 (the 'benchmark' year before Crossrail is due to open). Figure 5.8 looks at the period from 2016 to 2031, and includes the impact of Crossrail itself and several other schemes, such as improvements to Thameslink. Figure 5.9 is a combined graphic overlaying the post 2016 improvements on those between 2007 and 2016. Table 5.3 gives a range of accessibility/connectivity statistics at the borough level relating to these maps.

Figure 5.7 Change in connectivity to metropolitan and major town centres in London 2007-2016. Change in the number of centres that can be reached within 45 minutes travel time, by Census output area.



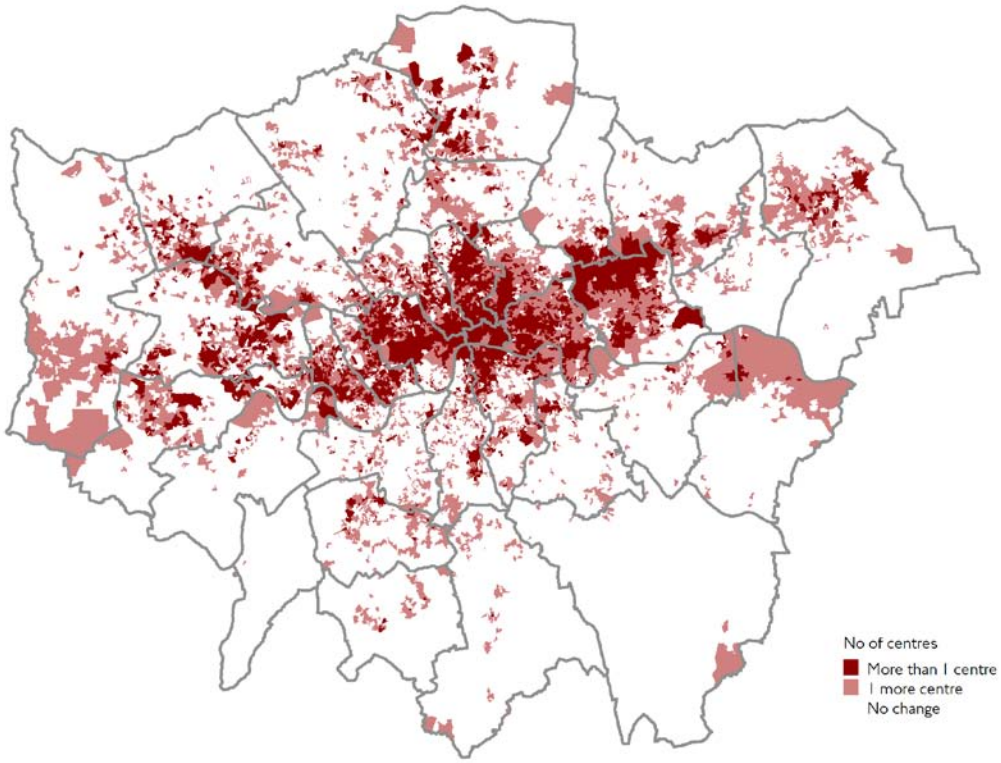
Source: TfL Planning Strategic Analysis.

Looking first at figure 5.7, it can be seen that improvements are widespread, reflecting incremental schemes across the rail and Underground networks. Examples of these improvements have included the recent establishment of the London Overground, improving connectivity throughout inner London by the creation of a high-frequency inner orbital route. Other examples include new stations at Mitcham Eastfields and Shepherds Bush as well as the on-going upgrades under the Tube upgrade programme. Although not shown on the maps, there have also been widespread improvements to regional and international rail networks, including new domestic services on High Speed One, and various upgrades to radial long-distance rail routes serving London.

Figure 5.8, looking at planned change from 2016 to 2031, clearly shows the 'step change' impact of Crossrail, with improvements concentrated on an east-west axis and

with a particular focus on the area around Abbey Wood – one of the eastern termini for Crossrail services. The impacts of continued improvements to Thameslink are also visible on a north-south axis, alongside benefits from the continuing Tube upgrade programme. However, the geographic spread of improvements is more concentrated post-2016 than before, reflecting a greater degree of uncertainty – at this distance – as to the exact nature of some of the more local improvements.

Figure 5.8 Change in accessibility/connectivity to metropolitan and major town centres in London 2016-2031. Change in the number of centres that can be reached within 45 minutes travel time, by Census output area.



Source: TfL Planning Strategic Analysis.

Table 5.3 sets out several statistics that relate to these maps. The first four columns relate to the average number of metropolitan and major centres that can be reached within 45 minutes of each Census output area (COA) within the borough. In all cases there is an increase, although in many cases this is fractional at the borough level, reflecting averaging across small area geographies. It is generally the case that the better-connected boroughs towards central London tend to see the greater increase in connectivity in future, although there are noteworthy increases for Hackney and Newham in east London. The second group of four columns concern the average time to the nearest metropolitan or major centre from each Census output area within the borough. Here, the large majority of boroughs see an improvement, as much as a 5.1 per cent reduction in average travel time. Interestingly, it is not the case that boroughs that see the greatest change in connectivity to town centres see the largest reductions in average travel time. This reflects the emphasis in this comparison on strategic rail projects, which work to improve connectivity at the city-wide scale.

Table 5.3 Change in connectivity to metropolitan and major town centres in London 2007-2031.

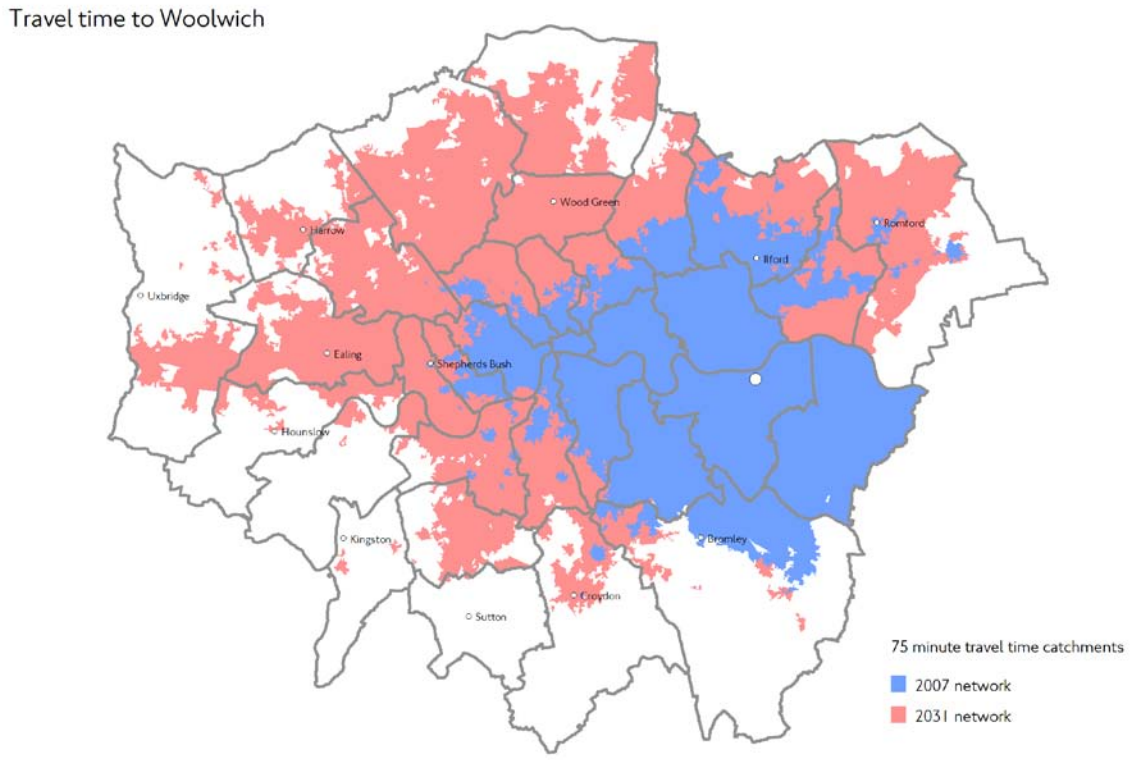
Borough	Average no. of centres accessible within 45 minutes in 2007	Average no. of centres accessible within 45 minutes in 2016	Average no. of centres accessible within 45 minutes in 2031	Difference 2007 to 2031 - % change	Average time from each COA - 2007	Average time from each COA - 2016	Average time from each COA - 2031	% Change 07 to 31
Kingston	3	3	3	2.4	22.8	22.7	22.7	-0.3
Bromley	3	3	3	6.0	24.4	24.0	24.1	-1.2
Sutton	3	3	3	8.3	24.1	24.0	24.0	-0.5
Croydon	3	3	3	8.1	25.9	25.8	25.8	-0.5
Barking and Dagenham	4	4	5	8.0	24.5	23.9	24.0	-1.9
Bexley	3	3	3	13.6	23.7	24.2	22.8	-3.7
Richmond upon Thames	6	6	6	6.4	21.1	21.0	21.0	-0.3
Hillingdon	2	2	2	19.8	29.7	29.1	28.2	-5.1
Enfield	2	2	3	18.4	26.1	26.0	25.9	-0.9
Redbridge	4	4	4	10.9	26.7	26.6	26.6	-0.3
Havering	2	2	3	20.3	29.4	29.6	29.4	-0.0
Greenwich	5	5	5	13.7	22.5	22.5	22.3	-1.2
Hounslow	6	6	6	12.3	25.1	25.0	25.0	-0.5
Barnet	3	3	4	25.9	30.7	29.6	29.3	-4.5
Harrow	3	4	4	22.8	26.1	25.8	25.7	-1.6
Haringey	6	6	7	15.0	22.0	21.8	21.8	-0.9
Ealing	7	7	8	12.5	21.7	21.6	21.6	-0.9
Waltham Forest	5	5	6	23.1	23.4	23.3	23.3	-0.3
Lewisham	5	6	6	19.6	19.2	19.0	19.0	-0.6
Merton	8	9	9	15.5	21.0	20.8	20.8	-1.0
Brent	6	7	8	22.5	20.9	20.8	20.8	-0.7
Wandsworth	12	13	14	16.2	15.0	15.0	15.0	-0.5
Lambeth	10	12	12	20.0	17.8	17.7	17.7	-0.6
Newham	6	6	8	41.9	18.7	18.5	18.1	-3.2
Hackney	8	9	10	33.4	17.9	17.8	17.8	-0.6
Hammersmith & Fulham	14	16	17	23.1	13.4	13.4	13.4	-0.4
City of Westminster	18	19	21	18.1	17.2	17.0	17.0	-1.3
Kensington and Chelsea	16	18	19	20.3	13.8	13.8	13.7	-0.7
Southwark	9	11	12	36.9	19.9	19.6	19.6	-1.8
Camden	12	14	15	30.2	15.7	15.4	15.4	-1.6
Tower Hamlets	10	12	14	35.6	21.3	20.9	20.8	-2.2
Islington	10	12	14	41.3	14.0	13.9	13.9	-0.7
City of London	21	23	26	21.6	18.6	18.2	18.0	-3.3

Source: TfL Planning Strategic Analysis.

Example of connectivity improvements – Woolwich

Figure 5.9 shows the connectivity improvement to/from Woolwich. Woolwich has benefitted in particular from the extension to the DLR network in 2009, and will also benefit from proximity to Crossrail after 2016. Between 2007 and 2016 the connectivity improvements are widespread but relatively local within east and south east London, reflecting the DLR extension. From 2016 however Crossrail considerably extends the accessibility catchment of Woolwich, with large parts of the remainder of London becoming accessible within the 75 minute threshold set for this graphic.

Figure 5.9 Change in 75 minute travel time catchment to/from Woolwich, 2007 and 2031 compared.



Source: TfL Planning Strategic Analysis.

Table 5.4 illustrates the impact of this improved connectivity on population and jobs. In 2007, before DLR and Crossrail, almost 113,000 people could access Woolwich within 30 minutes. In 2031, with both DLR and Crossrail, this number almost doubles - to 224,000. The increase between 2007 and 2031 in the number of people who can access Woolwich within 75 minutes is even more dramatic – up from 2.6 million to 6.0 million. In terms of jobs, the impact of these changes in unlocking access to opportunities is very clear. Whereas in 2007 just 125,000 jobs were accessible from Woolwich within 45 minutes (reflecting a 'typical' commuting time), this rises to 1.8 million in 2031.

Table 5.4 Change in population accessibility to Woolwich, and employment accessibility from Woolwich, 2007-2031.

Woolwich

2011 forecast population

Time	<30 minutes	<45 minutes	<60 minutes	<75 minutes
2007 network	112,800	339,600	1,040,900	2,628,400
2016 network	116,800	398,700	1,367,200	3,263,400
2031 network	224,400	1,281,400	3,490,700	6,045,300

2011 forecast employment

Time	<30 minutes	<45 minutes	<60 minutes	<75 minutes
2007 network	42,100	125,000	889,800	2,576,900
2016 network	43,200	175,200	1,435,600	2,887,300
2031 network	329,800	1,805,400	3,000,900	4,092,100

Source: TfL Planning Strategic Analysis.

5.7 Physical accessibility to the transport system

Summary

It is important that London's transport system is accessible to all members of the community, and efforts continue to be made to update the transport system to achieve this. TfL's draft Accessibility Implementation Plan [3] summarises current plans, and is based on the concept of 'whole journeys', rather than focusing on specific elements of the infrastructure. The 2012 Games gave TfL the opportunity to examine in detail aspects of physical accessibility to the transport system and to promote independent travel for disabled Londoners. Many aspects of enhanced provision during the Games are being taken forward as part of the wider legacy of the 2012 Games (see also section 8.10 of this report).

Summary of current accessibility provision

Previous Travel in London reports have set out statistics describing the accessibility status of key elements of the transport infrastructure in London. These have been combined into a 'physical accessibility' strategic outcome indicator for the MTS, expressed in terms of a weighted percentage score across the modes. The trend for this indicator is one of relatively slow incremental improvement (table 5.5), and the most recent value for 2012/13 continues this trend, with a score of 46 per cent. The speed of progress with this indicator reflects the generally low level of heritage provision and the large-scale, capital-intensive nature of the changes to infrastructure that are often required.

Table 5.5 Modal composite physical accessibility score.

Year	Composite physical accessibility score (%)
2007/08	(36)
2008/09	(36)
2009/10	37
2010/11	38
2011/12	44
2012/13	46

Source: TfL Planning Strategic Analysis.
Note: Values prior to 2009/10 are based on a dataset that differs in minor respects to that used from 2009/10.

5.8 Customer satisfaction and the journey experience

Summary

Improving the quality of Londoners' overall daily travel experience is a priority for the Mayor. Previous Travel in London reports have described the range of perception and customer satisfaction-based indicators that TfL uses to understand how Londoners view their travel experiences and therefore the impact of the Mayor's transport policies on their quality of life. These indicators are generally relatively slow to change, as the impact of individual specific improvements is often difficult to detect in surveys at the London wide level. Also, as improvements are made over time, so public expectations also tend to rise. Nevertheless, the positive impact on journey quality of recent large-scale step-change projects such as the transformation of the London Overground network and Tube upgrades has been clearly seen in indicators at the modal level, and the general trend in the summary indicators over the past five years has been one of improvement.

Recent trends in perception/customer satisfaction based MTS strategic outcome indicators

Previous Travel in London reports have described the suite of surveys that TfL uses to monitor aspects of the journey experience. Results are presented in terms of mean scores out of 100 (these are not percentage scores), based on a response ranking system from zero (lowest satisfaction) to 10 (highest satisfaction). TfL interprets these scores in a semi-subjective way, based on experience (this albeit open to different interpretation by different people) based on the scale shown in table 5.6.

Table 5.6 TfL's interpretation of customer satisfaction scores.

Score	Interpretation
Under 50	Very poor
50 to 54	Poor
55 to 64	Fairly poor
65 to 69	Fair
70 to 79	Fairly good
80 to 84	Good
85 to 89	Very good
90 or more	Excellent

Source: TfL Customer Satisfaction surveys.

Table 5.7 updates the key perception/customer satisfaction MTS strategic outcome indicators for the most recent year, against the longer-term trend, and also shows TfL's qualitative assessment of the position shown by each indicator for the latest year.

Table 5.7 Summary of trends in perception-based MTS strategic outcome indicators. Mean scores out of 100.

Indicator	2009 or 2009/10	2010 or 2010/11	2011 or 2011/12	2012 or 2012/13	2013 or 2013/14	TfL's assessment
Perception of journey experience	64	66	66	67	70	now 'fairly good'/general improvement
Public transport customer satisfaction	79	80	80	83	n/a	'good'
Satisfaction with public transport crowding	76	76	76	77	n/a	'fairly good'
TLRN road user customer satisfaction	n/a	72	75	76	n/a	'fairly good'/steady improvement
Perception of the urban realm	63	64	66	65	65	'fair'/slow improvement
Perception of transport-related noise	70	71	74	76	75	'fairly good'/general improvement

Source: TfL Customer Satisfaction surveys, mode share based upon journey stage estimates; TLRN users satisfaction survey; TfL Streets Management Customer Satisfaction survey; TfL Perceptions of Travel Environment survey.

The table shows that the trend for all indicators is one of steady improvement. Scores for 2012 or 2012/2013 reflect the period of the 2012 Games, during which customer satisfaction scores for the principal public transport modes were at highest-ever levels.

Perception of journey experience

This indicator looks at how London residents perceive their journeys overall. It complements mode-specific scores reported elsewhere and recognises the complex interaction between modes that is typical of travel in London.

The average satisfaction rating for travel in the Capital among Londoners in 2013 was 70 out of 100. This is the highest rating since the survey began, and continues a steady upward trend over the last five years.

Public transport customer satisfaction

This is a composite indicator based on scores for each of the individual modes weighted by their respective share of total public transport travel in London. Scores have improved over recent years, with a particular improvement to a value of 83 in 2012 – among other things reflecting the exceptional performance of the transport networks during the 2012 Games.

Satisfaction with public transport crowding

Scores for this indicator have been stable over the review period. The values correspond to a 'fairly good' assessment according to TfL's criteria.

TLRN road user customer satisfaction

This indicator is defined as the satisfaction of London residents with the operation of the Transport for London Road network (TLRN). The survey includes those who travel on the TLRN by car (as driver), bus, cycle, motorcycle, commercial vehicle or as a pedestrian.

The index for 2012 (that for 2013 is not yet available) increased by one point over 2011 to an average score of 76. However, this conceals considerable movement at the sub-mode level (although smaller sample sizes mean that scores for individual modes are subject to greater statistical error). Scores for car, taxi, bus and motorcycle users increased notably over 2011, whereas those for cyclists and pedestrians fell.

Perception of urban realm

Each year, London residents are asked to rate their satisfaction with the quality of streets, pavements and public spaces in their local area. For 2013 the average satisfaction rating was 65 out of 100. This indicator has shown an overall trend of slow improvement over the review period. Scores are relatively low compared to those that look at aspects of the transport system specifically, reflecting the fact that transport occurs in the context of the wider urban realm, not all of which can be controlled directly by transport providers.

Perception of transport-related noise in local area

Thinking about the area where they live, Londoners rate their satisfaction with transport-related noise as 75 out of 100 on average, which is regarded as being 'fairly good' according to TfL's scale, and consistent with the results from the preceding two years.

5.9 Transport, air quality, and greenhouse gas emissions

Summary

London's air quality has improved in recent years, although emissions of two local air quality pollutants continue to pose a challenge, and rates of reduction in London's greenhouse gas emissions are running behind applicable climate change reduction targets.

The London Atmospheric Emissions Inventories

Travel in London report 5 previewed the latest release of the London Atmospheric Emissions Inventory (LAEI) and associated London Energy and Greenhouse Gas inventory (LEGGI). These datasets detail air pollutant emissions from all identifiable sources across London, and are now available for general use on the London Datastore [4].

Normal practice has been to comprehensively update the inventories on a two-yearly basis, and hence the next full update is not expected before late 2014. As an interim measure, a partial update to the mobile source components of the inventories has been made, giving estimates of the amount of pollution (for the three atmospheric pollutants of greatest concern in London) emitted by ground-based transport sources, and the relative contributions to this total of the different modes of transport.

The 'base' year of the most recent full update to the inventories was 2010 (ie the data was representative of actual emissions in 2010), although the inventories also contain a comprehensive set of projections for future years. The interim updates to the ground-based transport sources give compatible estimates for 2011 and for 2012, alongside a revised estimate for road traffic in 2010, re-based using actual observed data on traffic volumes, composition and camera-based data describing the emissions performance of vehicles operating in London. Estimates for non-road ground-based transport sources have also been updated at the aggregate level using available data on changes to activity levels on these modes between 2010 and 2012.

Emissions of particulate matter (PM_{10}) from ground-based transport

Compliance with health-based air quality limit values for ambient concentrations of PM_{10} has been achieved in London over recent years, based on measurements at monitoring sites reportable to the European Union. Continued reductions to PM_{10} emissions are important to help reduce the adverse health impacts – it is estimated that PM_{10} is responsible for around 4,270 additional deaths 'brought forward' in London each year [5] - there is no 'safe' level of PM_{10}.

Ground-based transport accounts for about half of total PM_{10} emissions in London (including emissions from tyre and brake wear). Concentrations in the air on a daily basis however typically also reflect the importation of PM_{10} from elsewhere. This tends to be a particular factor during air quality 'episodes', when meteorological conditions prevent the dispersion of emissions, leading to elevated concentrations for a period of several days.

Table 5.8 Emissions of particulate matter (PM_{10}) from ground-based transport sources. Tonnes per year, whole Greater London area.

Source	2010 LAEI original estimate	Updated estimate for 2010	Estimate for 2011	Estimate for 2012
Road transport	597	599	525	467
Rail	129	Not updated	(129)[1]	(129)[1]
Shipping	9	Not updated	9	10
Total ground-based transport (excl. aviation)	735	(737)	663	606
Aviation	93	Not updated	96	95
Total mobile sources	827	Not updated	759	701

Source: TfL Planning Strategic Analysis.
1.Values for Rail not updated this year.

Table 5.8 shows the recent trend for PM_{10} emissions from the various forms of ground-based transport in London. Considering road traffic first and noting that the absolute emissions estimate for 2010 for the most recent full LAEI update is closely similar to that for 2010 from the new update (based on actual observed data), the trend of rapid improvement for this emission is clear. A reduction of 22 per cent occurred between 2010 and 2012, this reflecting a combination of the increased uptake of vehicles built to cleaner 'Euro' emissions standards, and continuing year-on-year reductions to the amount of road traffic circulating in London (see section 3.10 of this report).

Estimates for other ground-based transport sources reflect, for this update, changes to the observed levels of activity associated with each, based on the previous full LAEI estimate. In total, PM_{10} emissions from ground-based transport (excluding aviation) fell by 17.7 per cent between 2010 and 2012, this mainly reflecting reduced road traffic emissions.

Emissions of oxides of nitrogen (NO_x) from ground-based transport

Oxides of nitrogen are present in the air in several different forms. The pollutant of most direct concern in London is nitrogen dioxide (NO_2), owing to its adverse health impacts. However, the larger proportion of NO_2 in London's air is not emitted directly, but is formed through chemical reactions in the atmosphere involving nitrogen oxide (NO) and Ozone (O_3). The combination of NO and NO_2 is collectively referred to as NO_x, and it is in these terms that emissions are measured.

Compliance with European Union limit values remains problematic in London, with concentrations of NO_2 close to roads in much of central and inner London continuing to exceed these limits.

Ground-based transport accounts for just under half of total NO_x emissions in London. Table 5.9 shows the recent trend for NO_x emissions from the various forms of ground-based transport in London.

Considering road traffic first and noting that the absolute emissions estimate for 2010 for the most recent full LAEI update is broadly comparable to that for 2010 from the new update (based on actual observed data), the reduction between 2010 and 2012 was 12.1 per cent, from 23,361 tonnes to 20,535 tonnes. Again this reduction partly reflects continuing improvements to vehicle emissions

performance (although progress for NO_x has been rather slower and less successful to date than that for PM_{10}) and falling traffic levels.

Estimates for other ground-based transport sources reflect, for this update, changes to the observed levels of activity associated with each. In total, NO_x emissions from ground-based transport (excluding aviation) fell by 12.4 per cent between 2010 and 2012.

Table 5.9 Emissions of oxides of nitrogen (NO_x) from ground-based transport sources. Tonnes per year, whole Greater London area.

Source	2010 LAEI original estimate	Updated estimate for 2010	Estimate for 2011	Estimate for 2012
Road transport	23,657	23,361	21,644	20,535
Rail	3,920	Not updated	(3,920)[1]	(3,290)[1]
Shipping	368	Not updated	354	409
Total ground-based transport (excl. aviation)	27,945	(27,649)	25,918	24,234
Aviation	3,871	Not updated	3,995	3,943
Total mobile sources	31,816	Not updated	29,913	28,177

Source: TfL Planning Strategic Analysis. (1) Values for Rail not updated this year.

Emissions of carbon dioxide (CO_2) from ground-based transport

Carbon dioxide is the major greenhouse gas, and emissions are the subject of reduction targets at the international, national and London-wide scales. Ground-based transport accounts for slightly more than 20 per cent of total CO_2 emissions in London. Table 5.10 shows the recent trend for CO_2 emissions from the various forms of ground-based transport in London.

Looking first at road traffic, the reduction between 2010 and 2012 was 5.1 per cent, from 6,643 kilotonnes to 6,307 kilotonnes. This again reflects a combination of less road traffic and improved vehicle performance, although the pace of technology-led improvement to CO_2 emissions from road vehicles is slower than that for PM_{10} and NO_x.

Including the other ground-based transport sources, total ground-based transport emissions of CO_2 emissions fell by an indicative 4.0 per cent, although full data for rail-based modes, which have seen increased services on many lines over the most recent two years, were not available for this update.

Table 5.10 Emissions of carbon dioxide (CO_2) from ground-based transport sources. Kilotonnes per year, whole Greater London area.

Source	2010 LAEI original estimate	Updated estimate for 2010	Estimate for 2011	Estimate for 2012
Road transport	6,771	6,643	6,413	6,307
Rail	1,630	Not updated	(1,630)[1]	(1,630)[1]
Shipping	20	Not updated	19	22
Total ground-based transport (excl. aviation)	8,420	(8,292)	8,062	7,959
Aviation	1,000	Not updated	1,032	1,019
Total mobile sources	9,420	Not updated	9,094	8,978

Source: TfL Planning Strategic Analysis. (1) Values for Rail not updated this year.

5.10 Resilience of the transport system to the effects of climate change

TfL has assessed and evaluated the future climate change impacts on its assets and services, referencing the latest generation of climate projections, the 2009 United Kingdom Climate Projections (UKCP 09 [6]). A particular focus has been on the projections for Greater London rainfall and temperature in the 2020's, 2050's and 2080's. TfL has liaised with the GLA and used its understanding of what the UKCP 09's range of probabilistic projections mean for London, as presented in the draft Mayor's Climate Change Mitigation and Energy Strategy (CCMES) [7]. The 'medium' emission scenario has been used and it has been identified that the risks in the 2050's are likely to be:

- Higher summer temperatures – with the average summer days being 2.7°C warmer and very hot days 6.5°C warmer than the baseline average.
- Warmer winters – winters will be warmer with the average winter day being 2.2°C warmer and a very warm winter day 3.5°C above the baseline.
- More seasonal rainfall – summers will be drier, with the average summer 19 per cent drier and the driest summer 39 per cent drier than the baseline average.
- Wetter winters – with the average winter 15 per cent wetter and the wettest winter 33 per cent wetter than the baseline average.
- Sea level rise – sea levels are projected to rise by up to 96 cms by the end of the century.

There are a number of elements of London's transport network that have the potential to be affected by weather related events, such as flooding, overheating, low temperatures and snow. The TfL functions which are most likely to be affected by climate change include:

- Those relating to the provision of public passenger transport including Tube, rail, bus and River Services.
- TfL's functions as highway authority and traffic authority for GLA roads.
- TfL's facilitation of the discharge of the Mayor's general transport duty (which is a duty to develop policies and proposals for the implementation of safe, integrated, efficient and economic transport services to, from and within Greater London).
- The implementation of the policies and proposals contained in the Mayor's Transport Strategy, in particular proposals which relate to adaptation to climate change.

TfL analyses extreme weather and other risks to its assets and services as part of its corporate approach to risk assessment. The key adaptation risks that have been identified by TfL are:

- Flooding;
- extreme high temperatures;
- low temperatures and temperature fluctuations;
- population migration risks;
- air quality.

TfL's risk assessments show the majority of adaptation risks are in the 'low' or 'medium' categories, when compared with the full range of business risks. At a high level, TfL's approach follows the principles set out in the draft Mayor's Climate Change Adaptation Strategy of 'prevent, prepare, respond, and recover'. On a more day-to-day level, these risks are managed through normal business operations and future planning. Examples of TfL's activities in the last year demonstrate the range of activities taking place under this heading:

- **Rail and Underground.** London Underground has started work on a comprehensive flood risk review. This will examine all flood risks across the entire LU network including

the connecting parts of London Overground and the DLR. The review will consider all potential water entry points into the system. This will be at least 850 sites, including circa 300 stations, 500 or more shafts and 50 or more tunnel portals. It will take into account the predicted changes to rainfall patterns as a result of climate change, which is expected to result in significantly more intense storms. This project will deliver a summary report that identifies all locations vulnerable to flooding inundation across the LU network, the level of risk exposure and recommendations for mitigation measures.

- **Surface Transport.** TfL manages the key Transport for London Road Network, which carries around 30 per cent of traffic vehicle-kilometres in London. It also manages road gullies and any carrier drains between them and the public sewer system. TfL Surface Transport has a programme of proactive maintenance activities that it carries out regularly, and a particularly enhanced set of activities if rainfall likely to cause surface water flooding is forecast. TfL responds to weather forecasting services notice of abnormal rainfall and uses 'gully suckers' and larger vacuum machines for treating known vulnerable locations on the road network.
- **Project management.** TfL has included questions in sustainability appraisal in its 'Pathway' project management process for projects and programmes for construction related projects valued at more than £1m. Project managers are required to consider how what they are having designed and built will be resilient to the extreme weather and changing climate over its whole design life, sometimes up to 120 years hence.
- **Working with boroughs.** TfL has continued to provide support and works collaboratively with boroughs that are developing their Surface Water Management Plans. In doing this, the boroughs have been identifying their critical drainage areas and ensuring that any flood risks associated with TfL's assets in their borough are assessed and mitigated.

5.11 Focus on: Real-world emissions from road vehicles in London

Background

As part of its responsibility to compile atmospheric emissions inventories for London, TfL has been aware for some time of a disparity between estimates of vehicle emissions that are recommended for use by the UK and European Union authorities, and those that actually occur under typical operating conditions in London. The principal source of these disparities is the difference between typical traffic conditions in London (stop-start conditions, featuring frequent acceleration, braking and slow-speed movement) and those assumed by vehicle testing cycles, which are intended to replicate typical overall service conditions. However, other factors are also involved, most notably some basic differences between the actual performance of vehicle technologies, including exhaust after-treatment systems, particularly as vehicles age. Also, systems mandated by the legislation ('Euro' emission standards for local air quality pollutants), and proven under idealised test conditions, may perform differently under real-world or 'off-cycle' conditions.

Why is this important?

Air quality modelling, for example to assess the changes in concentrations of pollutants in the air in response to policy initiatives, relies on estimates of emissions from emissions inventories. However, the modelling is also carefully calibrated to actual measured concentrations, and appropriate adjustments to compensate for differences are made as part of the modelling process. This means that the absolute concentrations of pollutants that are forecast by the models can be considered to be 'correct' and fit-for-purpose. But recent experience with

models has revealed the 'error term' to be undesirably large. Furthermore, to the extent that emissions from the various vehicle types are differently mis-represented, the validity of policy judgments made on the basis of model outputs could potentially be affected.

TfL and the wider air quality community are fully aware of these issues, and share and implement best practice in emissions estimation. As part of this wider work, TfL has recently sponsored a series of chassis dynamometer emissions tests of representative types (vehicle size, age/condition and fuel type) of passenger cars operating in London. These tests have been conducted according to a series of bespoke 'drive cycles', carefully derived so as to represent typical driving conditions in London.

The results of these tests are confirming other observations of actual vehicle performance under real-world driving conditions. It is intended that these new data will be used to further improve future versions of the London inventories, although it must be stressed that current inventories already include many features that are intended to allow them to reflect actual traffic conditions in London more accurately – for example very detailed representation of London's bus fleet and comprehensive data on traffic speeds and composition on individual road links.

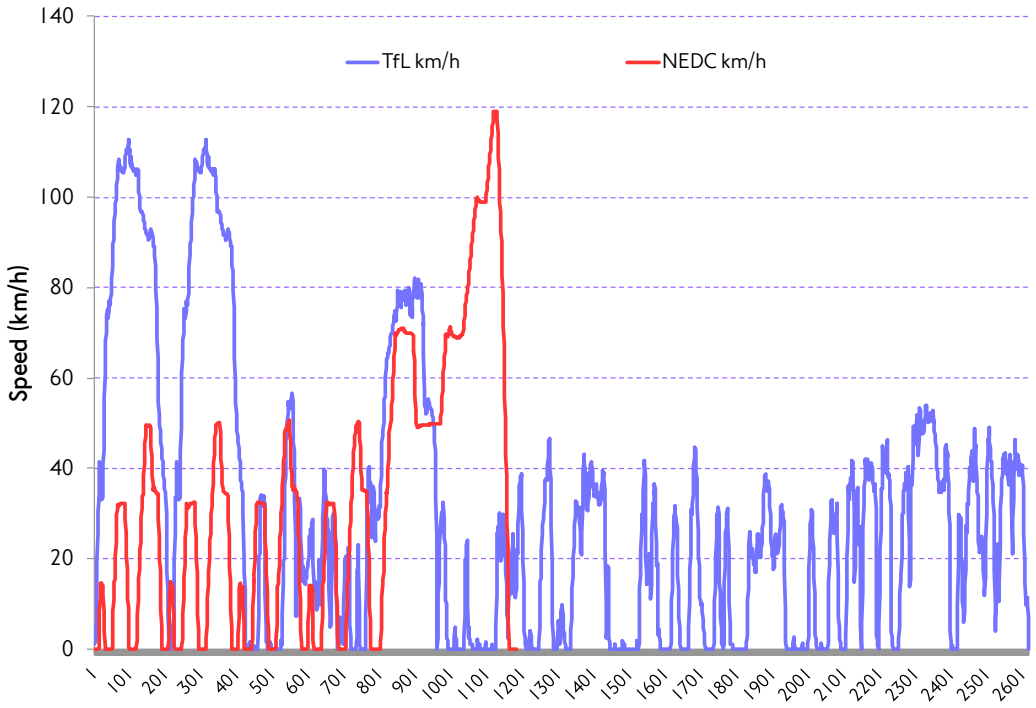
Furthermore, a common issue with tests of this nature is that they are usually based on only a small number of individual vehicles. Therefore, while the results of individual vehicle tests should not be taken as definitive, if independent tests across several vehicles are corroborative, it is possible to use them in combination to develop new sets of emissions factors for use in emissions inventories.

The following material provides just an outline of the results of some of these tests, concentrating on CO_2 emissions, which are directly linked to vehicle fuel consumption. A fuller summary of this material, extended to cover the key local air quality pollutants of NO_x and PM_{10}, will be published by TfL in 2014.

TfL passenger car emissions testing

In order to better understand the emissions characteristics of the London passenger car fleet, a new drive cycle was developed, representing the mix of road types and traffic conditions found in London. This new cycle is illustrated below, overlain by the New European Drive Cycle (NEDC) conventionally used for type approval emissions testing (figure 5.10). What is obvious is the additional 'transience' of the new London cycle, better representing typical driving conditions in London. The new cycle has an average speed of 26.34 km/h, compared with 33.35km/h for the NEDC.

Figure 5.10 A comparison of the TfL passenger car drive cycle with the NEDC type approval drive cycle.



Source: TfL Planning Strategic Analysis.

Some example results from TfL emissions testing

Seven different types of car have been tested, to represent the market segmentation of the UK vehicle fleet. All of these vehicles were built to Euro 4 specification. Two further Euro 2 specification family saloons were tested to allow comparison with cars that utilise a different engine management strategy and without on-board diagnostics. For each market segment, petrol or diesel fuel was selected to represent the most popular fuel type in that segment. Tests were conducted to simulate operating conditions on urban, suburban and motorway roads and during free-flow, AM peak and inter peak traffic conditions. Exhaust emissions from all cars were sampled and analysed to reveal the levels of all the legislated air quality pollutants (for example, NO_x, PM_{10}) and CO_2.

Motorists often ask why they are unable to achieve the 'official' fuel economy figures for their car. This test programme quantifies, for London, the level of discrepancy between real driving conditions and the type approval test. The overall underestimation of CO_2 emissions from passenger cars in London is calculated to be 25 per cent. This is caused by the omission of vehicle ancillary systems in the DfT emissions factors and the impact of differing drive cycles in the all-important 5 – 40km/h urban speed range.

Table 5.11 shows results from three different tests. These are: the type approval NEDC test; the TfL 'warm start' suburban test under free-flow traffic conditions; and the TfL 'cold start' urban test under inter-peak traffic conditions. These have been selected because the warm start suburban free-flow cycle produces results most similar to NEDC and the 'cold' urban inter- peak produces the greatest

difference from NEDC. All the other TfL cycles produce test results in a range between these.

It is clear from table 5.11 that some of the emissions values are better than the NEDC results, while others are more than double those of the NEDC. This illustrates the scale of the problem when attempting to characterise the emissions of traffic in London. It also demonstrates the variance that exists between 'real-world' driving conditions and the NEDC type approval test. The existence of a variance is widely accepted, but here it is quantified for common London driving conditions. It is also apparent that diesel cars produce CO_2 emissions significantly lower than petrol cars of a similar size. However the air quality emissions performance of diesels will normally be worse than petrol engines of a similar Euro standard.

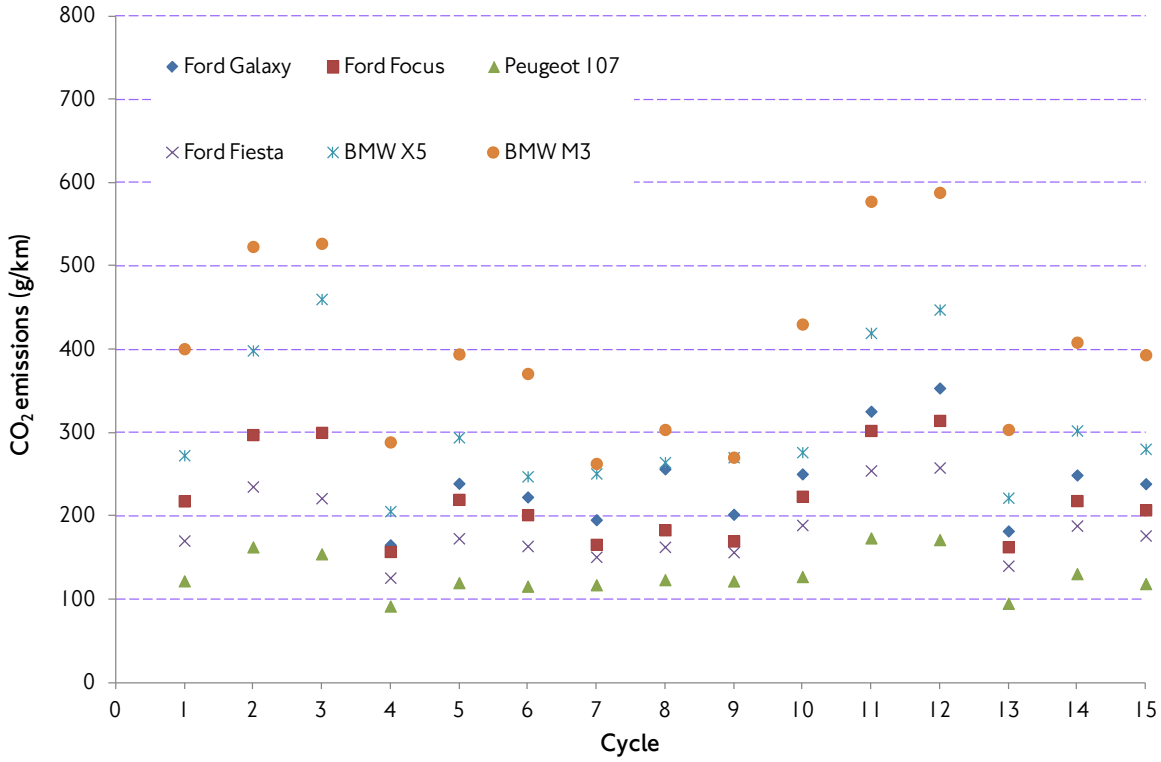
Table 5.11 Comparison of CO_2 emissions, per vehicle type, measured over type approval and TfL drive cycles.

Market segment	Fuel type	New European drive cycle (CO_2 g/km)	TfL warm suburban free flow (CO_2 g/km)	TfL cold urban inter-peak (CO_2 g/km)
Compact	Petrol	109	92	171
Mini	Diesel	119	126	189
Supermini/small family	Petrol	162	157	315
Family/MPV	Diesel	172	165	353
Prestige saloon/sports	Petrol	323	289	588
SUV 4x4	Diesel	214	206	448
Hybrid saloon	Petrol/electric	92	90	104
Family saloon (Euro 2)	Petrol	178	190	413
Family saloon (Euro 2)	Diesel	151	139	266

Source: TfL Planning Strategic Analysis.

Figure 5.11 reveals the disparity in CO_2 emissions from a range of typical light-duty vehicles seen on London's streets. Included in this comparison are representatives of the main market segmentation groups within the UK vehicle fleet. The Peugeot 107, Ford Focus, and BMW M3 have petrol engines, while the Ford Galaxy, Ford Fiesta and BMW X5 have diesel engines. Also included in this comparison is a diesel fuelled, Ford Transit van of 3,500 kg gross vehicle weight. The CO_2 performance is shown for each of the test cycle permutations that were used. It is clear that the emissions occur in a range from just under 100 g/km to almost 600 g/km, dependent on vehicle type and duty cycle. What is also significant is the extent to which the range of emissions, from lowest to highest, vary between duty cycles.

Figure 5.11 TFL passenger car drive cycle CO_2 emissions results shown by vehicle type and test cycle phase

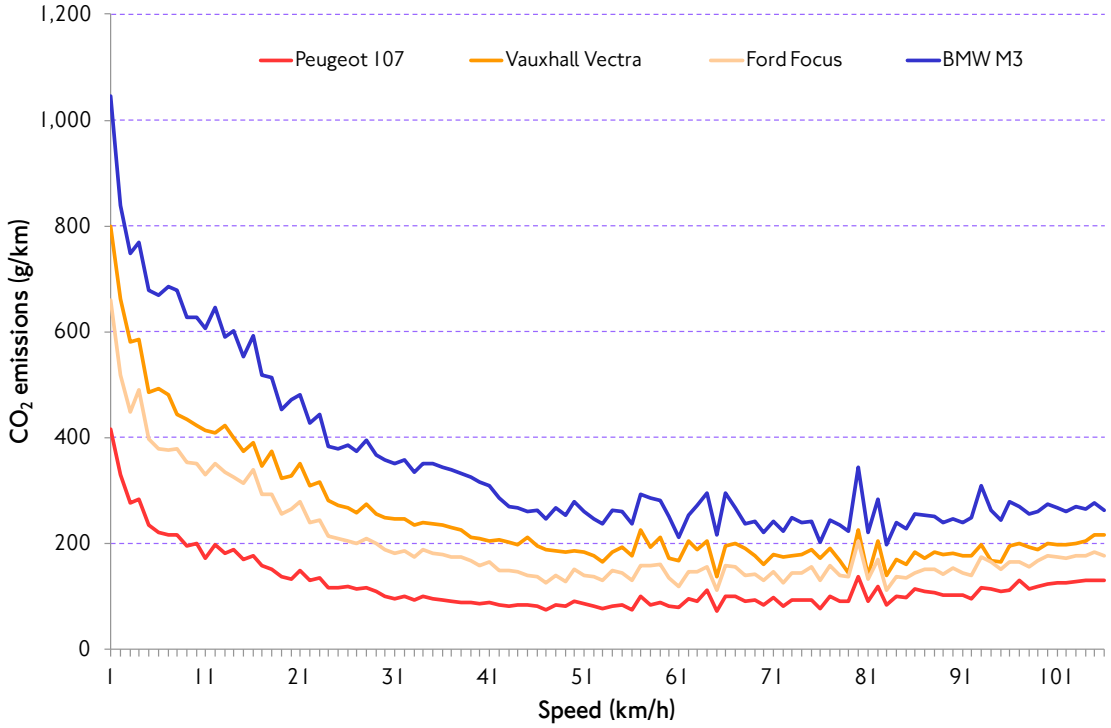


Source: TfL Planning Strategic Analysis.

Another important aspect of CO_2 emissions quantification is the effect of running at low speeds and of idling when stationary. Figure 5.12 shows the CO_2 emissions in grams, plotted against vehicle speed for five of the test vehicles. This shows the dramatic increase in emissions at speeds below 10 km/h, which is important in urban driving conditions, particularly in queuing traffic. This data is taken from the second-by-second emissions data accumulated during the testing.

Figure 5.12 shows CO_2 emissions, plotted against speed and compared with the estimates of the DfT emissions factors, averaged for all the tested petrol vehicle types. This indicates the variance in fuel consumption (and commensurate CO_2 emissions) between a car operating in London traffic conditions and the estimates made in the DfT emissions factors. In particular, it can be seen that there is a variance of, broadly, 20 per cent between the averaged CO_2 emissions in g/km, plotted against vehicle speed, when compared with the averaged CO_2 emissions from the DfT speed/emissions estimates. In this figure, the CO_2 emissions for each of the tested passenger cars have been averaged to produce a single value at each increment of vehicle speed. The same has been done for all the DfT emissions curves, relevant to the cars being tested. As seen in the figure, the CO_2 emissions, when measured in g/km are greater at low vehicle speeds.

Figure 5.12 CO_2 emissions from test vehicles plotted against vehicle speed (km/h).



Source: TfL Planning Strategic Analysis.

Some initial analysis – likely implications for emissions assessment

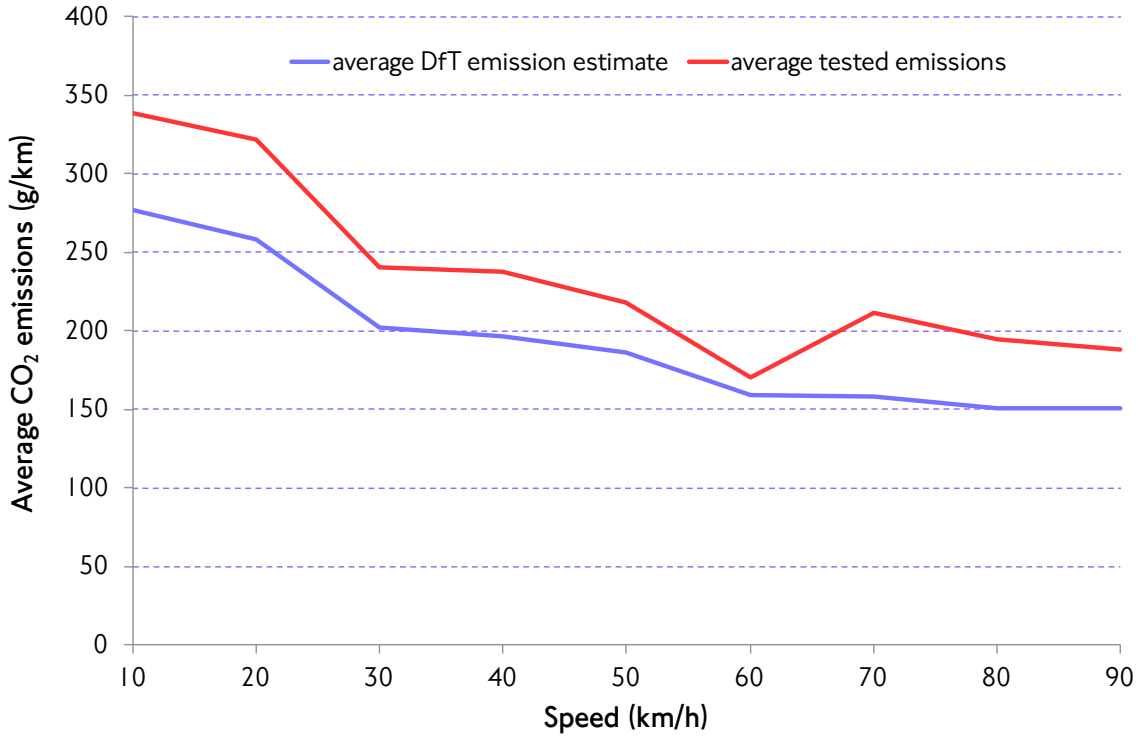
Some initial analysis has been completed to assess the quantum of likely variance from the NEDC derived data used by the Vehicle Certification Agency (VCA) for type approval purposes. Table 5.12 below shows a selection of average CO_2 results for generic vehicle types, as tested on the TfL cycles, 'official' type approval figures for equivalent cars taken from the VCA database and, as a further comparison, DfT emissions estimates are included to indicate how far they are at variance with the new data. On average, the London cycles produce around 20 per cent greater emissions of CO_2.

Table 5.12 Comparison of average CO_2 emissions from TfL test cycles, compared with type approval and DfT emissions estimates (generic passenger car types).

Vehicle tested	TfL drive cycle	Vehicle Certification Agency (g/km)	Vehicle Certification Agency – difference (%)	DfT emissions curves (g/km)	DfT emissions curves – difference (%)
Small petrol	116	109	-6%	140	+21
Small diesel	161	119	-26%	119	-26
Medium petrol	199	159	-20%	172	-14
Medium diesel	241	196	-19%	147	-39
Large petrol	356	285	-20%	250	-30
Large diesel	262	217	-17%	202	-23

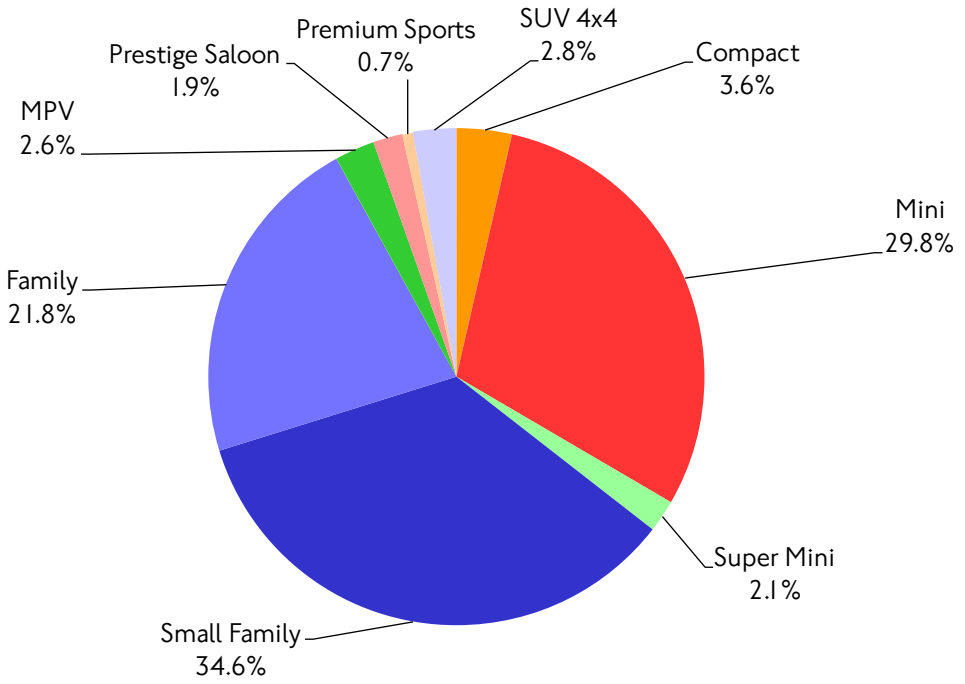
Note: The TfL drive cycle emission calculations used here are for hot starts. Cold starts add approximately 20 per cent to the grams/km over the first 300 seconds of drive time.

Figure 5.13 Comparison of DfT estimated CO_2 emissions against speed and TfL tested emissions against speed.



Source: TfL Planning Strategic Analysis.

Figure 5.14 Proportions of cars, by market segment group, seen by TfL ANPR cameras over a six month period (mid October 2009 to mid April 2010).



Source: TfL Planning Strategic Analysis.

Using the same assumptions for speed and distance used in the TfL air quality assessment tool, the variance is the equivalent of an extra 880,000 tonnes of CO_2 emitted by cars in London in 2010.

Next steps

Further testing work is underway to assess the emissions of light and heavy goods vehicles while operating under London driving conditions. For these vehicle types, particular importance will be placed upon the loaded condition of the vehicle and resultant emissions per tonne/kilometre. This summary has focussed upon CO_2 emissions. Similar analysis is also being carried out upon the important air quality emissions of oxides of nitrogen (NO_x) and particulate matter (PM_{10}) measured over the same test programme. Reports on the findings of these further investigations will be published during 2014.

5.12 Transport operational efficiency, asset condition and public transport fares

Summary

Keeping tight control of operating and other costs is important as it contributes to the aim of improving value-for-money, limits the demands made upon tax payers and fare payers, and helps to ensure that TfL has a budget that balances income against costs. In a similar way, knowledge of the assets which TfL owns and which underlie services is crucial to ensure that the organisation can meet its objectives of operating a safe, secure and reliable network, while also optimising investment decisions about asset maintenance and replacement. This section looks at three MTS strategic outcome indicators that describe recent trends in these areas.

Operational costs (gross and net expenditure per passenger kilometre)

Table 5.13 shows a segmental analysis of TfL's expenditure on public transport services for the most recent four years. These are reproduced on a comparable basis, taking account of changes to TfL's accounting conventions in the interim. Looking across all four years, both gross and net operating costs per passenger kilometre have been relatively stable. The former has stood at 24 pence for three of the past four years, while the latter has also stood at 5 pence for three of the past four years, both including the most recent year.

Looking at the most recent year, passenger kilometres increased across the rail modes, with exceptional growth on both London Overground and the DLR. In 2012/13, TfL helped deliver the 2012 Olympic and Paralympic Games. During this time, LU, the DLR and London Overground saw record passenger numbers and extended operating hours. London Overground opened the new South London line in December 2012, further boosting passenger kilometres. Total gross expenditure per passenger kilometre was broadly constant from 2011/12 to 2012/13, but the year saw increased costs on London Tramlink and the DLR, matched by decreases on London Overground. In total, gross expenditure increased by 5.8 per cent. Expenditure during 2012/13 was partly increased in relation to previous years to provide enhanced transport services for the 2012 Games.

Table 5.13 TfL's expenditure and revenue on public transport services. 2009/10-2012/13.

2012/2013	Passenger kilometres* (millions)	Gross expenditure (£m)	Gross expenditure per passenger kilometre (£)	Net expenditure (£m)	Net expenditure per passenger kilometre (£)
London Buses	8,258	1,917	0.23	463	0.06
London Underground	10,099	2,320	0.23	20.6	0.00
Docklands Light Railway	524	139	0.27	8	0.02
London Tramlink	156	35	0.22	12	0.08
London Overground	780	207	0.27	74	0.09
All above modes	**19,817**	**4,618**	**0.24**	**578**	**0.05**

2011/2012	Passenger kilometres (millions)	Gross expenditure (£m)	Gross expenditure per passenger kilometre (£)	Net expenditure (£m)	Net expenditure per passenger kilometre (£)
London Buses	8,219	1,853	0.23	486	0.06
London Underground	9,519	2,180	0.23	19	0.00
Docklands Light Railway	455	104	0.23	0	0.00
London Tramlink	148	30	0.20	8	0.05
London Overground	645	196	0.30	93	0.14
All above modes	**18,986**	**4,363**	**0.24**	**606**	**0.05**

2010/2011	Passenger kilometres (millions)	Gross expenditure (£m)	Gross expenditure per passenger kilometre (£)	Net expenditure (£m)	Net expenditure per passenger kilometre (£)
London Buses	8,082	1,824	0.23	524	0.06
London Underground	8,875	2,050	0.23	109	0.01
Docklands Light Railway	414	92	0.22	3	0.01
London Tramlink	146	29	0.20	9	0.06
London Overground	691	125	0.18	57	0.08
All above modes	**18,208**	**4,120**	**0.21**	**702**	**0.05**

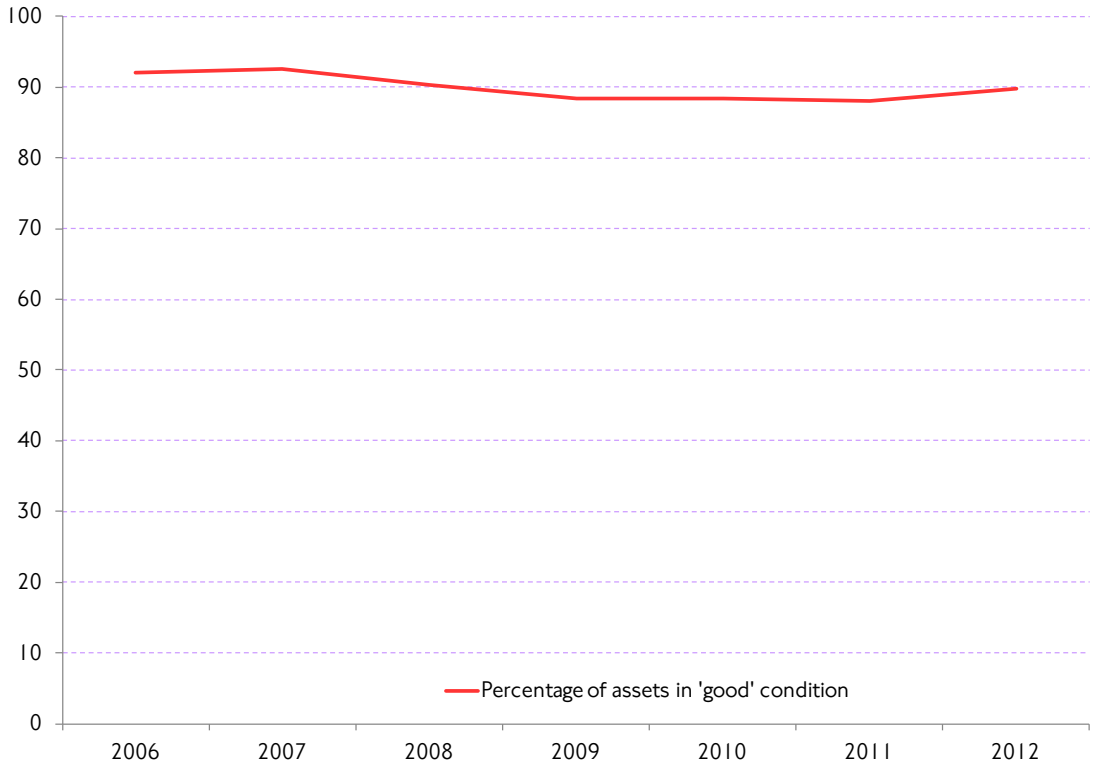
2009/2010	Passenger kilometres (millions)	Gross expenditure (£m)	Gross expenditure per passenger kilometre (£)	Net expenditure (£m)	Net expenditure per passenger kilometre (£)
London Buses	8,013	1,818	0.23	652	0.08
London Underground	8,456	2,290	0.27	494	0.06
Docklands Light Railway	365	93	0.25	13	0.04
London Tramlink	139	30	0.22	13	0.09
London Overground	437	101	0.23	65	0.15
All above modes	**17,410**	**4,332**	**0.24**	**1,237**	**0.08**

Source: TfL Group Financial Accounting.
Note: Due to accounting conventions, passenger kilometres may not match those in Chapter 3.

Asset condition

Good knowledge of the condition of assets that TfL owns and which underlie services is important to enable the organisation to meet its objectives of operating a safe, secure and reliable network, whilst also optimising investment decisions with regard to asset replacement. For the purposes of MTS monitoring, a composite asset condition measure that describes the condition of TfL's assets across the modes has been developed. This is based on the percentage of key assets meeting basic 'pragmatic' standards, usually in terms of age or state of repair, the specific measures for each mode being weighted according to the relative use made of that mode, as has been described in greater detail in previous Travel in London reports.

Figure 5.15 Composite asset condition indicator. Percentage of in-scope asset that is deemed to be in a 'good' condition (weighted by relative use of each mode).



Source: TfL Group Planning Strategic Analysis.

Figure 5.15 shows the available time series for this indicator, in terms of the percentage of in-scope (i.e. monitored) asset deemed to be in 'good' condition. The indicator achieved its highest level in four years of slightly less than 90 per cent in 2012. The trend for this indicator has been relatively smooth, remaining close to 90 per cent in all years, despite several step-changes in TfL's assets over the period, including the complete renewal of rolling stock on the London Overground and Victoria line, and the progressive replacement of rolling stock on all of the sub-surface Underground lines. In considering trends in this indicator, it is important to realise that the passage of time ages all of the assets in the current capital stock. Therefore, to maintain overall assets in good condition, it is necessary to replace a proportion of them this year.

Real fares levels

The real fares level measures the average actual fare paid in London per kilometre travelled. It is a composite measure, covering bus and Underground only, calculated as the total actual fares revenue for passengers paying full adult fares, adjusted for inflation and divided by corresponding actual bus and Underground passenger kilometres.

In 2012, the average adult composite bus and Underground fare paid fell to 21.6 pence per kilometre, from 21.8 pence per kilometre in the previous year.

Notes and references

(1) https://www.gov.uk/government/publications/strategic-framework-for-road-safety
(2) http://www.tfl.gov.uk/assets/downloads/corporate/safe-streets-for-london.pdf
(3) http://www.tfl.gov.uk/static/corporate/media/newscentre/archive/20465.html
(4) http://data.london.gov.uk/datastore/package/london-atmospheric-emissions-inventory-2010
(5) http://www.london.gov.uk/priorities/environment/clearing-londons-air/air-pollution-and-public-health
(6) http://ukclimateprojections.defra.gov.uk/
(7) http://www.london.gov.uk/priorities/environment/consultations/climate-change-mitigation-and-energy-strategy

6. Implementing the Mayor's Transport Strategy: An assessment and interpretation of progress so far

6.1 Introduction and content

A key role of Travel in London reports is to provide an objective assessment of progress towards the goals set out in the Mayor's Transport Strategy. The strategy was published in 2010, based on data typically reflecting conditions in 2008 or 2006, and there are now five or more years of observed data and experience with which to 'take stock'.

The purpose of these assessments is not to 'hold TfL and the Mayor to account', or to develop or frame policy or specific schemes, but to assist the on-going policy making process by providing evidence to ensure that transport policy continues to address the most significant challenges in the most fully-informed way. Measuring trends and interpreting developments in their wider context provides both stimulus and evidence for the development and refinement of policy. It highlights areas where conditions have not developed as expected, or cases where new factors not anticipated several years ago have arisen, such as London's increasingly rapid population growth, and assists future policymaking by giving insights into the nature, causes and implications of these trends.

This section brings together evidence, discussed in more detail throughout this report, to give an overall summary of progress at the strategic level towards MTS goals. It uses the set of 24 formal strategic outcome indicators set out in the Strategy as a framework, coupled with a less-formal assessment of the evidence, to give an appreciation of what is going well, what is not going so well, where particular attention should be focused going forward, and what is new that needs to be taken into account in future policies.

6.2 Mayor's Transport Strategy goals and strategic outcome indicators for monitoring implementation of the strategy

The 24 MTS strategic outcome indicators provide a formal framework for monitoring progress against MTS goals. These indicators are broadly to be updated each year, although in practice this has not always been possible, for example where complex model-based simulations of transport network improvements are only produced to a limited number of 'assessment years'. In addition, in certain cases, changes to the method and coverage of the input data supporting these indicators has led to breaks in the continuity of time-series. Nevertheless, sufficient data are available in this report as a whole to enable a relatively complete assessment of progress.

The strategic outcome indicators broadly cover each of the MTS's six transport goals:

- Supporting economic development and population growth
- Enhancing the quality of life for all Londoners
- Improving the safety and security of all Londoners
- Improving transport opportunities for all Londoners
- Reducing the contribution of transport to climate change and improving its resilience to the impacts of climate change

- Supporting the delivery of the 2012 Olympic and Paralympic Games and their legacy

In addition, there are 'contextual' indicators that relate to overall travel demand and mode share trends, which are considered first in the sections below. The following commentary is framed around this context and the six MTS transport goals, the strategic outcome indicators applicable to each, and other key evidence that contributes to a rounded assessment of progress. Note that full descriptions of the technical nature of these indicators have been given in earlier Travel in London reports.

6.3 Travel demand, mode shares and the wider context

There are three MTS strategic outcome indicators under this heading:

Total number of trips in London. In 2006, 23.8 million trips were made in London on an average day (based on a seven-day week). In 2008 this had risen to 24.6 million trips. In 2012 25.9 million trips were made, an increase of 8.8 per cent over 2006, 5.4 per cent over 2008, and 1.5 per cent over 2011.

The average rate of growth in total trips in London was 1.4 per cent per year from 2006, and 1.3 per cent per year from 2008, ie the rate of growth accelerated in the most recent year.

Total number of journey stages in London. In 2006, 27.2 million journey stages were made in London on an average day (based on a seven-day week). In 2008 this had risen to 28.6 million journey stages. In 2012 30.3 million journey stages were made, an increase of 11.4 per cent over 2006, 6.0 per cent over 2008, and 1.5 per cent over 2011.

The average rate of growth in journey stages in London was 1.8 per cent per year from 2006, and 1.5 per cent per year from 2008.

Mode shares for public and private transport, and for walking and cycling (journey stage level). The share of journey stages made by public transport in London increased from 38.8 per cent in 2006 to 44.2 per cent in 2012 – a net shift of 5.4 percentage points. There was a corresponding fall in the share of journey stages made by private transport – principally the car, down from 38.5 per cent in 2006 to 33.3 per cent in 2012.

The rate of change in this indicator has been relatively consistent since 2006 – the net change between 2011 and 2012 (the most recent year) being an increase of 0.9 per cent in the public transport mode share, and a reduction of 0.8 per cent in the private transport mode share.

The mode share for walking remained relatively constant at between 20 and 21 per cent of all journey stages between 2006 and 2012, although this conceals growth in the total number of walking journey stages, reflecting the growth in travel overall.

The mode share for cycling also remained relatively constant at 2 per cent of all journey stages, although the absolute increase in cycling stages was 25.0 per cent (this reflects the small basis for comparison in the mode share numbers).

So, it is clear from the above that there is continuing strong growth in travel demand in London, and that public transport is continuing to assume a larger share of total travel.

Also relevant are trends in the number of people resident in London and the number of jobs. Based on new data from the 2011 Census, London's population is now known to have risen more rapidly than previously understood in the second part of the last decade. London's population in 2012 was 9.4 per cent higher than the equivalent value in 2006, and 6.4 per cent higher than 2008. London's population is estimated to have increased by a further 1.3 per cent between 2011 and 2012 alone, and projections suggest that this higher rate of increase is likely to continue.

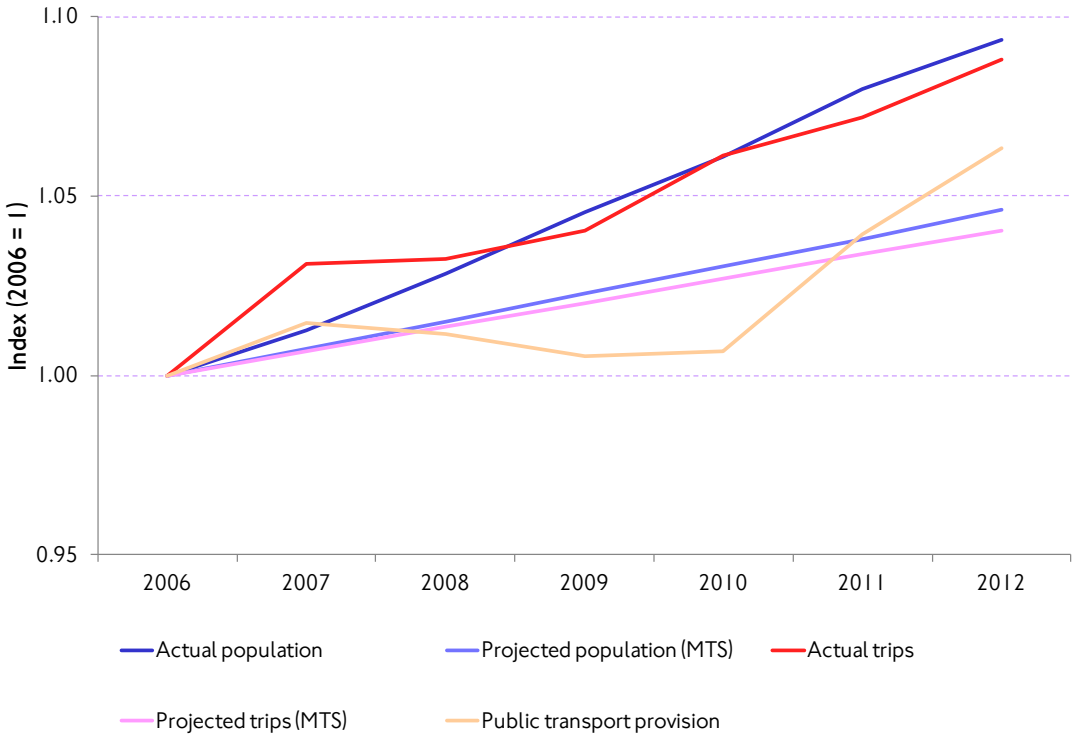
Increased population has therefore been the fundamental driver of travel growth over the past decade, and will continue to be so for the foreseeable future.

There were estimated to have been 4.76 million jobs in London in 2006, and 4.94 million in 2008. The recent recession had a significant effect on the number of jobs in London, but the latest estimates suggest that the Capital is emerging rapidly from the recession, with 5.02 million jobs in 2012.

What does all this mean for MTS ?

Figures 6.1 and 6.2 bring together the above trends visually, and compare them with MTS expectation.

Figure 6.1 Comparison of indexed projected and observed populations and public transport provision. Based on the position in 2006.



Source: TfL Planning Strategic Analysis.

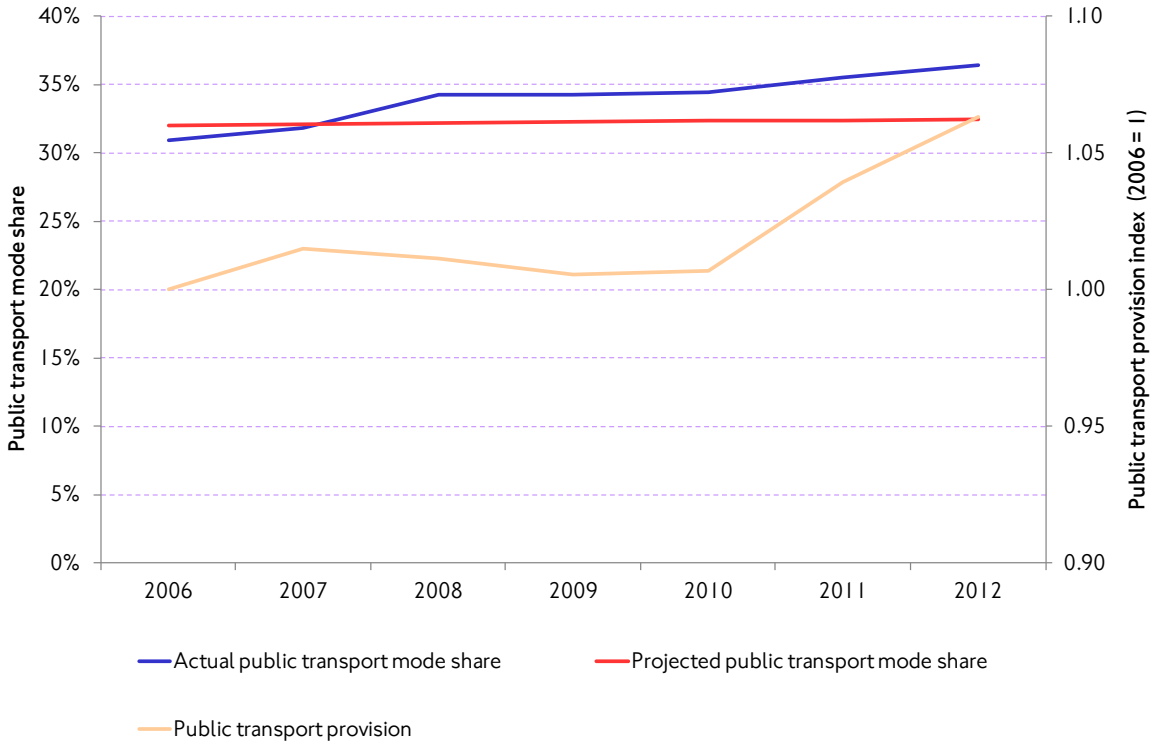
Figure 6.1 shows both actual population and actual trips growing significantly faster than the MTS projected. The gap – already roughly five percentage points in 2012 (based on 2006) – is set, according to the latest population projections, to continue to get wider. Indeed, these new projections see London growing at a level equivalent to absorbing the population of cities the size of Birmingham and

Glasgow combined. This means that projections of public transport crowding, road network congestion, and the requirement for new infrastructure and investment to support the growing population will occur earlier in the MTS timeline than previously envisaged.

An index of public transport provision (in terms of 'place kilometres' provided – see section 4.8 of this report) is also shown. Over the past six years, public transport provision has increased at a rapid but fairly irregular rate (this in part reflecting temporary closures for the Tube upgrade programme) and is now approaching a similar increase in percentage terms to those seen in population and trips. Although Crossrail, on track to open in late 2018, will provide a boost equivalent to an additional 10 per cent in London's total public transport capacity, the implications of continued trip growth at these rates beyond Crossrail are substantial, for both public transport and the road network.

One thing TfL is justifiably proud of is the sustained and continued upwards shift in the public transport mode share. This is unprecedented in London and most other major cities in the world, and is all the more impressive in that it has been achieved in the context of substantial overall growth in the demand for travel. Increased travel by public transport is both more efficient and more sustainable than travel by motor vehicle. Figure 6.2 shows that the public transport mode share has steadily advanced since 2006 and, in 2012, is running about 4 percentage points ahead of that expected by the MTS (an indicative profile).

Figure 6.2 Comparison of projected and observed public transport mode share and indexed public transport provision.



Source: TfL Planning Strategic Analysis.

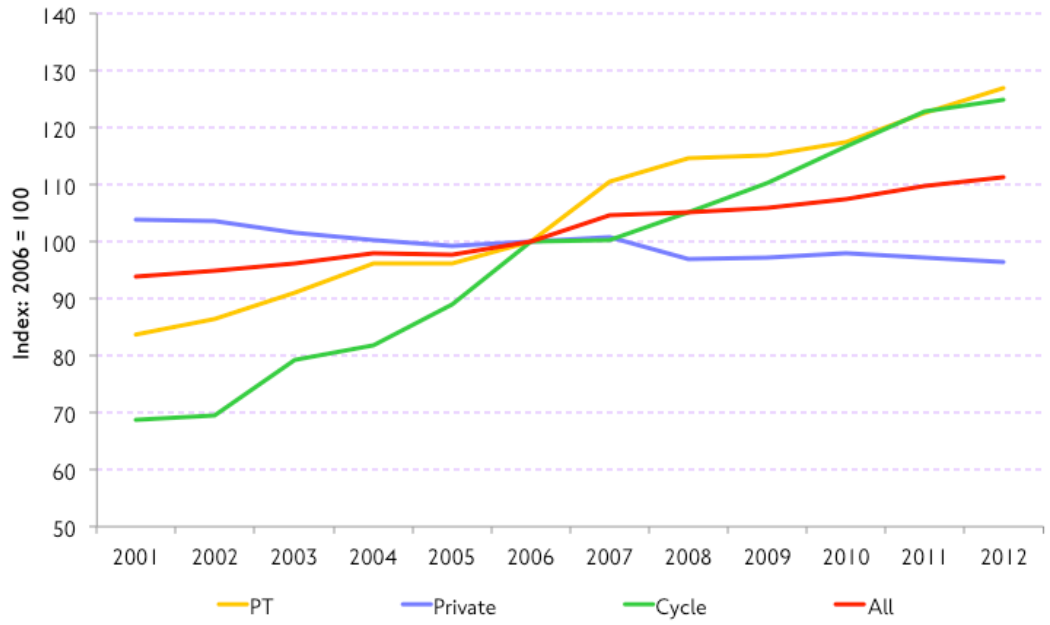
Alongside public transport, cycling has been the fastest growing mode in London in recent years. For cycling, the MTS targets a four-fold increase in the absolute

number of cycling trips by 2026, against a 2001 base which, given the position in 2006, would be the equivalent of a five per cent mode share (at the journey stage level) by the same date.

In terms of the absolute number of cycling trips in London, and despite strong growth in the earlier years and London's increasing population, growth over the most recent two years has been slower than expected. In part, this reflects the relatively unfavourable weather experienced throughout much of 2012 and into 2013. It must also be recognised that cycling is set to see a £913m programme of investment over the next 10 years, as the Mayor's Vision for Cycling in London [1] is rolled out.

In terms of cycling mode share, the 5 per cent equivalence was based on mode shares projected in the MTS. London's rapidly increasing population, and the fact that public transport mode share is advancing at a faster rate than foreseen by the MTS, is making this less applicable. This is because the 'pie' of total travel to which it applies is getting bigger at a faster rate than previously expected, and because the public transport mode share continues to advance at a rapid rate (figure 6.3).

Figure 6.3 Travel volumes by key modes. Index based on 2006 (=100).



Source: TfL Planning Strategic Analysis.

6.4 Supporting economic development and population growth

There are six MTS strategic outcome indicators under this heading covering:

- People's access to jobs (transport network connectivity)
- Smoothing traffic flow and journey time reliability for road journeys
- Public transport reliability
- Public transport capacity
- Operating costs per passenger kilometre
- Asset condition

People's access to jobs. This indicator uses travel time isochrones from large-scale transport models to assess the number of jobs available to people within a 45-minute travel time by public transport. It is presented as a London-wide average, based on an aggregation of small-area results. Although the indicator is updated annually, in the absence of substantial changes to the transport networks, the results tend to be heavily influenced by population change from year to year. So, as London's population grows, more people come within the scope of this indicator even if the transport networks remain the same. Changes to the number of jobs in London will also have a similar effect. Bearing this in mind, table 6.1 shows the trend of continuous steady improvement.

Table 6.1 Number of jobs reachable by public transport within 45 minutes. London-wide average based on residential population.

Year	Number of jobs
2006	937,900
2010	959,400
2011	980,200
2012	989,450

Source: TfL Planning Strategic Analysis.

As well as continuous incremental improvements to transport connectivity – at the London wide scale – reflecting recent projects such as the extension of the DLR and the development of the London Overground network, a major step-change is expected in late 2018 when Crossrail opens. The impact of this on connectivity is discussed further in section 5.6 of this report.

Smoothing traffic flow and journey time reliability (road journeys). As shown by figure 4.7 of this report, the MTS journey time reliability indicator, which measures the percentage of vehicle journeys completed within five minutes of a typical average journey time, has remained quite static over the four years of trend data now available. Overall reliability, as measured on selected major road corridors, is consistently close to TfL's working targets of between 89 and 90 per cent.

Despite the remarkable consistency of achieved reliability levels overall, it is known (and has been reported in previous Travel in London reports) that values typically achieved can vary considerably between individual major road corridors [2]. Such variation, of course, can be used to target improvement measures to greatest effect. However, it is also now becoming clear that improvement at the strategic level is very difficult to achieve. This is because around 80 per cent of the 'unreliability' in traffic flows on a day-to-day basis is caused by the variation (both

spatial and temporal) in traffic demand itself (see section 4.10 of this report). In addition, there will always be events that affect traffic not directly related to the road network and/or which cannot be addressed through road network management policies. Interventions to better manage the operation of the road network can only therefore impact on the remaining 20 per cent of unreliability, meaning that the scope to lift this indicator above its current circa 89-90 per cent level is quite limited.

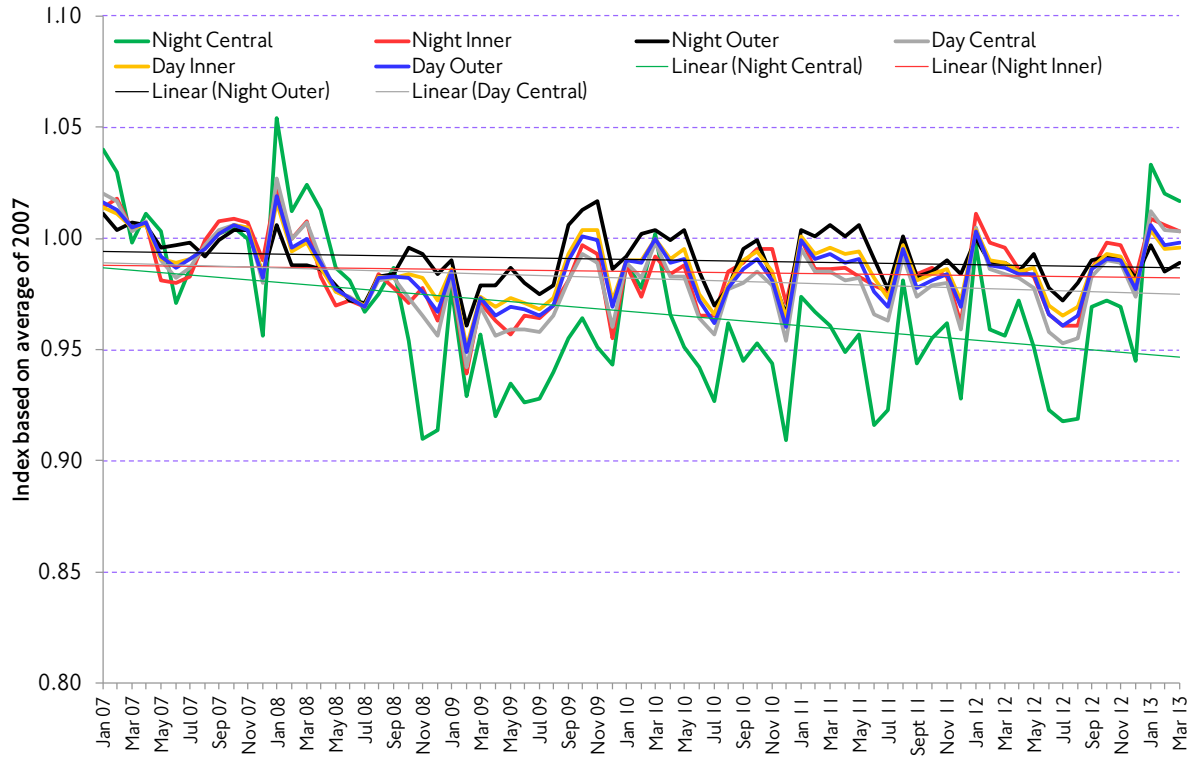
It is also worth noting that this indicator is that it only covers the major TLRN corridors (as was set out in the MTS). Equivalent reliability trends on the rest of the road network are not therefore known. It is possible that measures to improve reliability on the TLRN may impact on other parts of the road network, and understanding these relationships should be a priority going forward.

Journey time reliability is of course just one aspect of the 'driver experience'. As is highlighted in section 4.9 of this report, trends at the London wide level for average traffic speeds and congestion are increasingly complex. According to GPS-based measurements, and setting aside 'expected' seasonal, spatial and temporal variability, overall speeds and congestion levels have changed very little since comparable measurements began in 2006. This is in sharp contrast to the historic time-series, based on data from moving car observer surveys, which showed sharply increased congestion through the early/middle part of the last decade. It should also be seen in the context of continued slow falls to levels of traffic demand (see section 3.10 of this report), and the various measures to improve operation of the road network that have been put in place under MTS, for example the Lane Rental scheme. All other things being equal, both of these factors should lead to increased speeds and decreased levels of congestion – which are not being observed.

A possible explanation for this is the continued removal of effective road network capacity – a major factor driving increased levels of congestion during the last decade and fully explained in Travel in London report 4 [3]. Figure 6.4 shows some preliminary analysis that suggests that this is still a factor – at least in central London, with effective capacity removal 'accounting for the gap' between falling traffic levels and improved network management, and the observed flat trend for speeds and congestion.

Looking at the linear trend lines on the figure, and noting that the left-hand scale of the graph is based on an index value of 0.8, it is seen that night-time speeds, which nominally reflect the 'base' capacity of the network, are trending downwards in all parts of London. However, the fall in the central zone is particularly rapid. Daytime speeds in the central zone are relatively flat, which would be consistent with the slowly-falling traffic levels observed over the period covered by the graph.

Figure 6.4 Trend for selected indicators of average traffic speed, 2006-2013. Trafficmaster GPS data.

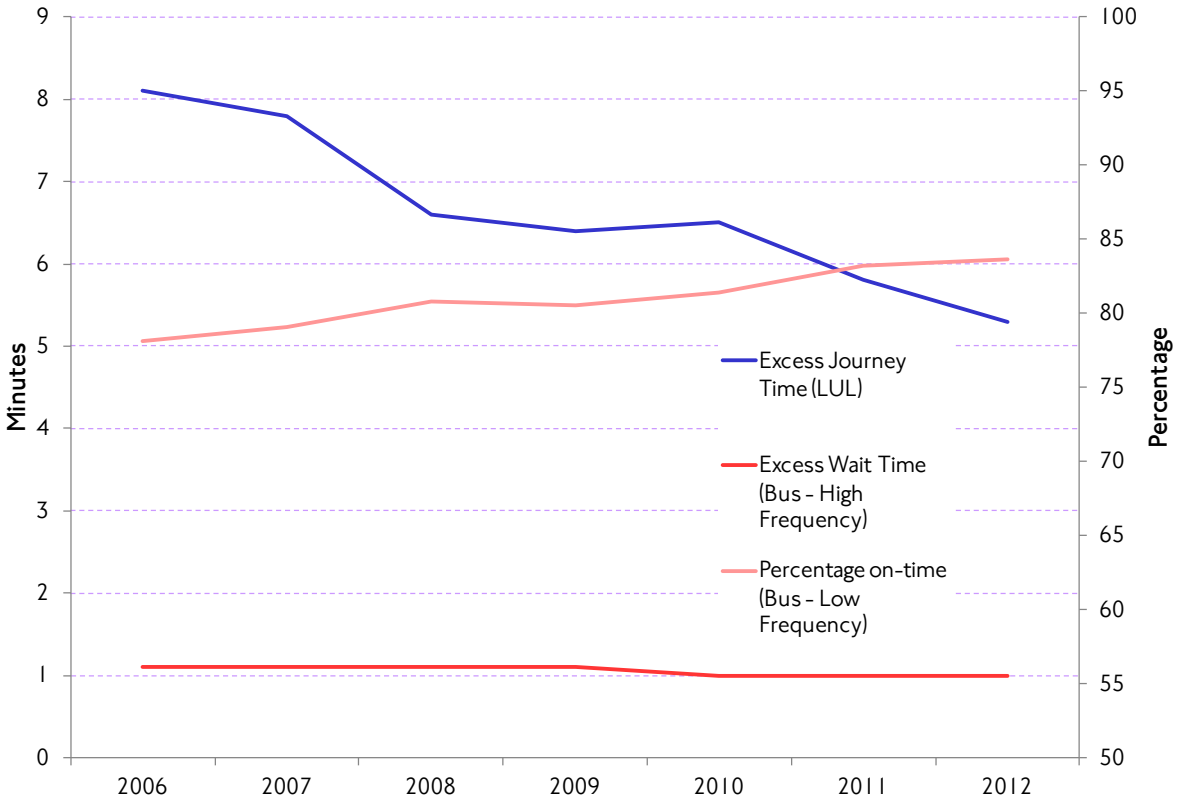


Source: TfL Planning Strategic Analysis, based on Trafficmaster GPS data provided by the Department for Transport.

In other words, falling traffic and improved network management may be masking the effects of the continued removal of road network capacity to support other MTS priorities for the road network. Given emerging priorities such as the Mayor's Vision for Cycling in London, this 'capacity take' from general traffic is only likely to intensify. This has been recognised by the Roads Task Force, whose report [4] seeks a balanced approach that minimises the impact of measures to improve the 'liveability' of streets on congestion. However, it is clear that this will be a difficult balance to achieve.

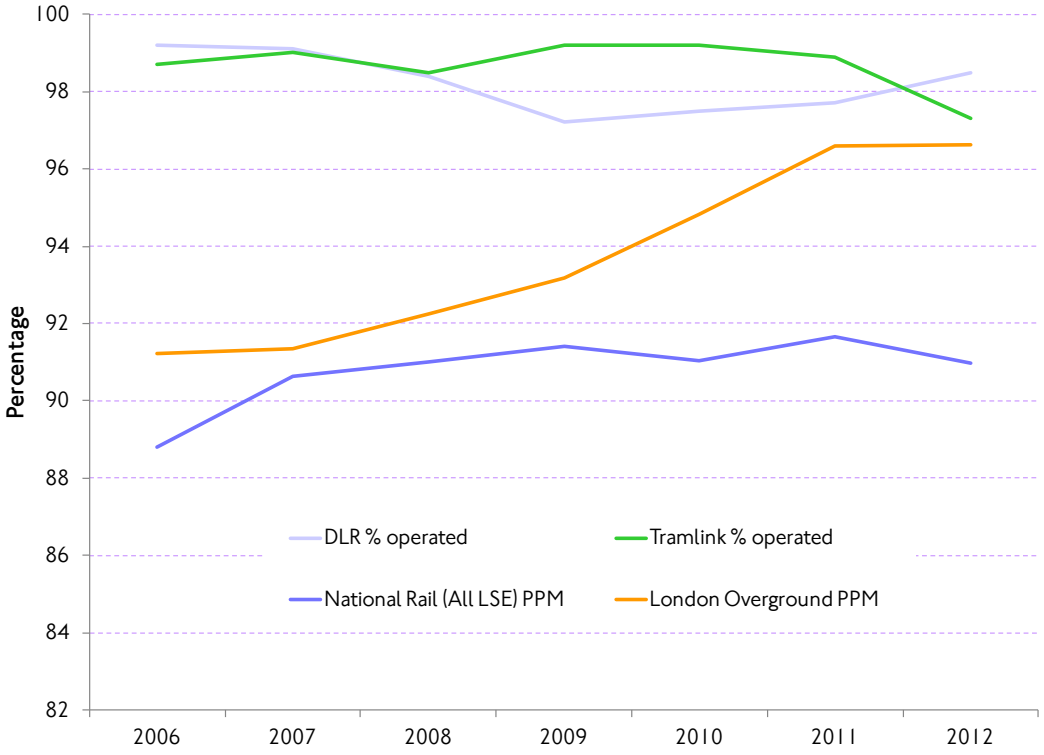
Public transport reliability. This indicator comprises individual indicators of reliability appropriate to each mode. There are two principal measures. That applicable to buses and the Underground is based on the concept of 'excess' journey or waiting time – the extra time that people have to wait over and above that if the service was running exactly to schedule. Those applicable to the other rail-based networks are based around percentage achievement of operational or reliability targets. Figure 6.5 shows reliability measures for bus and Underground – based on 'excess' wait or journey time respectively. Figure 6.6 shows the equivalent percentage-based indicator for the other major public transport modes.

Figure 6.5 Key reliability indicators for bus and Underground. 2006/07-2012/13.



Source: TfL Planning Strategic Analysis.

Figure 6.6 Key reliability indicators for other rail-based modes in London.



Source: TfL Planning Strategic Analysis.

Over the period since 2006, these measures across all of the major public transport modes in London have either shown a strong trend of improvement or have been broadly maintained at excellent levels. With the exception of National Rail, whose reliability indicator is not strictly comparable with those for the TfL modes, public transport modes in London are now achieving unprecedented levels of reliability. All key indicators are at, or close to, best-ever levels. This high standard of day-to-day operational performance was demonstrated to great effect during the 2012 Games when, despite unprecedented levels of demand and the potential stresses on the network from additional services, TfL modes typically achieved or bettered these (yearly average) values - see Travel in London report 5, chapter 10 [5].

Public transport capacity. This is measured in terms of 'place-kilometres' offered by the principal public transport modes, based on planned capacities (as opposed to that actually operated, although see service reliability indicators immediately above). Trends for the individual modes are described in section 4.8 of this report. Figure 6.2 (above) shows the aggregate trend across all modes since 2006. It shows that the trend is strongly upwards, albeit that the rate of improvement is not a steady one.

In 2012/13, there was 6.3 per cent more capacity provided across the public transport networks compared to 2006. Improvements to capacity on the Tube, reflecting the introduction of new more intensive timetables and new rolling stock, network extensions and the introduction of three-car operation on the DLR, and the development of the London Overground network over this period are the primary factors underlying this increase.

However, upgrades do come at a cost, and the hiatus in the trend in the latter part of the last decade is largely a reflection of the temporary closures of parts of the Underground network to facilitate the Tube upgrade programme, aimed at improving capacity over the longer term. Given the imperatives around the 2012 Games, these closures were not as frequent during 2012/13, and Games-related upgrades such as the DLR improvements also came into operation. Section 6.3 (above) discusses the relationship of this trend to demand growth, in the context of higher-than-previously-expected projections for London's population, based on new data from the 2011 Census.

Operating costs per passenger kilometre. Owing to changes in accounting conventions, it is not possible to achieve a long-term consistent time-series for this indicator. The consistent series that is available – from 2009/10 to 2012/13 – show a steady overall trend in terms of both gross and net expenditure per passenger kilometre.

Figure 6.7 Trend in gross and net operating costs per passenger kilometre, 2009/10-2012/13.

Source: TfL Corporate Finance.

Asset condition. Figure 6.8 shows the available time series for this indicator, in terms of the percentage of in-scope (i.e. monitored) asset deemed, according to benchmarks explained in Travel in London report 2 [6], to be in 'good' condition.

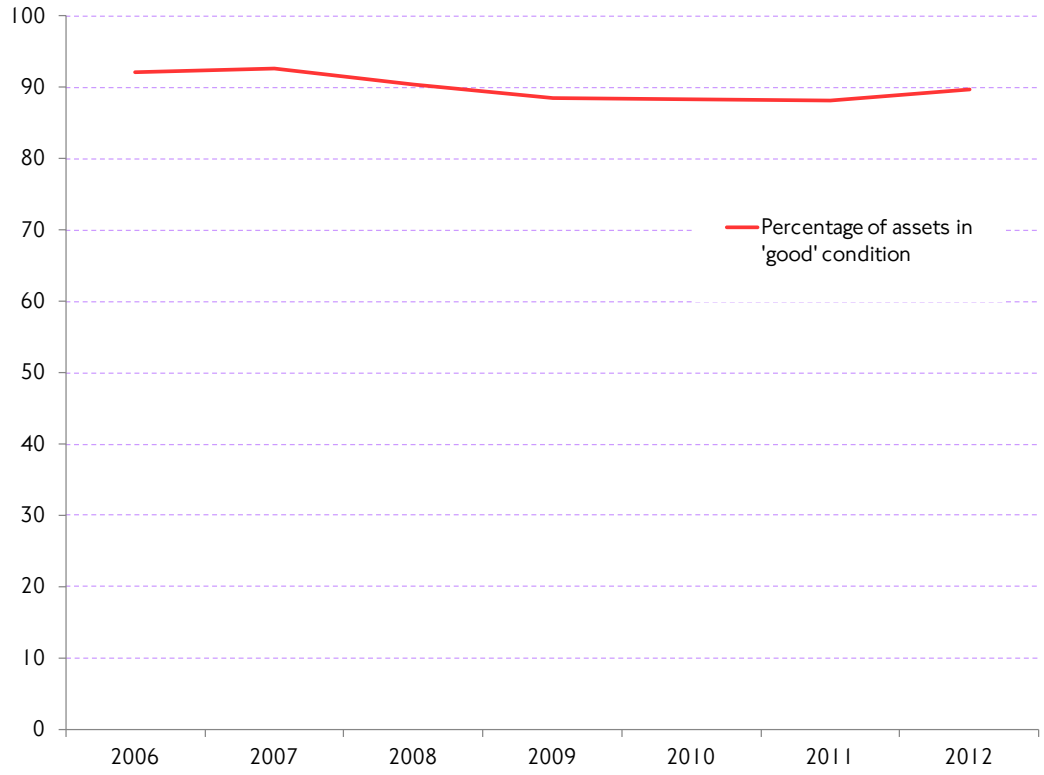
The initial fall in the indicator after 2007 coincides with the addition of London Overground to the network, with relatively old rolling stock. Rolling stock on London Overground has since been completely renewed, and this is reflected by an increase in the indicator more recently.

Overall, the trend for this indicator has been relatively smooth, remaining close to 90 per cent in all years, despite several step-changes in TfL's assets over the period, including the aforementioned investment in London Overground, complete renewal of rolling stock on the Victoria Underground line, and the (current) progressive replacement of rolling stock on all of the sub-surface Underground lines.

In considering trends in this indicator, it is important to realise that the passage of time ages all of the assets in the current capital stock. Therefore, to maintain overall assets in good condition, it is necessary to replace a proportion of them each year.

Taken together, MTS indicators for gross and net expenditure per passenger kilometre and asset condition demonstrate the track record of prudent stewardship and cost control that is sought by the MTS.

Figure 6.8 Composite asset condition indicator. Percentage of in-scope asset that is deemed to be in a 'good' condition. Weighted by relative use of each mode.



Source: TfL Planning Strategic Analysis.

6.5 Enhancing the quality of life of all Londoners

Transport is a necessary part of the daily experience of most people, for example when travelling between their homes and workplaces. Improvements to transport can therefore contribute to people's wider quality of life. Measurable elements, such as customer satisfaction with aspects of the transport system, and the wider urban realm, can be expected to reflect these improvements. Transport also affects people's health and well-being, with known negative effects arising from pollutant emissions to the atmosphere and transport-related noise. The MTS seeks to minimise these negative impacts of transport. Applicable MTS indicators of progress under this heading cover emissions of two major transport-related local air quality pollutants – particulate matter (PM_{10}) and nitrogen oxides (NO_x), as well as six customer perception/satisfaction indicators.

Emissions of particulate matter (PM_{10}) from ground-based transport. This is defined as tonnes of particulate matter (as PM_{10}) emitted from ground-based transport (excluding aviation) in London as a total over each calendar year. It is quantified by the London Atmospheric Emissions Inventory [7], which is partially updated for transport sources each year, and fully updated for all other sources every two to three years (including method changes, reflecting improving knowledge of pollution sources, but which affect the continuity of trend estimates).

Looking over the period 2010-12, PM_{10} emissions from ground-based transport (excluding emissions from vehicle tyre and brake wear) reduced by 17.7 per cent, from 737 tonnes, to 606 tonnes. This is a rapid trend of progress, fairly typical of

recent years, and largely reflecting the increasing adoption of later 'Euro' emissions standards for road vehicles. Road traffic emissions reduce as older vehicles are progressively removed from the fleet, and newer ones with improved emissions performance take their place, as part of the normal turnover of the vehicle stock. Initiatives such as London's Low Emission Zone [8] have helped advance this process for certain heavier vehicle types.

The impact of this over the last decade, in conjunction with improvements to other transport and non-transport sources of pollution, has been to reduce PM_{10} emissions to a point where ambient concentrations of PM_{10}, the relevant quantity for compliance purposes, generally meet European Union limit values at all in-scope locations in London. This has been the case for the last two years, albeit reflecting the achievement of standards that were originally targeted to apply from 2005 and that certain locations remain 'at risk' of exceeding during extreme weather conditions.

PM_{10} in the atmosphere, however, is known to be very injurious to public health. It has been estimated [9] that about 4,270 premature deaths per year occur in London as a result of air pollution (largely reflecting PM_{10}). To put this in context, it is about 30 times the number of people killed in road collisions in London each year. It is important to note that there is no 'absolutely safe' level for particulate matter in the atmosphere – in particular particles at the smaller end of the PM_{10} size range ($PM_{2.5}$) are known to be especially dangerous. Whilst there are limits to what can be achieved locally over the coming years (PM_{10} concentrations are heavily influenced by weather conditions and pollution transported from elsewhere), further reductions to particulate emissions, through continued adoption of later Euro emissions standards for road vehicles, and other measures such as Network Rail's electrification of the Great Western Main Line, expected to come on stream from 2017, are vital to reducing these health effects still further.

Table 6.2 Recent trends for key emissions from ground-based transport (excluding aviation). Tonnes per year, whole Greater London area.

Pollutant	2010 LAEI original estimate	Updated estimate for 2010	Estimate for 2011	Estimate for 2012
PM_{10}	735	737	663	606
NO_2	27,945	27,649	25,918	24,234
CO_2 (Ktonnes)	8,420	8,292	8,062	7,959

Source: TfL Planning Strategic Analysis, based on London Atmospheric Emissions Inventory.

Emissions of nitrogen oxides (NO_x) from ground-based transport. This is defined as tonnes of nitrogen oxides emitted from ground-based transport (excluding aviation) in London over the calendar year. It is also quantified by the London Atmospheric Emissions Inventory, and therefore comments above (for PM_{10}) in relation to time-series continuity of emissions estimates also apply. Ground-based transport emissions reduced by 12.4 per cent between 2010 and 2012, from 27,649 tonnes to 24,234 tonnes. As for PM_{10} this is a substantial reduction, although the pace of change is slower than for PM_{10}.

NO_x emissions are important in that they contribute to concentrations of nitrogen dioxide (NO_2) in the air. Nitrogen dioxide concentrations are the subject of EU limit values, and London is still some way from meeting concentration limits, these being widely exceeded at roadside sites throughout central and inner London. This

is in spite of good progress with PM_{10} from the progressive adoption of later Euro emissions standards (which also target NO_x) for road vehicles, and the London Low Emission Zone. Nitrogen dioxide in the atmosphere is also injurious to public health, although the effects are thought to be less severe than for PM_{10}.

It is thought that this lack of progress on reducing NO_2 concentrations reflects the inability of vehicles built to later Euro emissions standards to deliver their mandated reductions in NO_x emissions under real-world driving conditions – the relative performance of vehicle technologies under 'real-world' driving conditions in London in relation to their emissions standards is explored further in relation to carbon dioxide (CO_2) in section 5.11 of this report. This, coupled with an increasing dieselisation of the car fleet, partly encouraged by policies to meet greenhouse gas reduction objectives, has meant that actual NO_2 concentrations in the air have remained stubbornly above EU limit values.

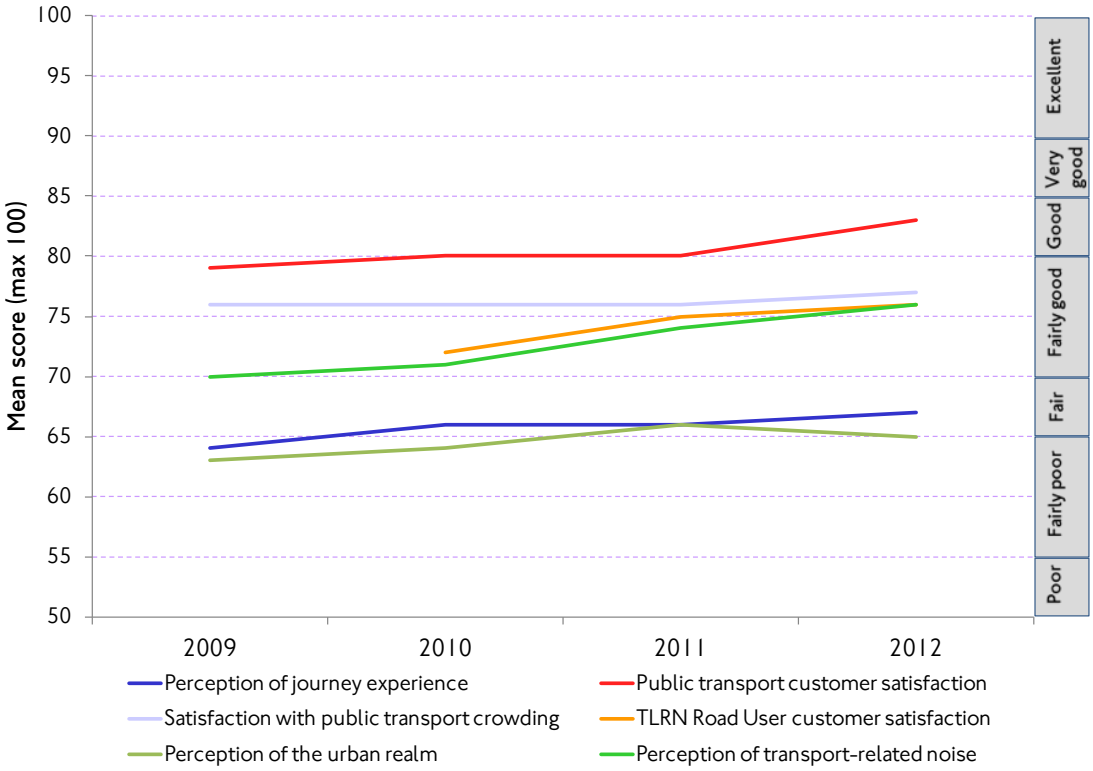
Current evidence is that the forthcoming 'Euro 6' emissions standard (vehicles to this standard will start to become widely available from 2014) will address this issue, and policymakers should therefore consider how best to encourage the earliest possible uptake of these vehicles, alongside the next generation of zero-emission (electric) vehicles, which will also bring benefits in terms of further reductions to PM_{10} and CO_2 emissions.

Perception of/customer satisfaction with aspects of the transport environment that contribute to quality of life. There are six perception/customer satisfaction based indicators under this heading that record people's satisfaction with various aspects of the transport system. They are scored on a scale from zero to 100, with higher scores meaning increased satisfaction for that aspect. The scores are derived from annual surveys conducted among Londoners or users of particular parts of the transport system, as appropriate. These surveys, and the measurements derived from them, have been fully described in previous Travel in London reports, and a synopsis is given in section 5.8 of this report. The indicators of interest here cover the following aspects:

- Public transport customer satisfaction
- Public transport crowding (satisfaction indicator)
- Road user customer satisfaction
- Perception of journey experience
- Perception of noise
- Perception of the urban realm

Figure 6.9 brings together and summarises progress with these indicators over the available time-series so far.

Figure 6.9 Summary of trends in perception-based MTS strategic outcome indicators for transport and quality of life. Mean scores out of 100, also showing TfL's assessment of scores.



Source: TfL Customer Satisfaction surveys, mode share based upon journey stage estimates; TLRN users satisfaction survey; TfL Streets Management Customer Satisfaction survey; TfL Perceptions of Travel Environment survey.

Looking at Figure 6.9, it is clear that the overall trend has been steadily upwards over the review period for most of these indicators, reflecting increasing levels of customer satisfaction with transport in London. To consider how 'good' these trends actually are, it is necessary to understand what the absolute scores mean, and also to understand any differentiation between the various components of the suite of indicators.

In terms of how good these trends actually are, TfL bases its assessment on a semi-subjective ranking, where bands of scores are graded in terms of descriptions such as 'fair', 'good' and 'excellent' – these are superimposed on the figure (see table 5.6 for further details).

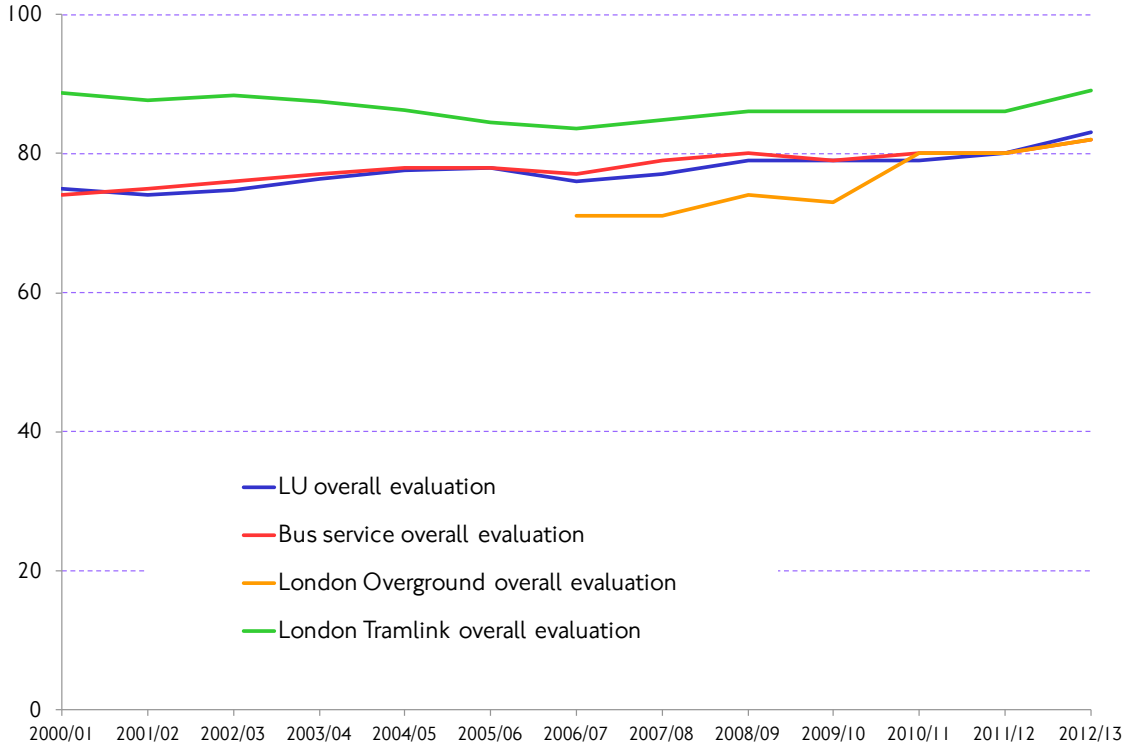
On this basis, overall public transport satisfaction is now considered to be firmly in the 'good' range (80-84). Notable is the substantial increase over the most recent year, partly thought to reflect the effect on public perception of the exceptional performance of the public transport networks to support the 2012 Games. Satisfaction with public transport crowding is, not surprisingly, lower, although is still rated as 'fairly good' according to the TfL scale, as is road user customer satisfaction. However, perception of journey experience is rated relatively lower still, this of course including aspects of the journey that are less immediately within TfL's control.

Looking at wider qualitative aspects such as perception of the urban realm, scores have latterly been towards the lower end of the 'fair' range – transport being a

crucial but nevertheless only one aspect of the customer experience of the urban realm. Finally, customer satisfaction scores with levels of transport-related noise in the local area lie in the middle of the 'fairly good' range – again perhaps surprising given the density and 24/7 activity levels of much of London.

In terms of what these tell us about differences, it seems that people appreciate the more immediate qualities of the transport system more highly than they do for wider aspects of the urban realm – which is not particularly surprising given the diversity of aspects that make up the urban travelling experience, such as the streetscape around transport facilities, and the corresponding diversity of authorities that have control over these. In the same way, inherently negative aspects such as crowding are rated relatively low of all the aspects that go to make up a journey.

Figure 6.10 Overall satisfaction with the principal public transport modes in London.



Source: TfL Customer Satisfaction Surveys.

Looking across the principal public transport modes, figure 6.10 shows a steady long-term trend of improvement for overall customer satisfaction (in terms of customers' 'overall evaluation') scores for each of the public transport modes. Evaluations for bus and Underground have increased steadily over the period, both having moved from the 'fairly good' to the 'good' category, according to TfL's assessment. By contrast, evaluations for Tramlink have fluctuated over the period, but are consistently higher than those for the other modes. London Overground, applicable only from 2006/07, has strongly improved from a low base, and is now on a par, in terms of overall customer evaluation, with longer-established scores for bus and Underground.

In terms of MTS goals for enhancing the quality of life of Londoners, it is clear that the relevant indicators are heading in the right direction. However, progress on

reducing harmful emissions from transport is slower than would be desirable, given the imperatives here to comply with European Union limit values for nitrogen dioxide and the implications of current ambient concentrations for public health. Customer perception and satisfaction scores with aspects of the transport system and the urban environment are rising steadily, as might be expected in the context of a transport system that is rapidly improving in many aspects. However, the scope for further substantial increases in these measures may well be limited because, as the quality of the provision rises, customer expectations also tend to rise.

6.6 Improving the safety and security of Londoners

London's transport networks are getting safer. Key indicators such as people killed or seriously injured (KSI) in collisions on the road network; reported crime on the public transport networks, as well as the number of people killed or seriously injured while travelling on the public transport networks, have all shown substantial progress since the middle part of the last decade. In 2012, for example, 17 per cent fewer people were killed or seriously injured while travelling on London's roads compared to the 2005-09 baseline. However, progress in reducing the number of people killed or seriously injured has slowed in recent years, and 'vulnerable' road users now account for the majority (80 per cent) of KSIs in 2012.

Applicable top-level indicators of progress under this heading are:

- Number of road traffic casualties (killed or seriously injured)
- Crime rates on public transport
- Perception of crime/safety while travelling

Number of road traffic casualties (killed or seriously injured). This is an established measure, the trends for which are discussed in section 5.2 of this report. To measure progress towards achieving the Mayor's long-term ambition of working together towards roads free from death and serious injury, Safe Streets for London, the Road Safety Action Plan for London 2020 [10], set a new target for London to achieve a 40 per cent reduction in KSI casualties by 2020 against the 2005-2009 baseline.

Comparing the number of casualties in 2012 against the longer-term 2005-09 baseline, fatal casualties were down by 36 per cent, KSI casualties were down by 17 per cent and, within this group, the number of child KSI casualties was down by 18 per cent. Despite these positive trends, 2012 saw a rise in the number of serious injuries, which increased overall by nine per cent between 2011 and 2012, with increases among cyclists (up 18 per cent), powered two-wheeler riders (up six per cent) and also children (up by 19 per cent).However, annual changes in collisions and casualties during 2012 should be considered in the context of long-term casualty trends in London, as year-on-year fluctuations are not always indicative of long-term trends.

TfL's Road Safety Action Plan takes forward a risk-based analysis in helping target road safety improvements to the most vulnerable casualty groups (see section 5.3 of this report). The Mayor's Cycling Vision for London will see more than £900m invested in improving facilities and conditions for cyclists in London, including segregated routes and measures to tackle contributory features associated with other road users, for example improving the safety of heavy goods vehicles, which are associated with a disproportionate number of cyclist deaths. To deliver further

improvements in road safety additional investment is being made in engineering, education, enforcement and road safety campaigns.

Crime rates on public transport. This is defined as reported crimes per million passenger journeys on the public transport networks. Figure 5.5 of this report shows a rapid downward trend for reported crime on all of the public transport modes. The risk of being involved in a crime on the London Underground has fallen by 44 per cent since 2006/07. Equivalent falls for the buses was 58 per cent, and 29 per cent for Tramlink. London Overground, perhaps surprisingly, given the heritage of some of the former National Rail lines that were incorporated into the new network, is revealed to be the 'safest' network, rates of reported crime being almost half those of the London Tramlink.

Perception of crime/safety while travelling. This is defined as the perception of London residents of their sense of safety and fear of crime when travelling in the city – during the day and at night. Data for this indicator for 2012/13 is unfortunately not available. The available time-series (from 2009) shows a mixed track record (table 6.3) in terms of year-to-year change. However, consistently around 95 per cent of people feel safe while travelling during the day, with just over three-quarters of people feeling safe whilst travelling during the night hours.

These scores are unlikely to move significantly from these ranges without either dramatic improvement or deterioration to the security situation in general – well away from the actual transport networks. It is notable that the widespread social disturbances of late summer 2011 were associated with small falls in the percentage of people feeling safe whilst travelling (from the component data this mainly reflected walking trips). This indicator should also be interpreted in conjunction with the trends in reported crime on the transport networks, as discussed above, which have been strongly downwards in recent years.

Table 6.3 Perception of London residents of their sense of safety and fear of crime while travelling. Percentage feeling safe while travelling during the day or at night.

Year	During the day	At night
2009	95	78
2010	97	78
2011	95	76
2012	n/a	n/a

Source: TfL Group Customer Research.

6.7 Improving transport opportunities for all Londoners

MTS goals under this heading relate to the contribution that transport can make to urban regeneration, improving access to services through greater connectivity, and improving the accessibility of transport services and infrastructure to all members of the community, particularly those with disabilities.

Applicable top-level indicators of progress under this heading are:

- Access to jobs and services
- Physical accessibility to the transport system
- Real fares levels

Access to jobs and services. This is defined as a local area score of average journey time by public transport, walking and cycling to jobs and local services. This indicator relies on comprehensive updates to transport model scenarios, and consequently it is only updated on a circa. five yearly basis. The most recent benchmark, reflecting conditions in 2010, was that the average journey time by public transport, walking or cycling to local area jobs and services was 17.4 minutes. This is an average across the whole of Greater London, based on numerous local-area scores.

In the absence of a comprehensive update to this indicator, it is worth reviewing the material discussed in section 5.6 of this report, which looks at how recent developments and extensions to the transport networks are improving connectivity across London.

Since the publication of the MTS, TfL has delivered several major public transport schemes, as well as a wide range of smaller improvements to all of the transport networks. The major schemes have included the transformation of the London Overground surface rail network, now providing high-frequency metro-style operations with a core orbital route through inner London and several extensions. On the Underground the benefits of the Tube upgrade programme are now feeding through, with enhanced service levels on many lines. On a smaller scale, continued incremental extensions to the Docklands Light Railway, the roll out of Barclays Cycle Hire in central and east London and the Emirates Air Line across the Thames in east London have also been noteworthy additions to London's transport, all of these to a greater or lesser extent improving connectivity, accessibility and the ability of Londoners to access to jobs and services.

All of this, alongside increasing population, means that the number of people that are able to access jobs and opportunities, within a set travel time threshold, has increased. Between 2006 and 2012, for example, the number of jobs available to the average London resident within 45 minutes public transport travel time increased by 5.5 per cent – to stand at just under one million jobs.

Looking forward, a major step-change will occur with the completion of Crossrail, although there are a host of smaller-scale but still key improvements also in prospect. These include the proposed Northern line extension to Battersea, opening up access to the massive regeneration scheme around Battersea Power Station, and TfL's forthcoming assumption of responsibility for National Rail metro services to West Anglia, which is expected to lead to increased service frequency on these routes.

Collectively, these improvements mean that the transport networks in London have more connectivity, and accessibility to jobs, services and other opportunities is improved. All of this means, for example, that by 2031 residents of Newham will, be able to access 42 per cent more town centres within 45 minutes than is currently possible. More dramatically, residents of Woolwich will, in 2031, be able to access 14 times more jobs within 45 minutes than was the case in 2007.

Physical accessibility to the transport system. This is defined as the level of step-free access across the TfL public transport and streets networks, expressed as a weighted average according to the relative use made of each mode. It is expressed as a percentage score. Table 6.4 shows the trend in yearly scores over the available time series for this indicator.

Table 6.4 Level of step free access across the TfL public transport and streets networks. Weighted percentage score.

Year	Percentage step-free score
2006/07	n/a
2007/08	36
2008/09	36
2009/10	37
2010/11	38
2011/12	44
2012/13	46

Source: TfL Planning Strategic Analysis.
Note: Values prior to 2009/10 are based on a dataset that differs in minor respects to that used from 2009/10.

The trend for this indicator is consistently upwards, as infrastructure is progressively upgraded (for example, Green Park and Kings Cross Underground stations) or new infrastructure, such as stations on the East London line extension and DLR, is built to be fully accessible from the start. The pledge to make the 2012 Games the most accessible Games ever was a particular stimulus to maximise physical accessibility ahead of the Games, and strategies employed for the Games, for example mobile boarding ramps at selected Underground stations, have been carried on in the period after the Games.

However, London has a large estate of heritage assets where it is not possible to achieve change in levels of physical accessibility quickly or cheaply. The value of 46 per cent for 2012 means that just over half of the network is not accessible on this basis. Computer simulations continue to show that people using only the 'accessible' network suffer large time penalties when attempting to complete journeys that are not catered for directly by this network. TfL's Accessibility Action Plan [11] points the way forward here, but it is acknowledged that achieving universal step free access is a very long-term goal.

Real fares levels. The real fares level measures the average actual fare paid in London per kilometre travelled. It is a composite measure, covering bus and Underground only, calculated as the total actual fares revenue for passengers paying full adult fares, adjusted for inflation and divided by corresponding actual bus and Underground passenger kilometres. In 2012, the average adult composite bus and Underground fare paid fell to 21.6 pence per kilometre, from 21.8 pence per kilometre in the previous year.

6.8 Reduce transport's contribution to climate change and improving its resilience to the effects of climate change

The applicable MTS indicator under this heading is emissions of carbon dioxide (CO_2) from ground-based transport in London.

Emissions of CO_2 from ground-based transport. This is defined as tonnes of carbon dioxide emitted from ground-based transport (excluding aviation) in London over the calendar year. It is quantified by the London Atmospheric Emissions Inventory, and therefore the comments above (for PM_{10}) in relation to time-series continuity of emissions estimates also apply. Transport accounts for just over 20 per cent of London's total CO_2 emission.

Carbon dioxide is important because it is London's most significant greenhouse gas. It is the subject of several local, national and international reduction targets designed to address the challenges presented by climate change. The Mayor's Climate Change Mitigation and Energy Strategy [12] sets out the Mayor's target to reduce CO_2 emissions by 60 per cent against 1990 levels by 2025. In practice, this is specified as a fixed tonnage to be achieved by 2031, based on a 2006 baseline.

CO_2 emissions from ground-based transport have reduced by an indicative 6 per cent between 2008 and 2012 - indicative as an assessment has been made across methodologically incompatible estimates. The trend of reduction has been a steady one, mostly reflecting small but consistent year-on-year reductions to vehicle kilometres driven in London, as well as progressive improvements to the fuel efficiency of the road vehicle fleet. However, they equate to reductions of just over one per cent per year. Achieving the reductions set out in CCMES would require an indicative reduction of just over 3 per cent per year between 2006 and 2031, although as CCMES makes clear, the principal gains expected from transport are expected to occur later in the timeline.

In terms of resilience to the effects of climate change, this topic is now firmly embedded into TfL's business planning processes, with a number of initiatives to mitigate identified short-term risks underway.

6.9 Supporting delivery of the London 2012 Olympic and Paralympic Games and their legacy

The 2012 Games are now regarded as having been a great success, both as sporting events and, particularly, in the way that the transport networks operated to support them. Travel in London report 5 covers in some detail the travel demand patterns during the Games, describing how travel demand management and associated travel advisory campaigns played a key role in spreading demand, so that the extraordinary volumes of Games-related travellers could be accommodated on the networks. Much preparation was put into ensuring operational resilience of the networks during the Games, and this paid off, with generally record levels of operational excellence being achieved, and few reports of significant disruption.

While this is now history, it is important to see it from the perspective of the period before the Games, where there was widespread scepticism among stakeholders and the media that the transport networks would be able to cope, and that necessary measures to discourage non-Games travel would paralyse business and leisure activity in the rest of London. With the great assistance of London's travelling public, both expectations were comprehensively disproved. The commentary in Travel in London report 5 showed that London's transport successfully hosted an international event of the largest possible logistical scale – and that the rest of London was kept open for business, pretty much as usual.

Three key lessons arise from this assessment of Games time travel, in terms of the future use of large-scale travel demand management to help manage demand on the transport networks.

First, it can take a large number of people all making a relatively small change to achieve effects on the network of a useful scale. Travel in London 5 found that perhaps two-thirds of Londoners had changed their travel in some way during the Games - yet this only led to a 5 per cent overall net reduction in travel demand.

Second, in the absence of a high-profile incentive such as the Games, and in the absence of a large-scale travel advisory media campaign, people and businesses will organise their travel so as to be optimal for their own circumstances, rather than the good of the overall network, although it should be recognised that congestion on the networks does act as a powerful constraint on travel demand.

Third, surveys have found that normal change, or 'churn' in how individuals travel is very frequent. About one-fifth of individuals are found to change their travel in some way each year, mostly reflecting 'life changes', such as a new house or job. Yet day-to-day levels of demand on most parts of the network remain relatively stable. If, as this implies, people and businesses are routinely very sophisticated in optimising their travel choices, interventions to promote long-term sustained change, for example to reduce travel at peak times or encourage goods vehicle operators to move towards more operations during the overnight period, will need an equally sophisticated balance of 'carrot and stick'.

Attention now turns to the Games legacy. In a very real sense the Games are not over. London's bid for the Games was predicated on the commitment to support regeneration in parts of east and south-east London – which are some of the most deprived areas in the UK. As well as supporting the Games themselves, the £6.5 billion worth of transport infrastructure that was put in place before the Games has the equally important long-term aim of facilitating regeneration – improving prospects for people in this part of London by providing greater access to jobs, services and other opportunities. Achieving transformational change in the social and economic prospects of the six growth boroughs (which hosted the Games) will however require much more than transport investment, and future Travel in London reports will assess transport and related trends in the wider regeneration context of the Olympic legacy.

6.10 Focus on: London Underground's 150th year anniversary celebrations

2013 marked the 150th anniversary celebrations of the Tube. This section briefly reviews the historical context to the celebrations and the events themselves during 2013.

The world's first Underground railway opened on 9th January 1863 between Paddington and Farringdon. Today, after 150 years of evolution and change, LU carries more than a billion passengers each year. The Underground is also known the world over as the Tube. This name first came into use in the early 1900s after the first deep-level tube tunnels had been built.

TfL celebrated the Underground's 150th anniversary in a number of different ways that explored the impact that the Tube has had on London and the world throughout its history, and how that will continue into the future as the Tube continues to be at the heart of life in London, and is crucial to its continuing success and evolution.

Events during the year included a high-profile marketing campaign, designed to raise public awareness of the anniversary and the role of the Tube in the lives of Londoners. Special £2 coins and stamps were circulated by the Royal Mint and Royal Mail, and an official LU 150 history book titled 'Underground – How the Tube Shaped London' was published. Art on the Underground presented a full programme themed on the anniversary, and special steam-hauled trains were operated on parts of the network throughout the year (figure 6.11).

Figure 6.11 Special steam-hauled train at Amersham as part of LU's 150th Anniversary celebrations.

Notes and references

(1) http://www.london.gov.uk/sites/default/files/Cycling%20Vision%20GLA%20template%20FINAL.pdf
(2) See, for example, Travel in London report 4, section 4.14. http://www.tfl.gov.uk/assets/downloads/travel-in-london-report-4.pdf
(3) See Travel in London report 4, section 4.13. http://www.tfl.gov.uk/assets/downloads/travel-in-london-report-4.pdf
(4) http://www.tfl.gov.uk/assets/downloads/corporate/rtf-report-chapter-1.pdf
(5) http://www.tfl.gov.uk/assets/downloads/corporate/travel-in-london-report-5.pdf
(6) Travel in London report 2, section 4.12. http://www.tfl.gov.uk/assets/downloads/corporate/travel_in_london_report_2.pdf
(7) http://data.london.gov.uk/datastore/package/london-atmospheric-emissions-inventory-2010
(8) http://www.tfl.gov.uk/roadusers/lez/default.aspx
(9) https://www.london.gov.uk/priorities/environment/clearing-londons-air/air-pollution-and-public-health
(10) http://www.tfl.gov.uk/assets/downloads/corporate/safe-streets-for-london.pdf
(11) http://www.tfl.gov.uk/static/corporate/media/newscentre/archive/20465.html
(12) http://www.london.gov.uk/priorities/environment/consultations/climate-change-mitigation-and-energy-strategy

Spotlight topics

7. Spotlight on: Long-term travel trends in Greater London – what can we learn?

7.1 Introduction and content

This chapter looks at long-term trends in personal travel among London residents using compatible large-scale decennial travel surveys of Londoners, and related datasets, dating back to 1971. Key changes in travel behaviour over this timescale are characterised - for example the increase and subsequent decrease in the use of cars - and some of the socio-demographic and structural/economic trends underlying them are explored. Relating these individual trends to known outcomes in total travel in London provides insight and quantitative evidence that can be used to improve the effectiveness of TfL's tools for forecasting travel in future years.

7.2 Overview of data sources

This section summarises the key data sources that are available, and details the overall goals of the analysis summarised in this chapter.

Large-scale decennial surveys of Londoners' travel – the GLTS, LATS and LTDS surveys

Large-scale household-based surveys of London residents' travel have been undertaken on a broadly comparable basis since 1971. Until 2001, these surveys were undertaken every decade and were timed to coincide with the Census of population, data from which was required to 'expand' the survey sample to represent the total population of London. Since 2005/06, household-based travel surveys in London have been undertaken on a continuous rolling annual basis, these having very similar objectives and content to the previous decennial surveys, albeit with a relatively small annual (financial year) sample of households. By combining three years from the most recent surveys, it is possible to derive a synthetic dataset that is broadly representative of conditions in 2011, and also compatible with the historic large-scale surveys. Table 7.1 summarises the key features of these large-scale travel surveys available for this analysis:

Table 7.1 Summary of large-scale decennial surveys of Londoners travel.

Year	Survey name	Achieved household sample size (within Greater London area)	Sample size (per cent of London resident households)
1971	Greater London Transport Survey (GLTS)	36,900	1.4%
1981	Greater London Transport Survey (GLTS)	35,300	1.4%
1991	London Area Transport Survey (LATS)	44,700	1.6%
2001	London Area Transport Survey (LATS)	27,300	0.9%
2011	London Travel Demand Survey (LTDS)	21,600	0.7%

Household survey data from the 1971, 1981 and 1991 GLTS/LATS surveys were combined by the Transport Research Laboratory in the mid 1990s to create a 'time-series' dataset. This took a 'lowest common denominator' approach in terms of including only variables that were common across the three surveys, and in some

cases combining or otherwise aggregating the elements of these variables to ensure, as far as was possible, comparability across the three surveys.

This dataset provides the most readily accessible and consistent source of data from the earlier surveys and is used for this work, although it does have some significant limitations arising from the combination process. The 2001 LATS survey and more recent LTDS surveys were closely similar in concept and content to the earlier surveys. These remain as free-standing datasets, with data being extracted so as to be compatible with that from the time-series dataset.

Limitations affecting the scope of time-series analysis using decennial travel surveys

The following general limitations apply to all five of the travel surveys:

- Data are available for London residents only. The data do not therefore represent a complete picture of travel in London, which includes a significant volume of travel by non-residents (for example, daily commuters, tourists).
- Trip data are confined to trips that have an origin or destination (or both) within the Greater London area. Lengthy trips within the UK to/from London are therefore included in the data, but trips by Londoners wholly outside London are not. Long-distance overseas trips are included only to the point of international departure (UK port or airport).
- Only 'personal travel' trips are included. Therefore, journeys made as a direct requirement of work are excluded, for example drivers of public service vehicles and goods 'rounds men'. However, trips made in the course of work for business, for example, attending meetings at remote offices, are included.
- Data apply to average weekdays (Monday-Friday) only.
- Because of their decennial nature, it is not possible from these data to discern details of significant transport events that occurred part way through each decade. For example, the mid-1980s were a time of rapid and radical change to the public transport fares structure in London, whilst central London Congestion Charging was introduced in 2003.

Despite the combination process certain limitations remain in comparing data across the five surveys that cannot be further rectified, and that should be recognised in any comparisons:

- There were differences across the five surveys in population and demographic profiles used for 'expanding' the survey data to representative totals for London. Examples include the treatment of people aged under five, and the treatment of temporary visitors to London otherwise resident outside the area. Although steps have been taken to maximise comparability across the five datasets, comparisons of absolute numbers (people, trips, etc.) do need to be treated with some caution.
- There were numerous changes in definitions and survey procedures for journeys involving walking and cycling over the five surveys. It is therefore not possible to obtain estimates for travel by these modes that are sufficiently consistent for time-series analysis and these modes are regrettably omitted from this analysis, which is confined to 'mechanised' modes of travel only (including public transport).
- Procedures for geo-referencing trip data in the earlier surveys were not as precise as in the later surveys. There is therefore the possibility of some systematic bias in comparisons involving distances.
- For reasons that cannot now be traced, the 1981 GLTS appeared to have systematically under-estimated the number of non–car-owning households in relation to other sources.

Notwithstanding these limitations, it is possible to make direct comparisons across a wide range of travel characteristics and explore their underlying determinants. Aspects of travel that can be explored include: amount and rates of travel, usage of the different modes of transport, time and distance travelled, and the relationship of travel to a range of socio-demographic characteristics.

Because further modifications have been made to the original TRL dataset to make it compatible with the later surveys, for example standardising the area of geographical coverage to the contemporary GLA area, totals reported here for years 1971-1991 will differ from those originally reported by TRL[1].

Exploratory analysis of time-series trends

This analysis firstly explores the decennial travel surveys (and related data such as the Census) in a 'longitudinal' sense, identifying and quantifying the main trends in travel demand, travel behaviour and selected 'drivers of travel demand' over this 40-year period (ie five common data points). It is clear from this analysis that, while many aspects of travel and transport in London have changed radically over this period, other aspects have been more stable. For example, the total number of people living in London in 1974 was approximately the same as in 2011. However, both total travel and many key indicators of the ways in which people travel were very different.

By looking 'cross-sectionally' in detail at each of the five surveys, it is possible to capitalise on the relatively large sample sizes achieved by each survey, giving adequate resolution to explore spatial and various socio-demographic dimensions. Relationships so characterised at the level of the individual survey can then be assessed across all five surveys in chronological sequence. In this way not only can the nature of relationships be quantitatively described at each of the five points in time, but changes in the nature and strength of the relationships over time can also be described and potentially projected forward. This is important, because conventional 'straight-line' forecasts are frequently rendered incorrect when the nature of the relationships on which they are based changes over time.

The material reviewed in this chapter form an initial part of an on-going piece of work, further outputs from which will be reported in due course.

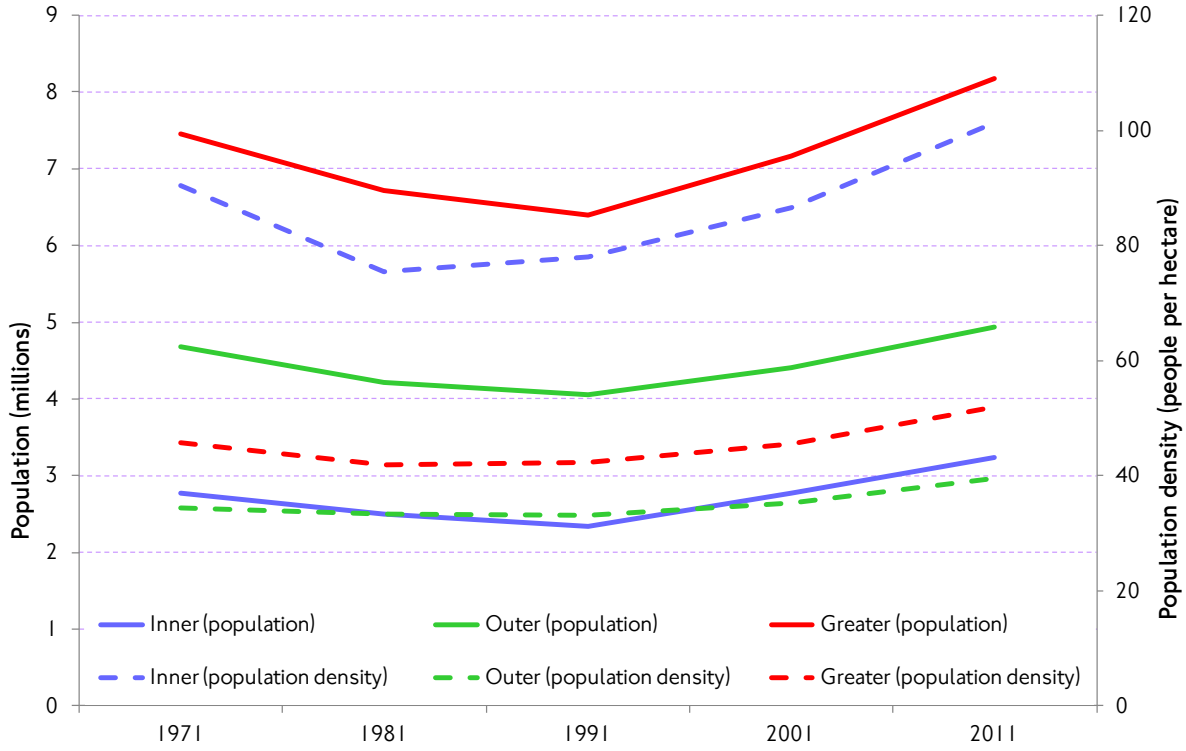
7.3 London's changing population

This section reviews key demographic indicators of London's population, as recently updated by the 2011 Census and including comparisons with historic Census data dating back to 1971. This provides essential context to understand how London's population has evolved over the last four decades, and includes certain transport-related variables as captured by the Census. Note that the decennial travel surveys are 'expanded' by Census estimates of population (ie the survey sample is weighted, at a disaggregate level, by the Census totals).

London's population – total residents and population density

Census estimates of the total resident population of Greater London are available for 1971, 1981, 1991, 2001 and 2011. Figure 7.1 shows what is now the recognised picture of decreasing population between 1971 and 1991, and increasing population thereafter. This trend is of particular interest because, at different points over the 40-year period, similar levels of population have corresponded to different aggregate travel demand patterns, reflecting both changes to the composition of the population, and the travel behaviour of those individuals making up the population.

Figure 7.1 Total resident population of Greater London (left hand scale) and population density (right hand scale), 1971 to 2011.

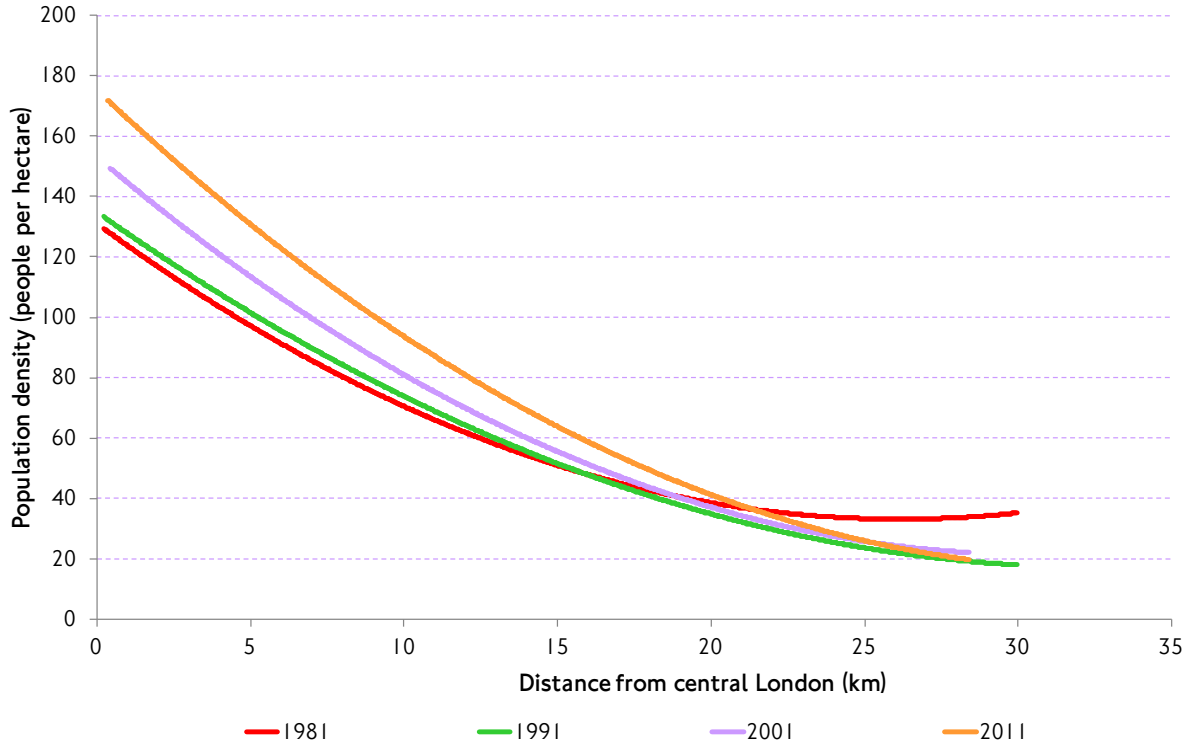


Source: Census of population.
Note: It is thought that the 1991 Census under-enumerated London's population by about 1 per cent relative to other Censuses.

When looked at in terms of population densities, it is seen that inner London lost population rapidly between 1971 and 1981, but has since re-gained population at a progressively accelerating rate. In 2011 there were 0.73 million more people living in inner London compared to 1981 – a 29.4 per cent increase, although this compares to a 9.9 per cent decrease over the single decade from 1971 to 1981. Comparing 1971 densities in inner London with those of 2011, the increase in population density (persons per hectare) was just 11.9 per cent.

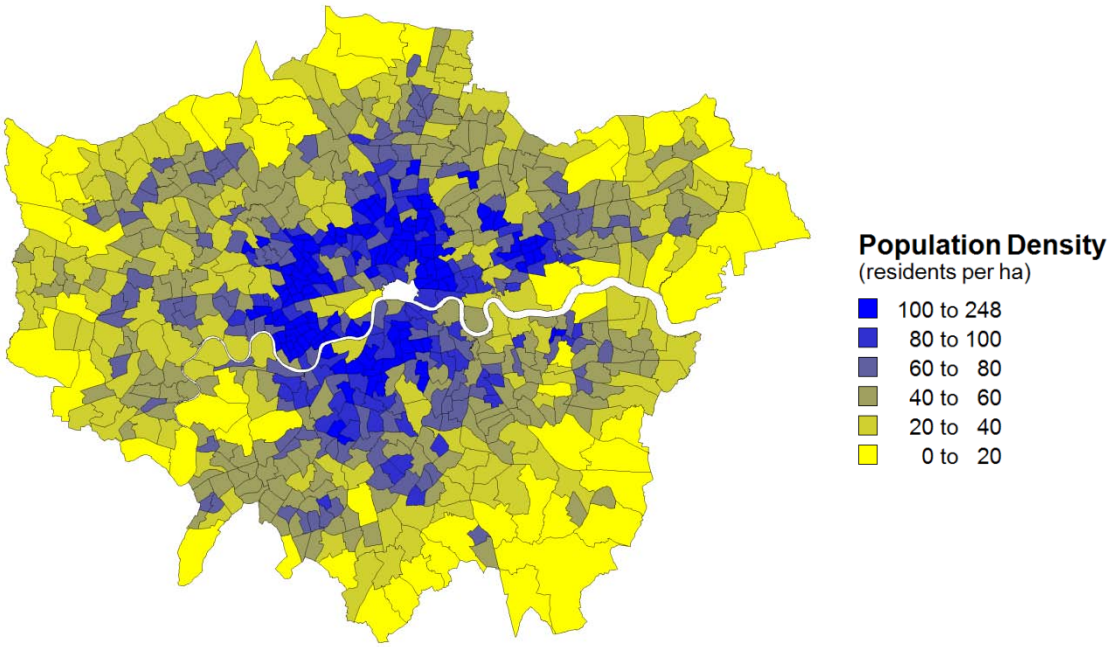
Figure 7.2 shows this in more detail, with 'best fit' lines derived to show the changing relationship between residential density and distance from central London over the 30-year period 1981-2011 (1971 data is not available in the required format), using appropriate 'small area' enumeration geographies.

Figure 7.2 Relationship between population density and distance from central London.



Source: TfL Planning Strategic Analysis, based on Census of population.

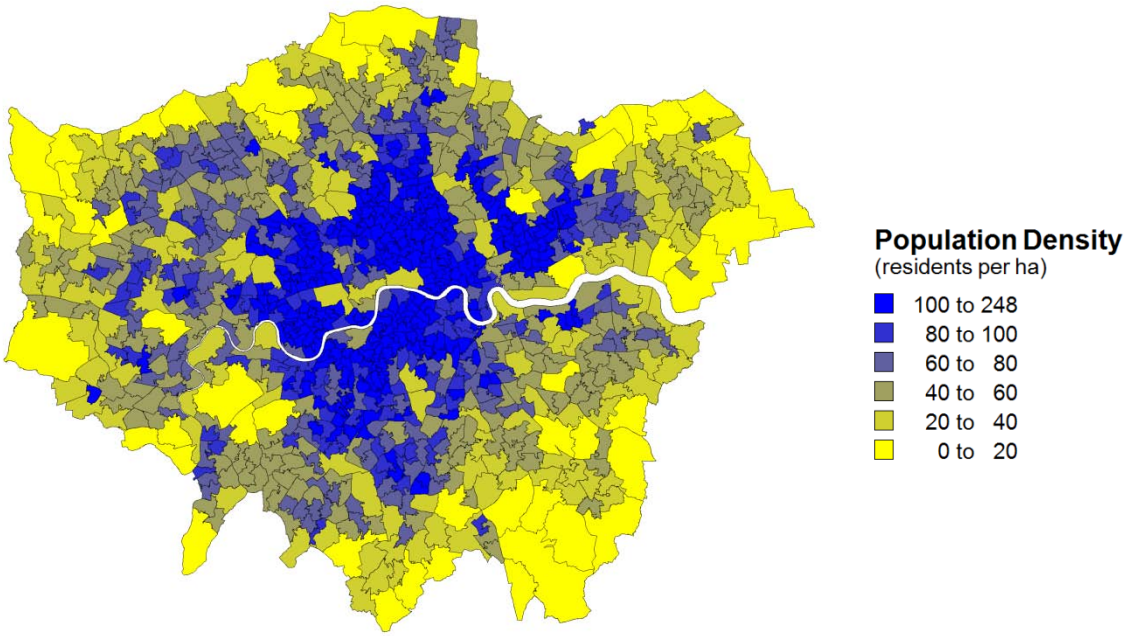
Figure 7.3 Population density map of London 1991.



Source: TfL Planning Strategic Analysis, based on Census of population.

Figures 7.3 and 7.4 show the population density of London for the years 1991 and 2011. They show that population density has been generally increasing across London, but is particularly noticeable throughout inner London.

Figure 7.4 Population density map of London 2011.



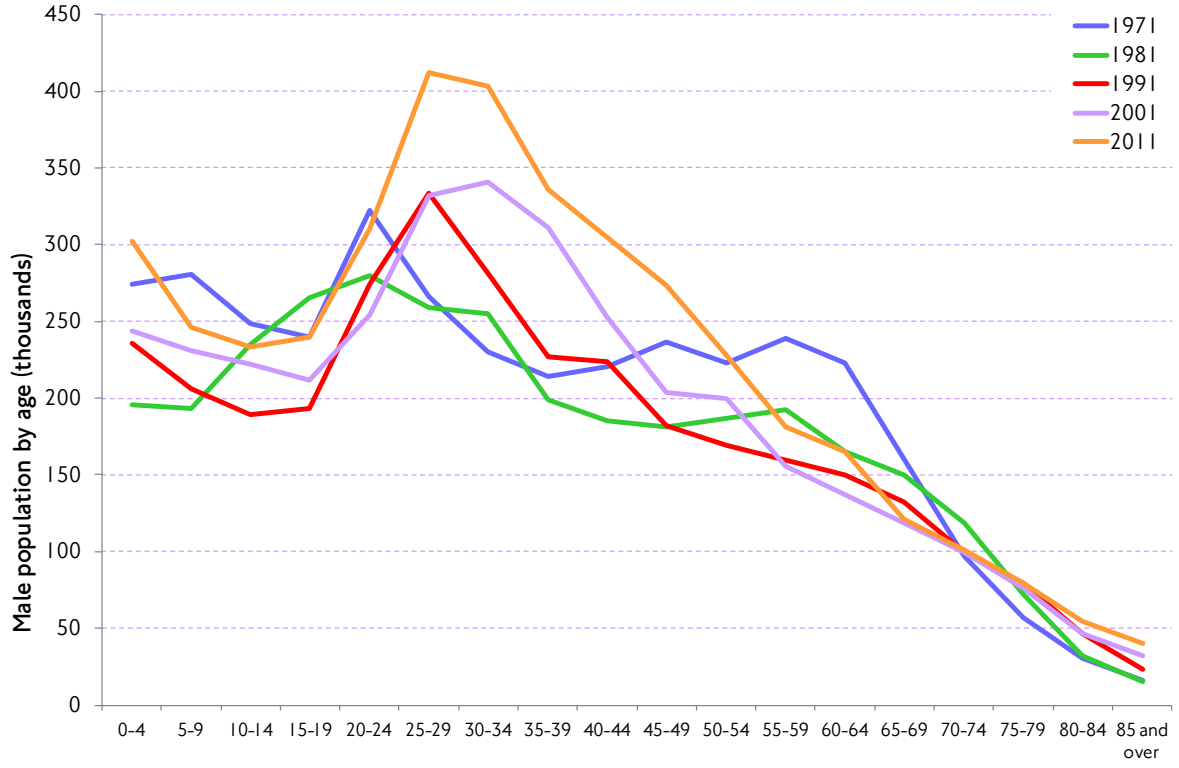
Source: TfL Planning Strategic Analysis, based on Census of population.

Of course the composition of London's population has also changed, and there are well-recognised dependencies between socio-demographic status and activity/travel levels. For example, people in employment will make trips to, from and related to work, whereas retired people will not make these trips. The following sections explore some of these aspects.

London's population – age profiles

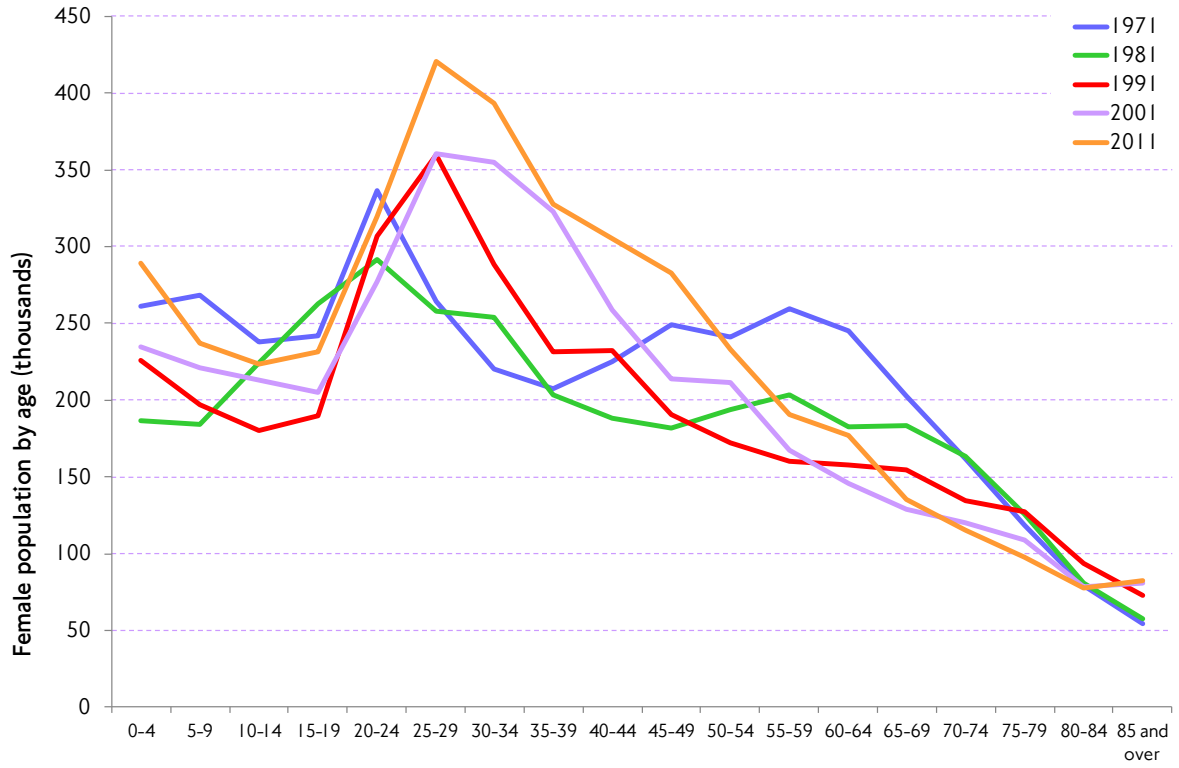
The age profile of London residents has undergone substantial change in the period since 1971. Figures 7.5 (male) and 7.6 (female) show the absolute number of residents at each age for each of the five censuses. Looking first at men, the overall shape of the profiles for 1971, 1981 and 1991 is broadly similar, although with a notable depopulation of men of later working age between 1971 and 1981. Between 1991 and 2001 there was a notable increase in men of younger-middle working age. Between 2001 and 2011 the impact of the general population increase is clearly visible with increases across most age groups, although particularly men of younger working age. Women show broadly similar patterns, with a notable de-population of women of older working age between 1971 and 1981, and more recent rapid increases of women of younger working age.

Figure 7.5 Total resident population of Greater London. Age structure (male).



Source: TfL Planning Strategic Analysis, based on Census of population.

Figure 7.6 Total resident population of Greater London. Age structure (female).



Source: TfL Planning Strategic Analysis, based on Census of population.

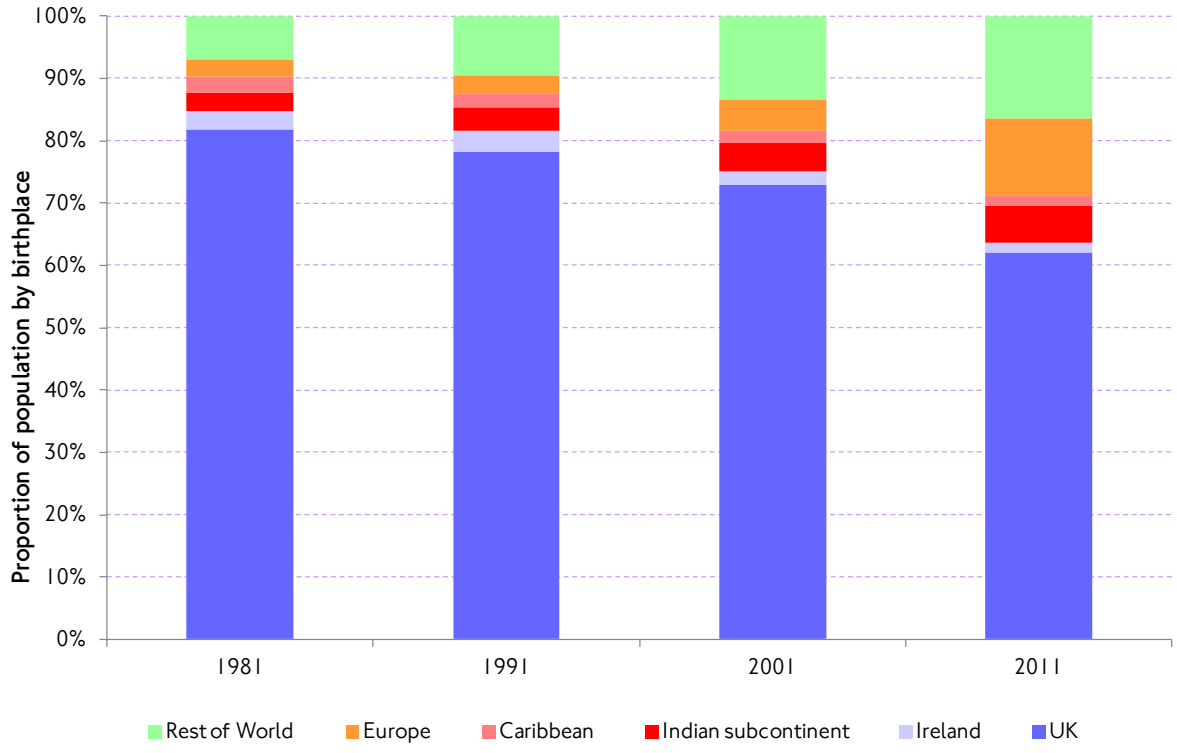
London in 2011 therefore had many more people of 'younger working age' than at any time since 1971. Interestingly, however, London's population has not been 'ageing', in the sense of their being more people of pensionable age. The total number of people aged over 65 resident in London has in fact fallen consistently over the four decades, with 0.90 million people aged over 65 in 2011 compared with 0.98m in 1971 – a 7.6 per cent decrease with persons over 65 making up 13.1 and 11.1 per cent of the total population respectively.

Ethnicity and migration

There are recognised differences in travel behaviour between different ethnic groups, and the hypothesis has been advanced that changes to international migration patterns over recent decades underlie some of the trends seen in the aggregate travel demand data. For example, it is believed that more recent, younger migrants from the European Union are less likely to own and use cars than average for the total resident population. It is probable that these differences are not so much intrinsic properties of the ethnic groups themselves; rather that they reflect distinctive socio-demographic/socio-economic biases characteristic of these groups - such as distinctive age profiles, preferred residential locations, length of 'establishment' in the UK and types of employment undertaken.

Available data on place of birth and length of UK residence are insufficient to allow this to be analysed in detail. However, as figure 7.7 shows, recent decades have seen substantial increases in the proportion of London residents who were not UK born, with 38 per cent of residents born outside the UK in 2011, compared with 27 per cent in 2001 and 18 per cent in 1981.

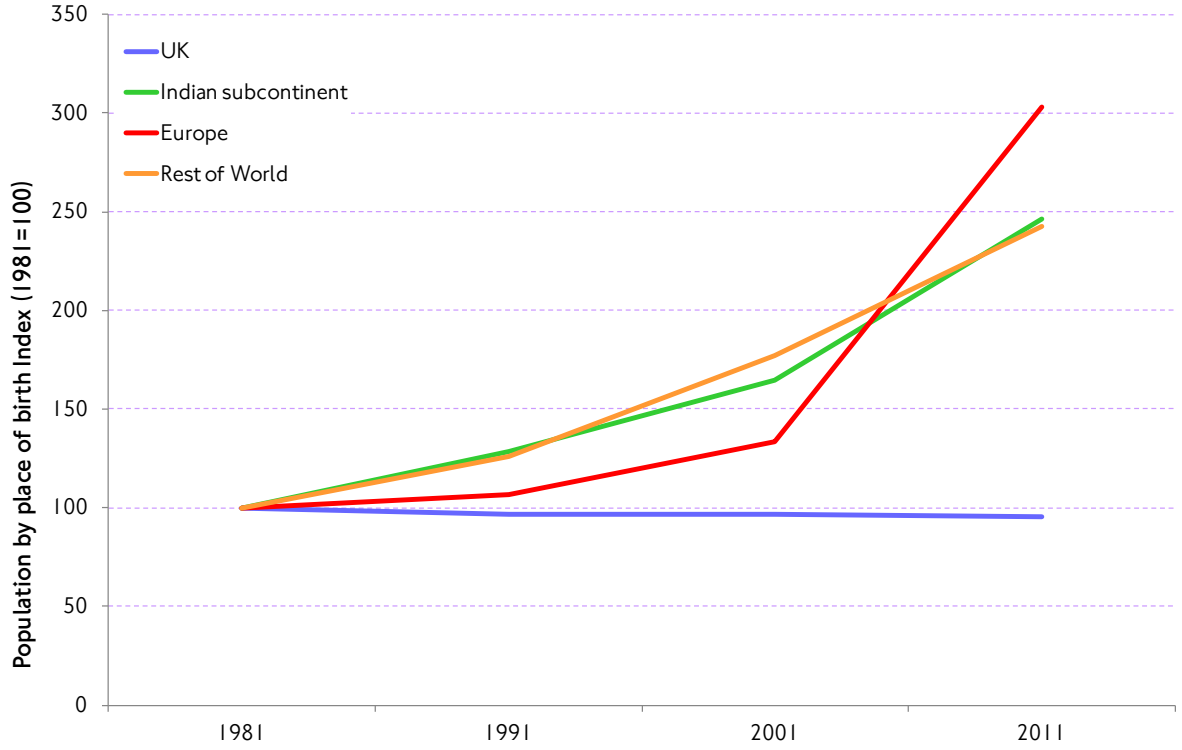
Figure 7.7 Proportion of London residents by country of birth, 1981-2011.



Source: TfL Planning Strategic Analysis, based on Census of population.

Figure 7.8 shows the impact of migration on London's population since 1981. The number of people born in the UK has remained relatively static in absolute terms, and is now 4.3 percentage points lower than in 1981. Between 1981 and 2001, there was strong growth in the number of residents born outside Europe, with 64.5 per cent more residents born in the Indian subcontinent, and 77.3 per cent more residents born in the rest of the world. Growth in the number of residents born in Europe was initially much lower, at 33.5 per cent between 1981 and 2001. However, in the last ten years alone, the number of people born in Europe (excluding the UK) resident in London increased by 126.9 per cent to 1.16 million.

Figure 7.8 Change in London's population by place of birth, 1981-2011. Index: 1981=100.

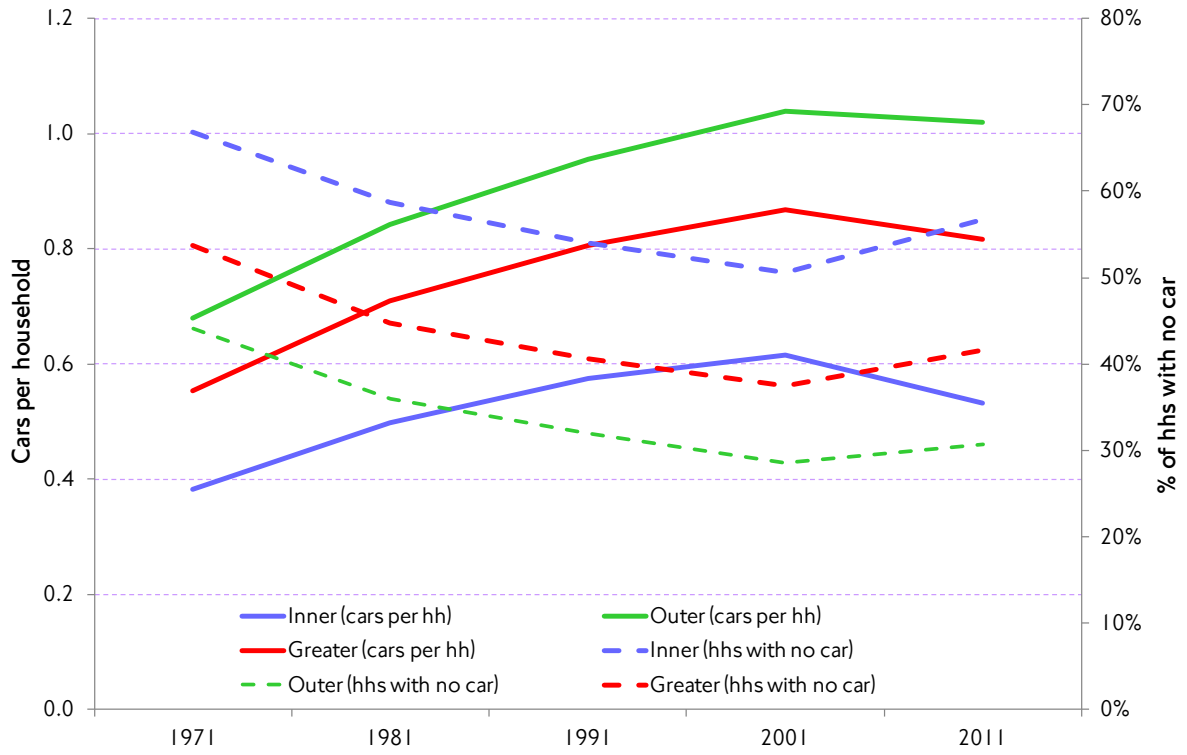


Source: TfL Planning Strategic Analysis, based on Census of population.

Car ownership

There is much evidence that car ownership has declined in London in recent years, and that this is a major factor underlying the observed reductions in car use. Figure 7.9 combines indicators of households without access to a car (right-hand scale) and the average number of cars per household (left-hand scale). Changing household structure is also a factor here, with a notable trend over the period towards smaller households. The average size of households in London fell from 2.72 to 2.35 people between 1971 and 2001, although this has increased in the last decade to 2.47 in 2011. Nevertheless the overall trend, of increasing car ownership until 2001, followed by declining car ownership to 2011, is clear.

Figure 7.9 Car ownership in London 1971-2011. Average number of cars per household (left-hand scale) and percentage of households without access to a car (right-hand scale).



Source: TfL Planning Strategic Analysis, based on Census of population.

Driving licence holding

The overall proportion of London residents (aged 17 and above) in possession of a driving licence increased from 40 per cent in 1971 to a peak of 66 per cent in 2001, subsequently decreasing to 63 per cent in 2011/12. Table 7.2 shows that there have between substantial differences by age and gender. Licence holding among woman increased dramatically in the 1970s and 1980s, from 20 per cent in 1971 to 50 per cent in 1991, after which the increase began to plateau, at 57 per cent in 2001 and 55 per cent in 2011/12. Licence holding among men is greater than among women – increasing from 62 per cent in 1971 to 75 per cent in 1991 and 2001, followed by a small reduction to 72 per cent by 2011/12.

Table 7.2 Proportion of London residents with a driving licence 1971-2011/12, by age and gender.

Year		17-24	25-44	45-59	60+	17+
1971	Male	54%	75%	68%	38%	62%
	Female	23%	31%	19%	6%	20%
	All	38%	53%	43%	19%	40%
1981	Male	49%	80%	76%	51%	68%
	Female	31%	49%	34%	12%	33%
	All	40%	65%	55%	28%	49%
1991	Male	61%	83%	83%	60%	75%
	Female	47%	67%	54%	21%	50%
	All	54%	74%	69%	37%	62%
2001	Male	47%	82%	85%	66%	75%
	Female	40%	69%	67%	32%	57%
	All	43%	75%	76%	47%	66%
2011/12	Male	35%	78%	83%	74%	72%
	Female	31%	61%	68%	46%	55%
	All	33%	69%	76%	59%	63%

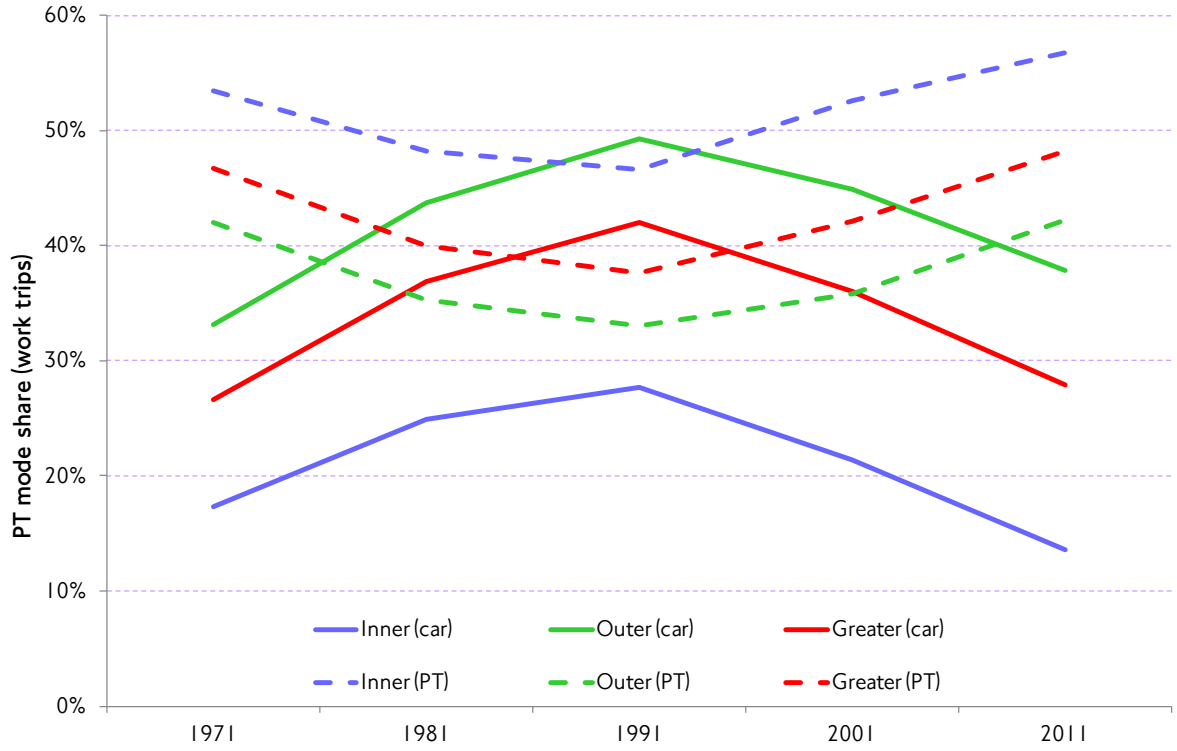
Source: TfL Planning Strategic Analysis, based on Census of population.

In 2011/12, people aged 45-59 were most likely to hold a driving licence, however in 1971, 1981 and 1991, 25-44 year olds were most likely. In 2001, there was little difference between the two age groups, with 45-49 marginally more likely to hold driving licence (76 per cent) than 25-44 year olds (75 per cent). While there has been a sharp reduction in licence holding among 17-24 year olds, decreasing from 54 per cent in 1991 to just 33 per cent in 2011/12, licence holding among people aged 60 plus has increased in every survey, from 19 per cent in 1971, to 37 per cent in 1991 and 59 per cent in 2011/12.

Census journey-to-work

Census journey-to-work data give a good overview of differing travel patterns among Londoners over the 40-year timescale. Figure 7.10 shows the mode share (public or private transport) for home-to-work ('commuting') trips, for residents of inner, outer and Greater London. The first observation is the general increase in car 'commuting' trips to 1991, followed by a decline back approximately to 1971 levels. The trend for public transport trips is the direct inverse. When viewed in the context of the changing absolute level of workers in London, it can be appreciated that the period of maximum mode share for car trips corresponded to a comparatively low absolute number of residents/workers. In contrast, the increase in public transport mode share since 1991 has corresponded to an increasing absolute population.

Figure 7.10 Mode shares for public and private transport for commuting journeys. Census travel to work data.



Source: TfL Planning Strategic Analysis, based on Census of population.

7.4 Key 40-year travel trends among London residents

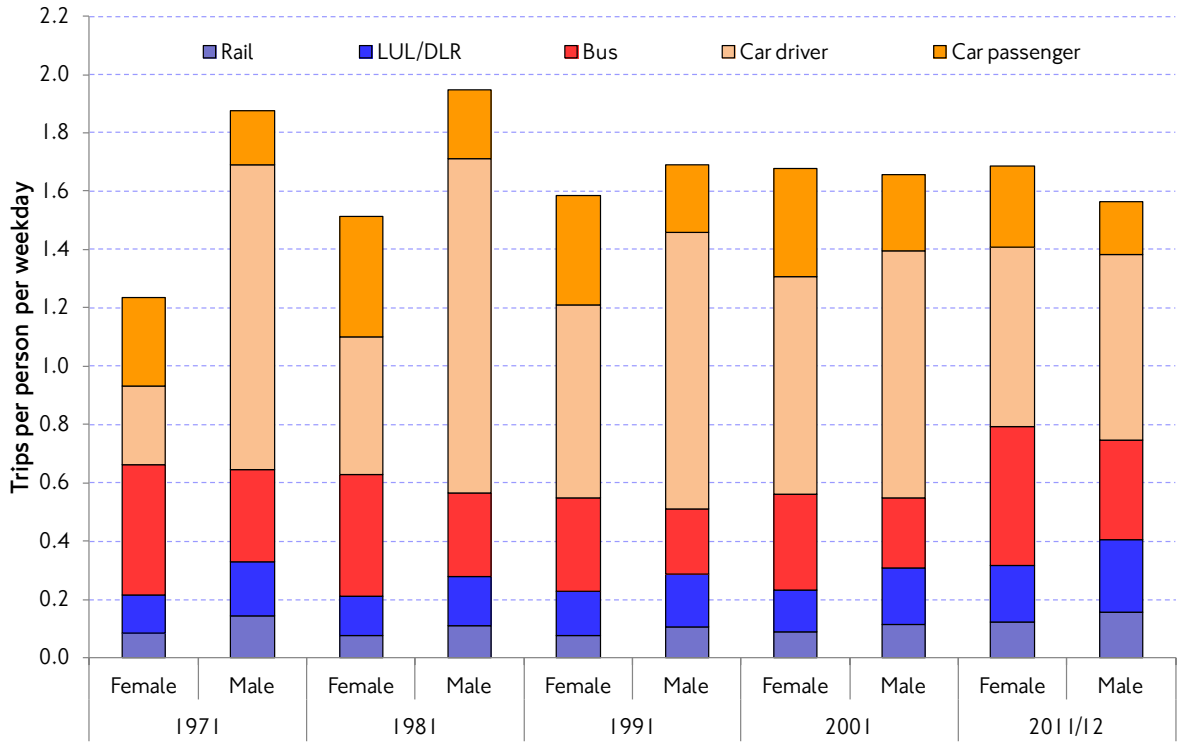
This section highlights some key trends in London residents' travel over the 40-year period covered by the London travel surveys. Examples are chosen to reflect the diversity of analyses that are possible with the travel surveys dataset. Collectively they highlight several areas that will be investigated further as part of the wider TfL project to better understand the drivers of travel demand in London.

Trip rates by main mode and gender

Trip rates measure the average number of trips made by individuals per day. They are therefore 'normalised' in terms of their relationship to changing absolute levels of population, and the trip rate multiplied by the resident population, in theory, gives the total number of trips made by London residents.

Figure 7.11 shows person trip rates by gender and main mode for all personal-travel trips across each of the five decennial surveys. The most obvious trend is a substantial increase in travel by women, with a corresponding although not necessarily directly related fall in travel by men. These shifts largely occurred prior to 1991, with a particularly noticeable increase in travel by women between 1971 and 1981. Since 1991 the overall gender balance has been broadly equal, although there is some evidence that the earlier trends have persisted at a much slower rate.

Figure 7.11 Trips per person per day (average trip rate) by gender and main mode. Decennial London travel surveys 1971-2011.



Source: TfL Planning Strategic Analysis.

Looking at the modal split of these trips is particularly instructive. It is clear that the increase in travel by women generally has been accompanied by a substantial increase in relative car use, whereas that by men has decreased. So, in 1971, women made slightly more than 1.2 trips per day in total, of which car driver trips accounted for 22 per cent. By 2011/12, women made a little less than 1.7 trips per day, of which car driver trips accounted for 36 per cent. Bearing in mind that only the 'mechanised' modes are included in this analysis, in 1971 women made two thirds of the trips of men, whereas by 2011 they made more trips than men.

Looking across both genders, table 7.3 shows average trip rates for the modes considered for each of the five surveys, for residents of inner, outer and GLA combined, together with Census estimates of the contemporary population. Multiplying one by the other (the third column), gives an impression of the total 'trip generation' of residents of each of these areas, even though of course the actual trips may occur elsewhere.

The table shows contrasting trends for public transport and car trip generation across the different surveys. Between 1971 and 1991 public transport trip rates dropped in line with population, resulting in a significant drop off in total public transport trips. In contrast, the car trip rate increased as population decreased, resulting in an increase in total car trips despite a fall in population. These trends reversed between 2001 and 2011/12, with public transport trip rates increasing substantially as population also increased whereas car trip rates fell.

Table 7.3 Average trip rate, total population and total trip generation potential, 1971-2011. Average weekday.

	Public transport trip rate	Car trip rate	Resident population (million)	Total public transport trips (million)	Total car trips (million)
1971	0.63	0.94	7.45	4.69	7.00
1981	0.57	1.20	6.71	3.82	8.05
1991	0.53	1.27	6.39	3.39	8.12
2001	0.55	1.28	7.17	3.94	9.18
2011/12	0.79	1.06	8.17	6.45	8.66

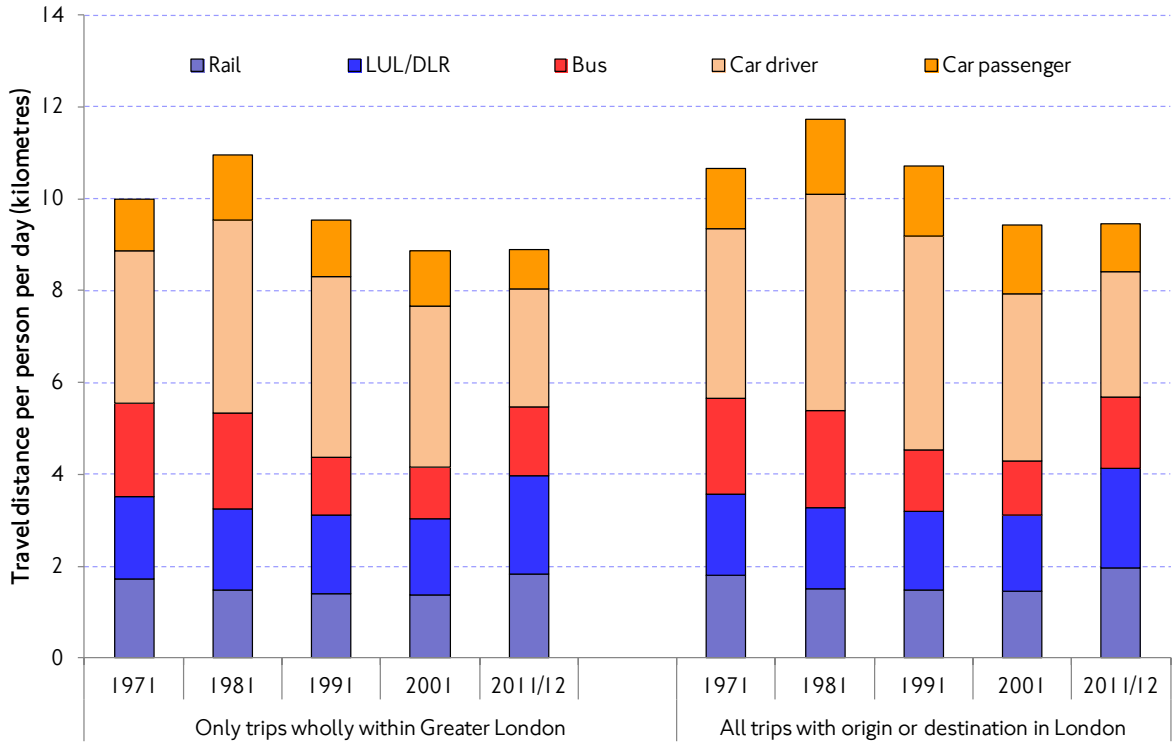
Source: TfL Planning Strategic Analysis.

Average distance travelled

The average distance travelled per person and the average time spent travelling are alternative measures of total travel. They are indicators of people's 'average travel budget', and understanding the extent to which this changes in relation to factors such as urban density, commuting patterns and increased leisure travel are important considerations for future travel demand forecasting.

Figure 7.12 shows a general shortening in the amount of travel per person – measured in terms of distance – over the 30-year period since 1981. This is in contrast to generally more stable average trip rates, which means that trips on average have tended to get shorter, and, from 1991, substantial increases to the absolute level of population.

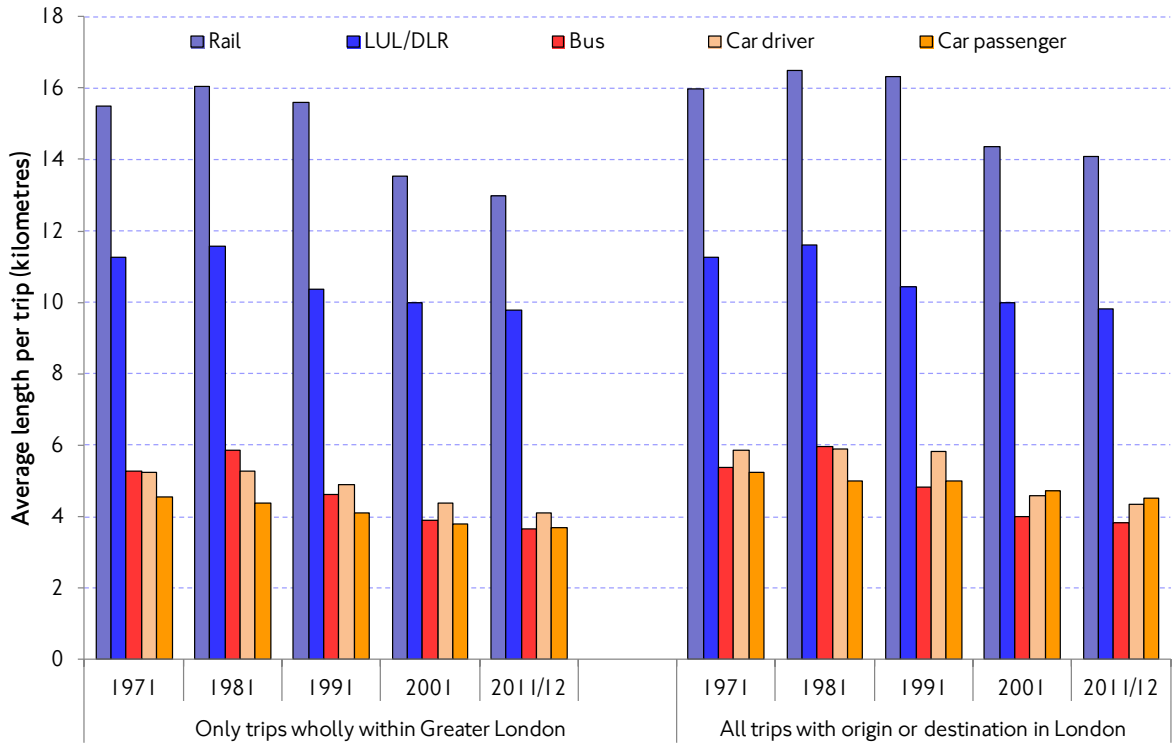
Figure 7.12 Average distance travelled per person by main mode of travel.



Source: TfL Planning Strategic Analysis.

The figure also reflects general changes in mode shares, most clearly visible in the reduced average distance travelled by car, which is down 39 per cent from its peak in 1981 for trips wholly within Greater London. Particularly interesting, however, is the reduction in average daily travel distance by bus, down 45 per cent between 1971 and 2001 for trips wholly within Greater London. This corresponds with an increase in distance travelled by car as a proportion of total distance travelled during this time. Between 2001 and 2011, average distance travelled by bus increased by about a third, which is in line with other forms of public transport, reflecting increased service provision and a wider mode shift away from the car. As these values relate to average distances per person, they do not immediately reflect fares and pricing changes specific to the bus network, but a general propensity to use buses in preference to other modes.

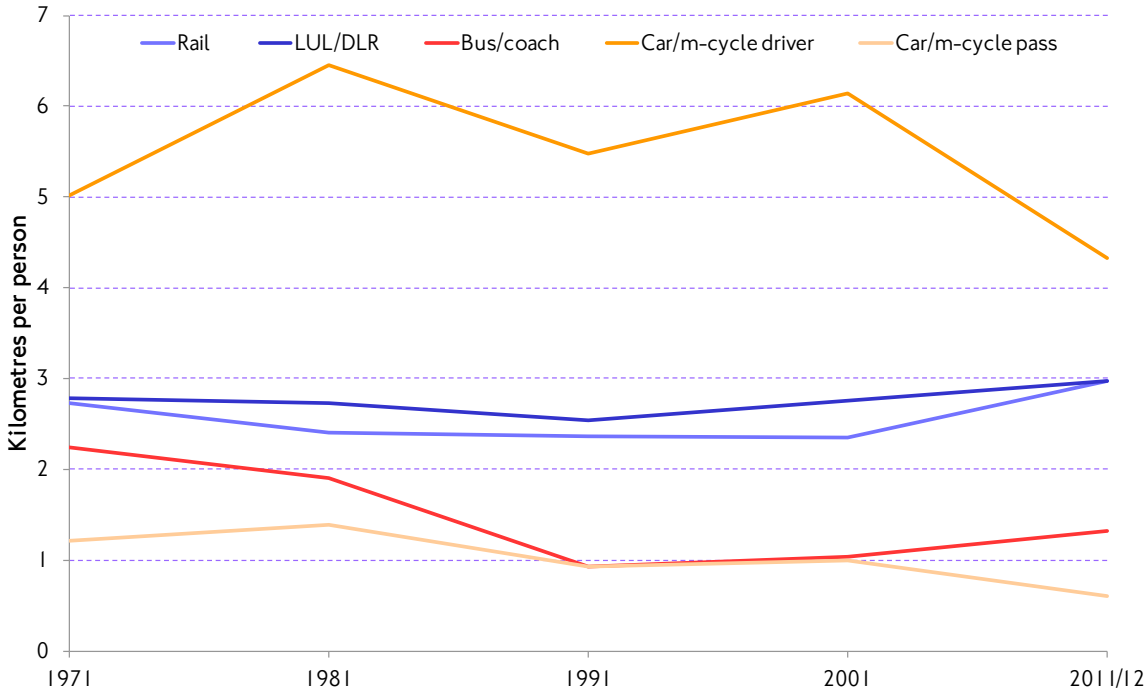
Figure 7.13 Average trip length by mode.



Source: TfL Planning Strategic Analysis.

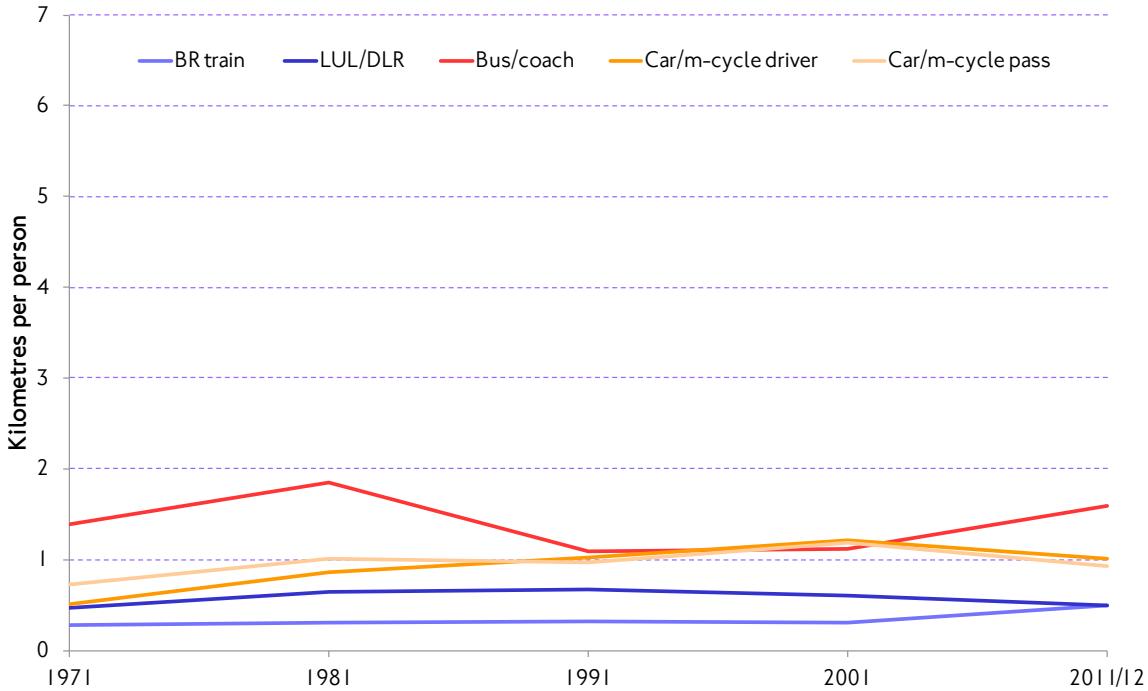
Figure 7.13 shows how the combination of changing trip rate and average trip distance (albeit limited to London residents) has impacted on the average trip distances for the individual modes. The most striking feature of this graphic is that it confirms the trend for average distance travelled per trip by all modes to have become progressively shorter over the period since 1981. Average trip lengths wholly within Greater London have decreased for all modes, most notably for bus for which 2011/12 trips are 38 per cent shorter than the 1981 average. Trends for trips with at least one end in Greater London are broadly similar. In contrast to figure 7.12, this shortening of average bus trip length is thought to reflect fares-related changes, such as the Travelcard, that have differentially encouraged shorter bus trips, together with the more recent large-scale increase to bus service provision.

Figure 7.14 Average distance travelled per person by mode (persons in full-time employment).



Source: TfL Planning Strategic Analysis.

Figure 7.15 Average distance travelled per person by mode (persons not in full-time employment).

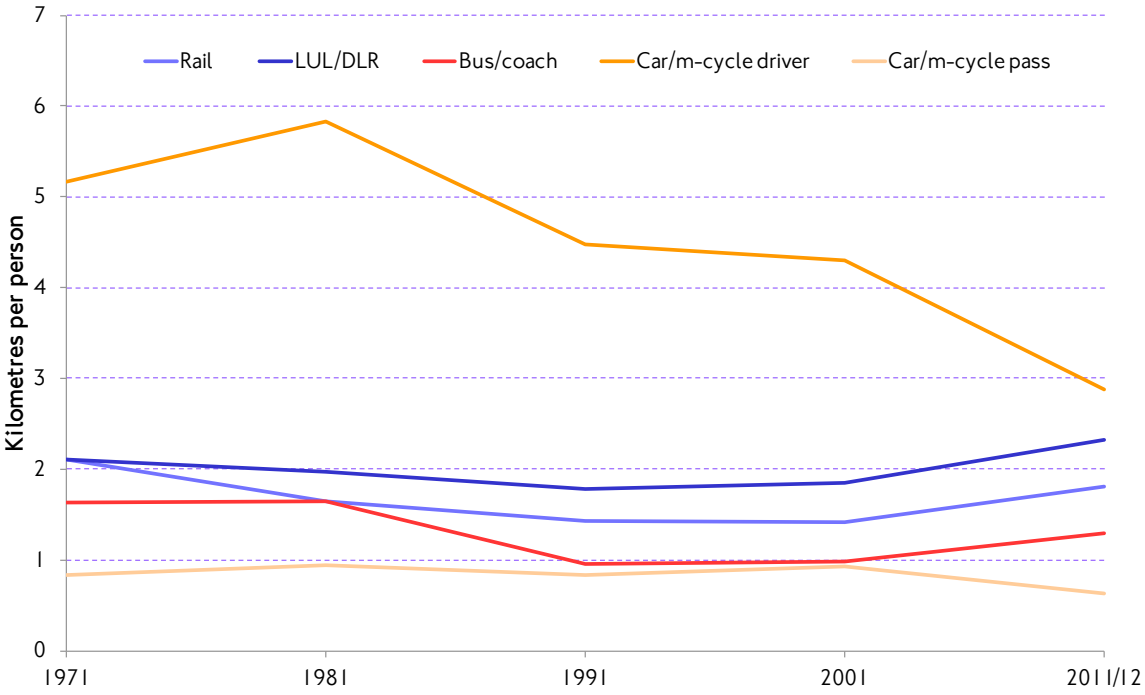


Source: TfL Planning Strategic Analysis.

Figures 7.14 and 7.15 above show the average distance travelled per person by mode for those in full-time employment and those not in full-time employment over time. Unsurprisingly, the average distance travelled by those in full-time employment is considerably higher for most modes across all surveys. A notable exception to this is bus, for which average distance travelled by those in employment has fallen below that of people not in employment in the past two decades. At the same time, average distance travelled by rail-based modes for those in employment has increased at a faster rate than for those not in employment. This suggests that there may have been a move away from bus towards rail for longer distance commuting trips by public transport.

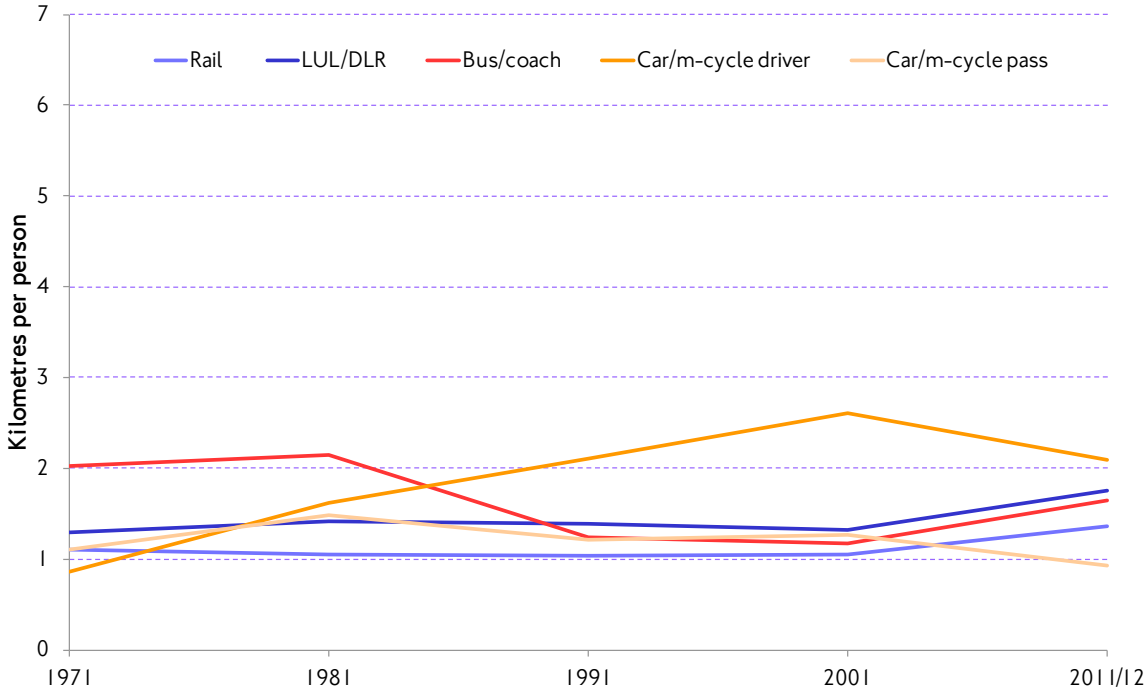
Figures 7.16 and 7.17 show the average distance travelled per person by mode for men and women. The key difference between the two is the contrasting trend for distance travelled by car drivers. For men this has decreased significantly since 1981 whereas for women it increased steadily up to 2001 before a slight decrease in 2011/12. Trends in other modes have been generally the same for both genders over time, with men travelling further by rail-based modes, and women travelling further by bus and as car passengers across all surveys.

Figure 7.16 Average distance travelled per person by mode (men).



Source: TfL Planning Strategic Analysis.

Figure 7.17 Average distance travelled per person by mode (women).



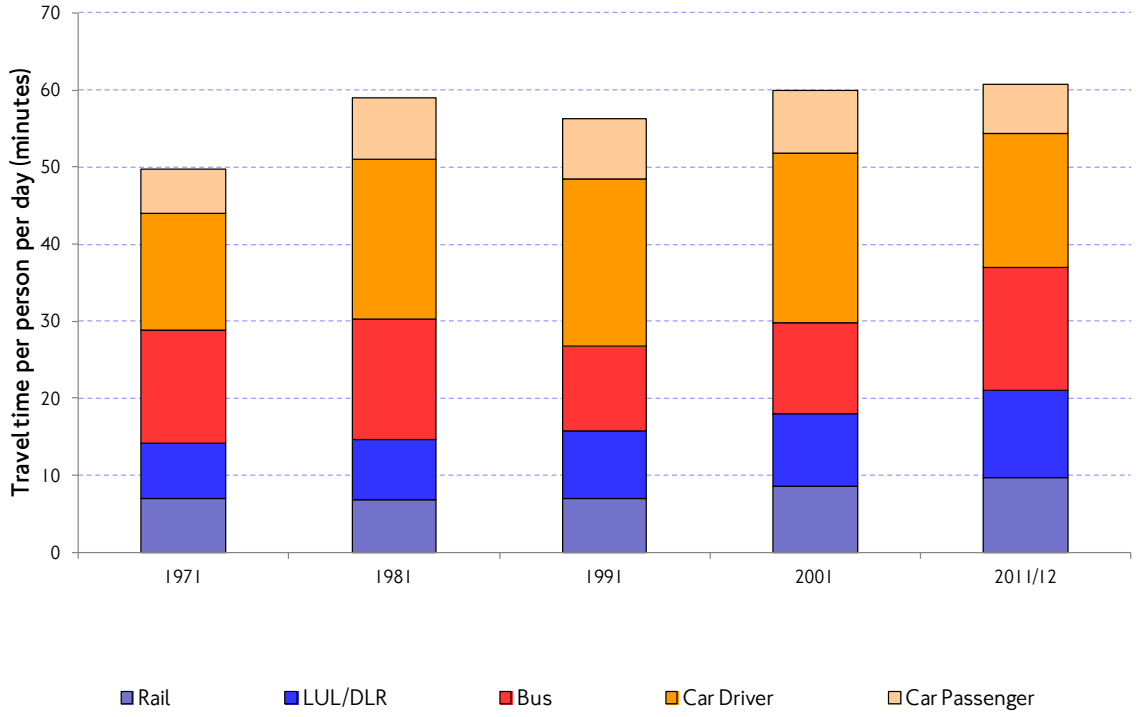
Source: TfL Planning Strategic Analysis.

Average time spent travelling

Figure 7.18 shows the average time travelled per person by main mode of travel for the modes under consideration. There was an increase in time travelled per person across most modes between 1971 and 1981, reflecting more widespread increases in trip rates. Between 1981 and 2011/12, the total time travelled per person by the modes under consideration has remained remarkably constant (close to one hour per day) but the mode shares have changed dramatically. In particular, there has been a large increase in time spent travelling by public transport in 2011/12 (from 30 minutes per person per day to 37 minutes per person per day) with a corresponding decrease in time travelled by car (from 30 minutes per person per day to 24 minutes per person per day).

Overall therefore, and particularly since 1981, despite widespread changes both to the ways in which people travel, and the travel options available to them, people have spent about the same amount of time in total travelling per day. It is however also clear from the preceding section that the trend for the average distance travelled has fallen. This is thought primarily to be a reflection of changes to the modal balance of people's daily travel. The observed trends of increased traffic congestion throughout the 1990s, leading to relatively slower journeys by road, and dramatically increased bus use in the most recent decade, are consistent with these trends and the relative mode shares in figure 7.18.

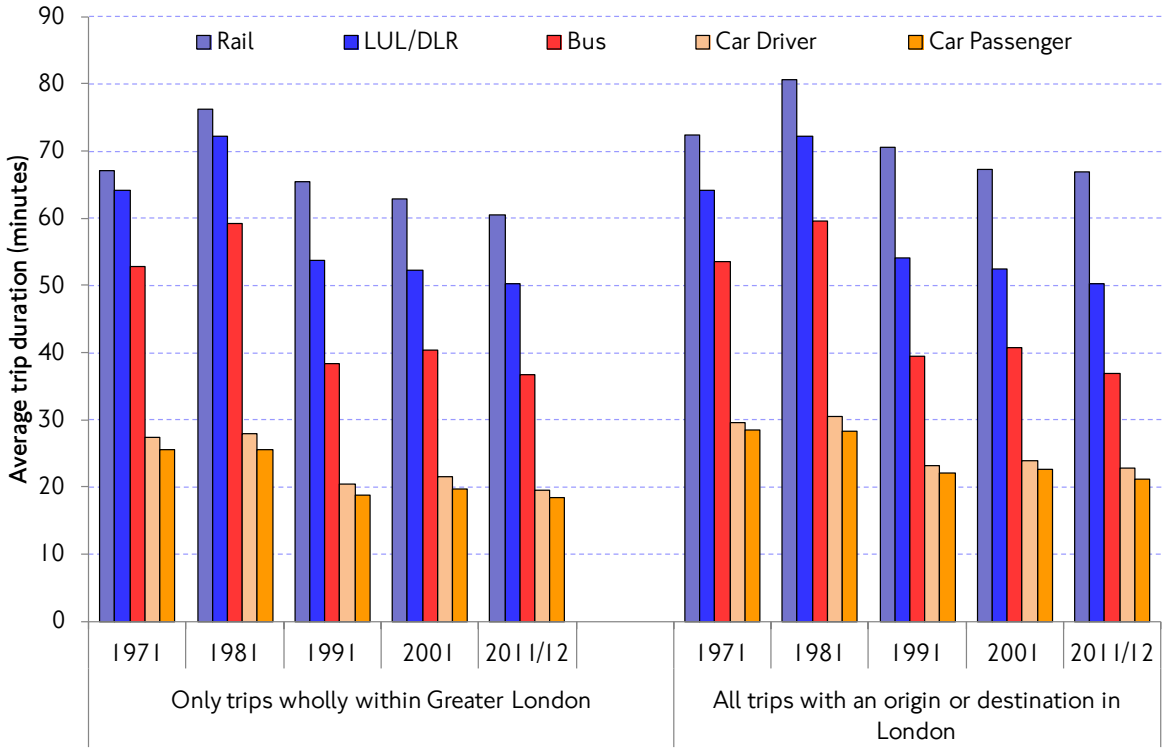
Figure 7.18 Average time travelled per person by main mode of travel.



Source: TfL Planning Strategic Analysis.

Looking more specifically at the average time spent travelling for each of the modes considered (figure 7.19), among the most notable features is the substantial reduction in trip duration for bus trips since 1981. This trend reflects a move towards a greater number of shorter distance bus trips, as well as better service reliability (walk and wait time would be included in this measure of trip duration). Similar to average trip distances per mode, trip durations peak in 1981 and have reduced since then. This is consistent with a trend of increasing trip rates and stable average time spent travelling as shown in figure 7.18. In general, people are taking more, shorter trips. Because the travel surveys only include London residents, factors such as the growth in longer-distance commuting by rail from locations outside the M25 will not be visible, although long-distance out-commuting by London residents will be captured. In interpreting figure 7.19, it is important to recognise that these are values per trip, based on the assigned 'main mode' of travel for that trip.

Figure 7.19 Average time travelled per mode.



Source: TfL Planning Strategic Analysis.

Time of day distributions of travel

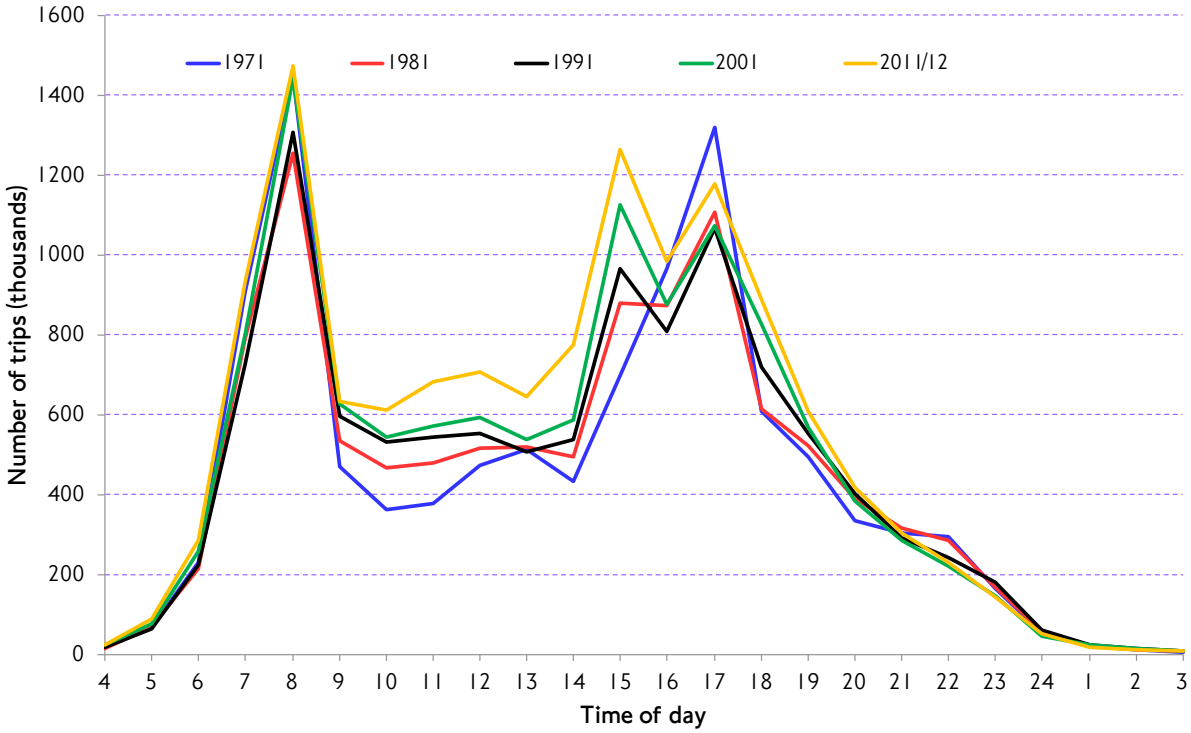
The maximum capacity provided on the transport networks is geared towards satisfying peak levels of demand, and it is at these times that the limitations of the networks are most readily apparent. Although lower levels of travel at other times of day are often matched by reduced capacity in the form of less-frequent public transport services, policies that encourage 'peak spreading', to even out peaks of demand and maximise use of the available capacity, may be a useful tool to better manage travel demand in future. Indeed, the occurrence of peak congestion itself has been observed to influence people's travel behaviour to avoid these times if it is possible to do so, given their particular requirements for travel.

Figure 7.20 shows, across a 24-hour average weekday, the number of trips made by London residents that start in each hour (considering only the modes that are consistently represented across the five travel surveys). The characteristic morning and afternoon peak periods are clearly recognisable. However, the figure also reveals several other interesting characteristics.

The general increase in volumes of travel between 1971 and 2011 is clear (the graphics show absolute numbers of trips), with most of this occurring in the mid-day period and early afternoon. Growth in each of the 'peak' hours has been more moderate. The PM peak profile for 1971 differs significantly from those for the other four survey years, in that it lacks the 'double peak' seen in the other survey years (education peak).

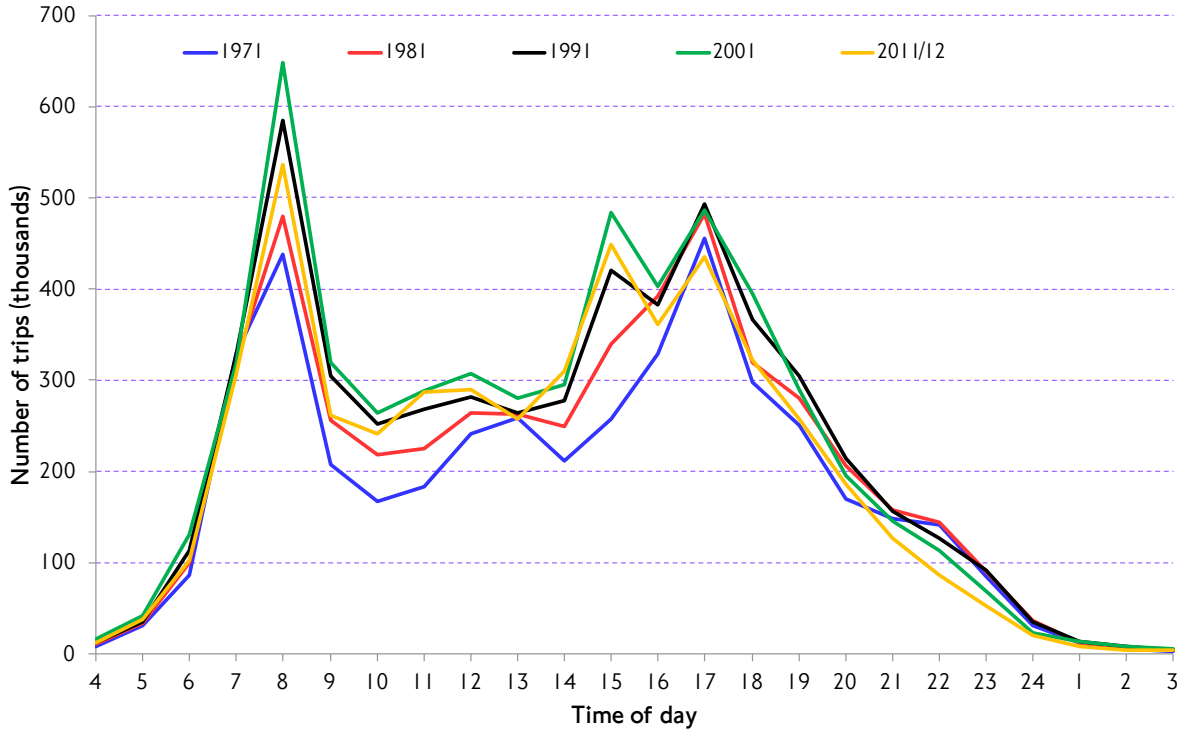
Within these profiles for overall travel, different modes show distinctive patterns and it is instructive to look at these in more detail.

Figure 7.20 Absolute number of trips made by London residents by hour of day. All mechanised modes.



Source: TfL Planning Strategic Analysis.

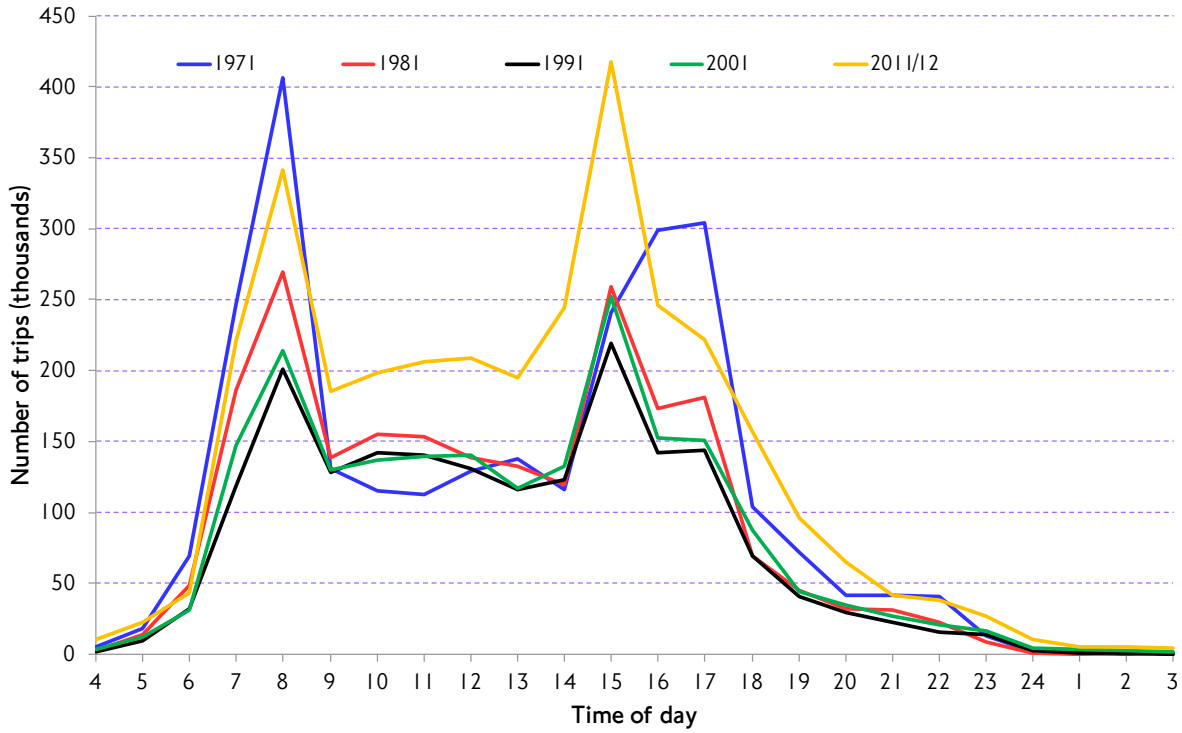
Figure 7.21 Absolute number of trips made by London residents by hour of day. Car driver trips only (as main mode).



Source: TfL Planning Strategic Analysis.

Figure 7.21 shows, across a 24-hour average weekday, the number of car driver trips made by London residents that start in each hour. Notable features include the increase – to a very sharp AM peak – up to 2001, and the sharp fall back since, despite increasing population between 2001 and 2011. There has also been a steady increase in car driver trips during the mid-afternoon, with the progressive emergence of a second (earlier) peak, thought to be related primarily to education trips (pupil escort). There has also been a gradual trend towards a greater proportion of trips being made outside the traditional peak periods.

Figure 7.22 Absolute number of trips made by London residents by hour of day. Bus trips only (as main mode).



Source: TfL Planning Strategic Analysis.

Figure 7.22 shows, across a 24-hour average weekday, the number of bus trips made by London residents that start in each hour. There has been a marked shift in the hourly distribution of bus trips over the past 40 years, and this net effect conceals several different influences.

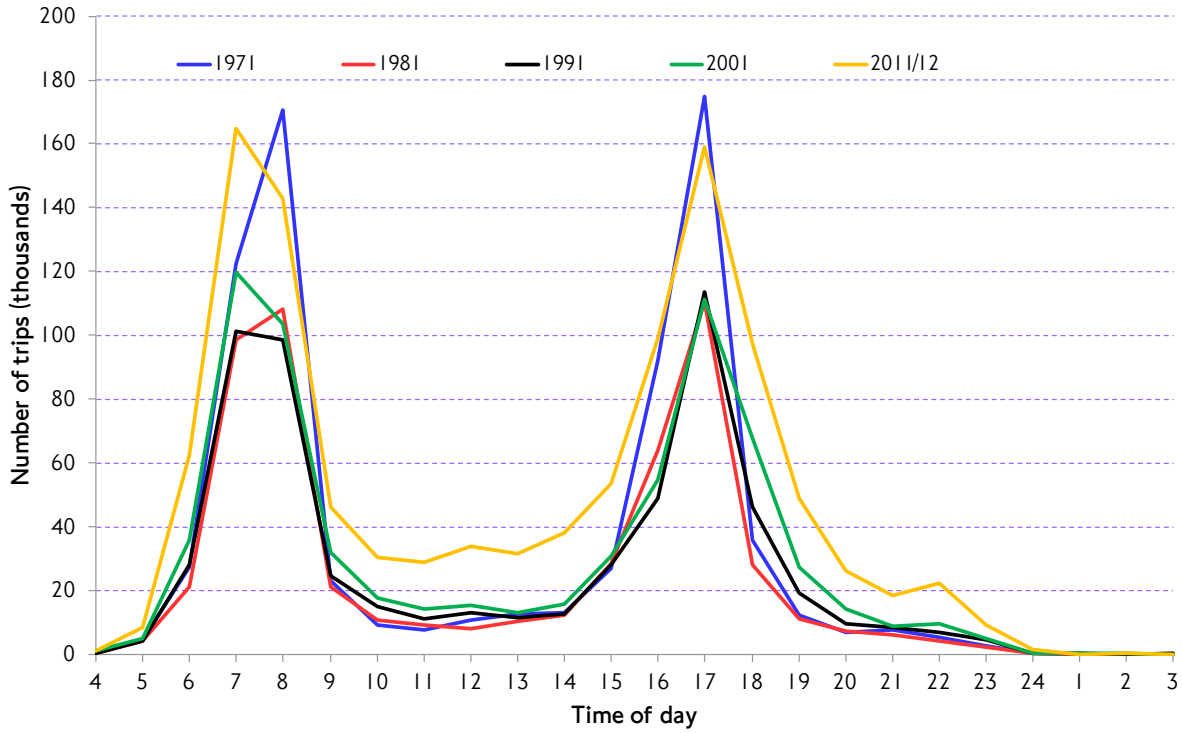
A noticeable feature of the graph is how different the profile for 1971 is compared to other years. In 1971, there was a very sharp morning bus peak, which fell away rapidly during subsequent decades, paralleling the wider decline in bus use noted elsewhere in this report. In this context the relative increase between 2001 and 2011 in AM peak bus travel is dramatic.

Looking at the profile for 2011, with the exception of the morning peak and later afternoon, the intensity of bus travel is the highest of all five surveys, again reflecting the increase in bus patronage over the most recent decade. During the inter-peak period too, levels of bus travel in 2011 are typically some 30-40 per cent higher than in earlier decades. It is notable that the afternoon peak for bus travel occurs earlier than for other modes, and earlier than it did in 1971, reflecting the

widespread use of buses for education-related trips, and the association of peak bus usage with school closing times.

Two other features of figure 7.22 are of interest. The first is the relatively later and flatter 'worker' PM peak in 1971, and the relative absence of an earlier 'education' peak. The second is the apparent lack of dramatic change in bus patronage in the overnight period, despite the transformation of London's night bus network, particularly over the most recent decade. Looking closely at the graph, it is possible to see that the (yellow) line for 2011 is comfortably above those for earlier decades during the night hours, although the absolute number of people carried is small in relation to the total number of bus passengers over a whole day.

Figure 7.23 Absolute number of trips made by London residents by hour of day. National Rail trips only (as main mode).

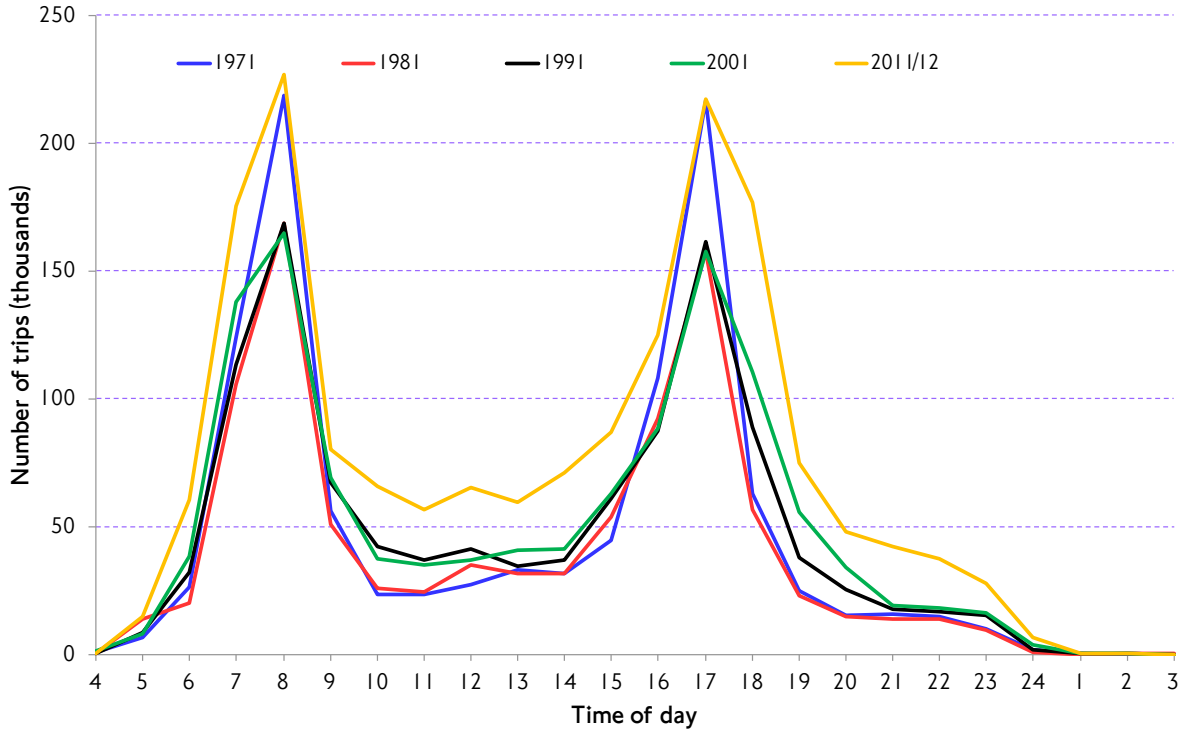


Source: TfL Planning Strategic Analysis.

Figure 7.23 shows, across a 24-hour average weekday, the number of National Rail trips made by London residents that start in each hour. The years 1971 and 2011 immediately stand out as those with the highest intensity of travel by this mode.

The highest peak hour volumes are visible in the 1971 survey, although those for 2011 are closely comparable. The peak hour volumes were considerably reduced in intensity between 1981 and 2001. It is possible to discern a trend towards an earlier AM peak, with a peak at 08:00 in the 1971 and 1981 surveys, an even split between 07:00 and 08:00 in the 1991 survey, and a prominent 07:00 peak in the most recent surveys. In the 2001 and 2011/12 surveys, a small kink in the graph has become apparent at 22:00, corresponding with the last trains home for many residents (the start times reflect those for the actual trip of which National Rail is a part, rather than the actual departure time from the National Rail station).

Figure 7.24 Absolute number of trips made by London residents by hour of day. Underground trips only (as main mode).



Source: TfL Planning Strategic Analysis.

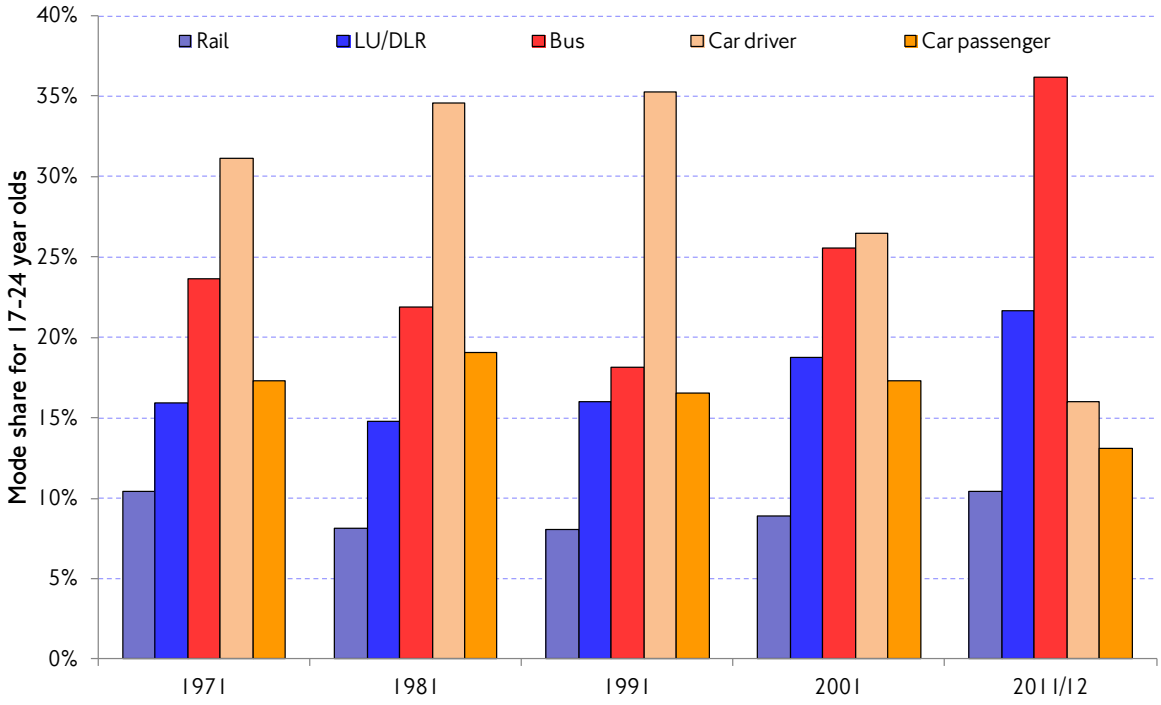
Figure 7.24 shows, across a 24-hour average weekday, the number of London Underground trips made by London residents that start in each hour. The AM and PM peak hour volumes are very similar for both 1971 and 2011/12, with intervening years considerably lower. While initially peak trips reduced to a lower level for the years 1981–2001, these have now rebounded to 1971 levels. Over the same period, there has been a gradual increase in trips outside of the peaks, more than double those of 1971 for example, as well as a significant increase in trips in the late evening. Since 2001 there has been a trend for the peaks to span a longer period of time, with the AM peak becoming apparent earlier and the PM peak remaining visible later than in previous years. So, although absolute levels of peak demand in the Underground, reckoned on an hourly basis, are now little different to 1971, the much 'wider' peaks are consistent with the substantial growth in Underground patronage, as discussed in section 3.4 of this report. Furthermore, because these are net hourly flows, based on the start time of the whole trip of which the Underground leg forms a part, it is not possible from these data to quantify demand pressures at the 'peak of the peak' – that part of the peak hour when absolute maximum levels of demand are reached. Furthermore, these comparisons do not include substantial volumes of Underground travel by non-London residents.

Travel by different age groups

In relation to age and propensity to travel, it is thought that aggregate travel patterns will reflect the general change to the age structure of the population of London over recent decades. For example, it is known from Census data that the population of London has 'got younger', in the sense that a greater proportion of

the population is comprised of young adults. Different age groups have different transport requirements and are likely to respond to transport policies in different ways – an obvious example is the relative attraction of cycling for younger people, but this is out of scope for this analysis. This section reviews the changes in mode share for different age groups across the five surveys in the context of these demographic changes.

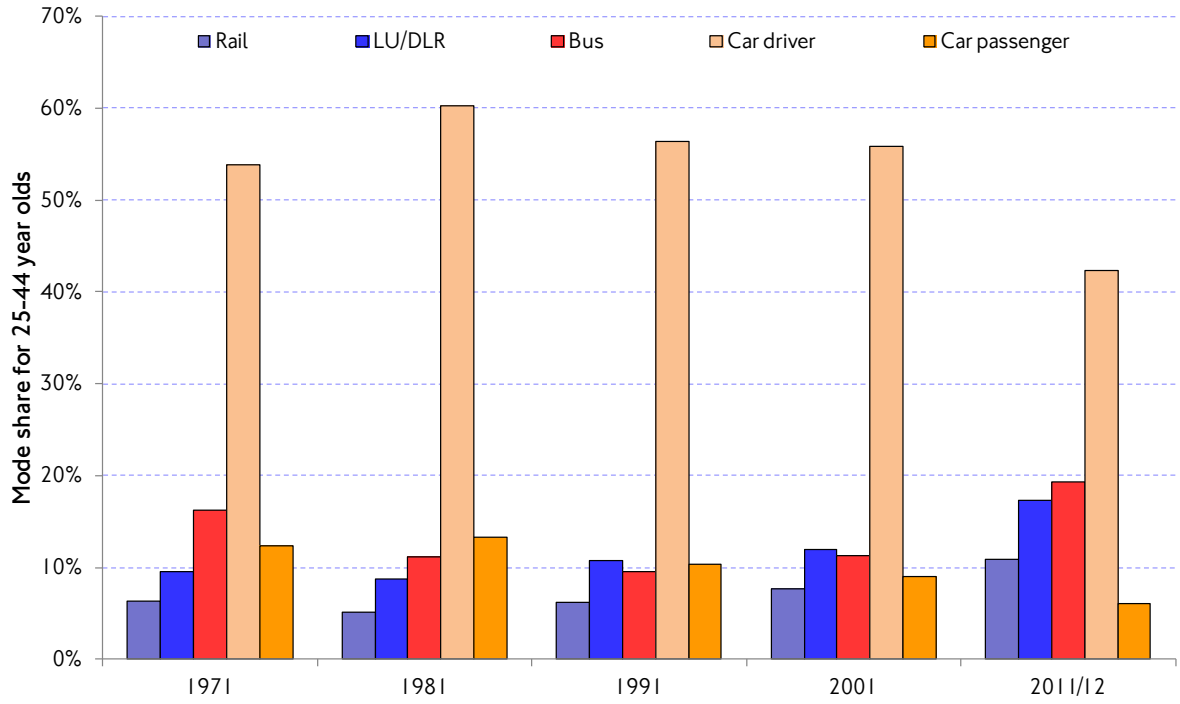
Figure 7.25 Mode share (as main mode) for persons aged 17-24. London residents, 1971-2011/12.



Source: TfL Planning Strategic Analysis.

Figure 7.25 shows the mode share for each of the modes under consideration for resident persons aged 17-24 across the five surveys. It is immediately apparent that there has been a significant recent shift from car driver to bus, reflecting recent concessionary travel policies for those in full-time education, as well as a more general reduction in car traffic during this time. This has taken place against a backdrop of a reduction in young people holding driving licences since 1991 (see also table 7.2). It is possible that many people within this age group have begun to delay obtaining a drivers licence due to a combination of the associated costs (for example, insurance) and wider transport policy (for example, increased bus service provision coupled with concessionary travel). The mode share of rail-based forms of public transport among this age group has increased steadily since 1981, although not to the same extent as that for bus.

Figure 7.26 Mode share (as main mode) for persons aged 25-44. London residents, 1971-2011/12.

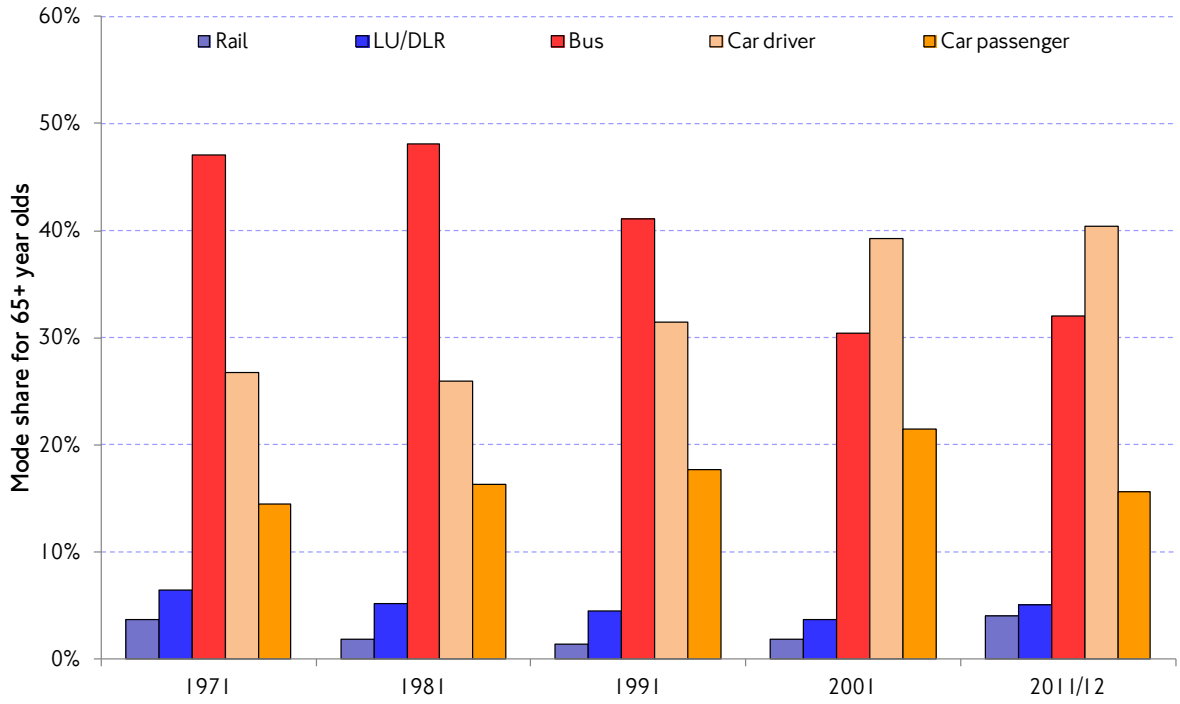


Source: TfL Planning Strategic Analysis.

Figure 7.26 shows the mode share for each of the modes under consideration for persons aged 25-44 (which might be characterised as 'younger workers') across the five surveys. In a similar way to the younger age group, there has been a recent shift away from car driver towards public transport, with car driver mode share dropping below 50 per cent mode for the first time in 2011/12. The trends in car driver and bus appear to be inversely related across the whole time series, with car driver mode share increasing when bus mode share decreases and vice versa. The increase in public transport mode share is most significant between 2001 and 2011/12, reflecting a period of increased investment and a greater policy focus on public transport.

Looking now at mode shares for persons over 65 years of age, figure 7.27 shows a different set of trends over the 40-year period from the younger age groups, with car driver mode share increasing while bus mode share has declined. The causes of these trends may be more societal than policy based. The proportion of older people holding driving licences has increased considerably since 1971. In particular, the proportion of women over the age of 60 holding a drivers license has increased from less than 10 per cent to more than 40 per cent (see table 7.2). As these age groups work through the population there is a 'cohort effect' of relatively older people sharing characteristics such as driving licence holding of the younger people of several decades earlier. The key point of interest here is the extent to which the observed tendency of younger people over more recent years to 'delay' getting a driving licence will persist as they work through the age groups, or the extent to which this will change as they grow older.

Figure 7.27 Mode share (as main mode) for persons aged over 65. London residents, 1971-2011/12.

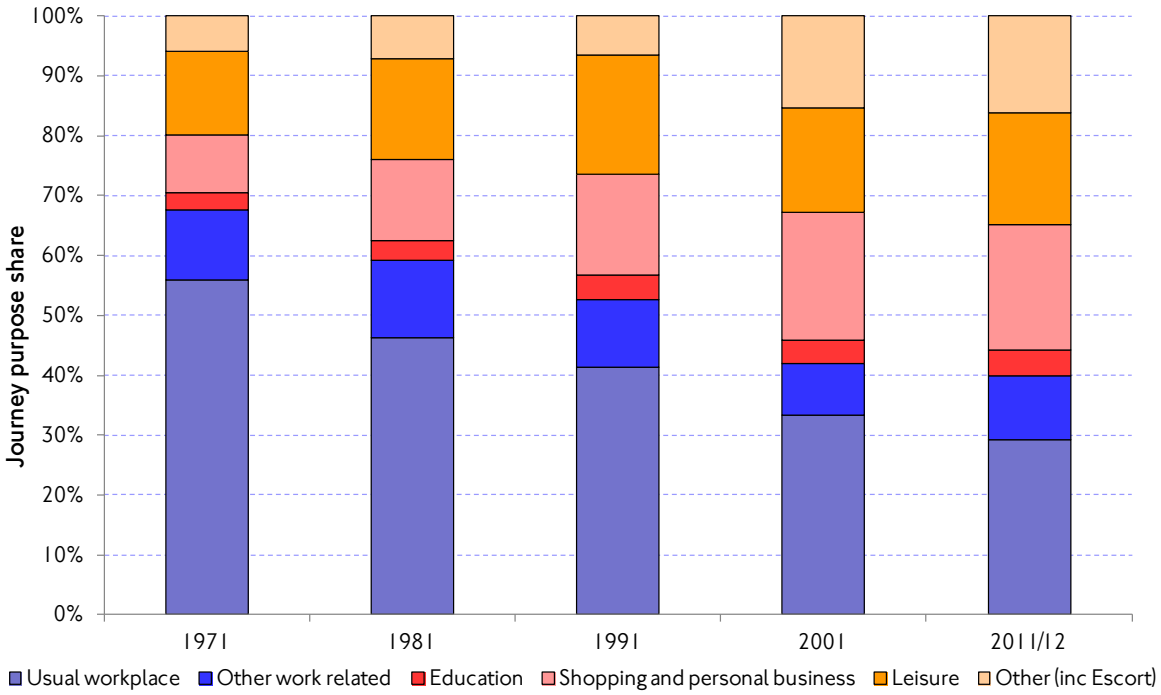


Source: TfL Planning Strategic Analysis.

Journey purpose

Looking now at the purposes for which people travel, figure 7.28 shows that there have been substantial changes to journey purpose shares among London residents, with trips to the usual workplace accounting for more than half of trips by mechanised modes in 1971 (56 per cent) to less than one third of trips in 2011/12 (29 per cent). Meanwhile non-work trips have correspondingly increased journey purpose share. It is incorrect to conclude that this is reflected in a substantial reduction, perhaps up to half, of 'work' trips on the transport networks; however, it does reflect a substantial increase in non-work trips, such as leisure and personal business trips, which would have the effect of reducing the work 'share', and the increasing flexibility of working patterns, where the daily 'trip to the usual workplace' of 1971 has been replaced, for some people, by flexible working patterns involving working from home or other 'remote' locations.

Figure 7.28 Journey purpose share for mechanised modes. London residents, 1971-2011/12.



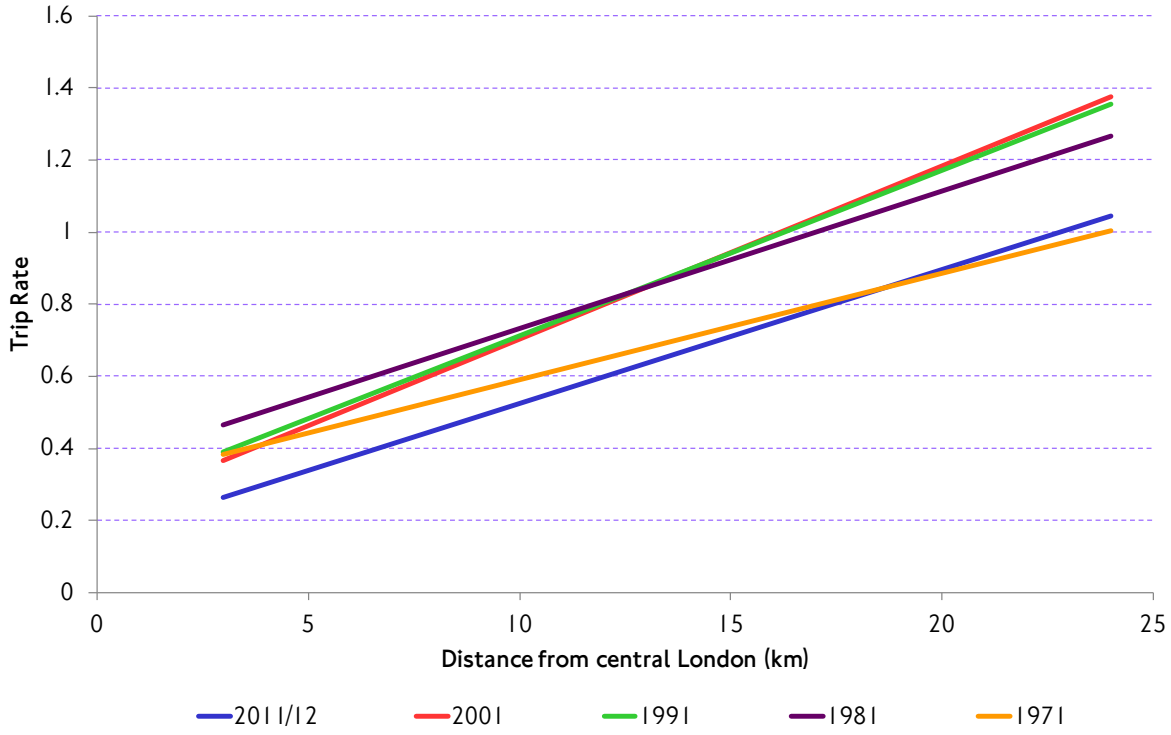
Source: TfL Planning Strategic Analysis.

Relationship of travel to distance from central London

Finally, it is instructive to look at how travel, in terms of trip rates, has changed over the 40 years covered by these surveys in relation to distance from central London, the actual criterion being household distance from Trafalgar Square. Note that for the purposes of this analysis small-area centroids were grouped in one-kilometre distance bands, to maximise the number of observations in each distance category. Linear trend lines have been used to simplify matters and are generally appropriate, although some of the relationships have non-linear features. Locations within three kilometres of Trafalgar Square have also been omitted, reflecting the relatively small number of residential households in this area.

Looking first at car driver trips (figure 7.29), there is the expected relationship of car driver trips increasing with distance from central London. Car driver trip rates at the periphery of outer London are up to three times those of inner London. Looking across the survey years, trip rates initially increased between 1971 and 1981, maintained a high level between 1981 and 2001, before falling back considerably in 2011/12.

Figure 7.29 Trip rate by distance from central London (car driver).



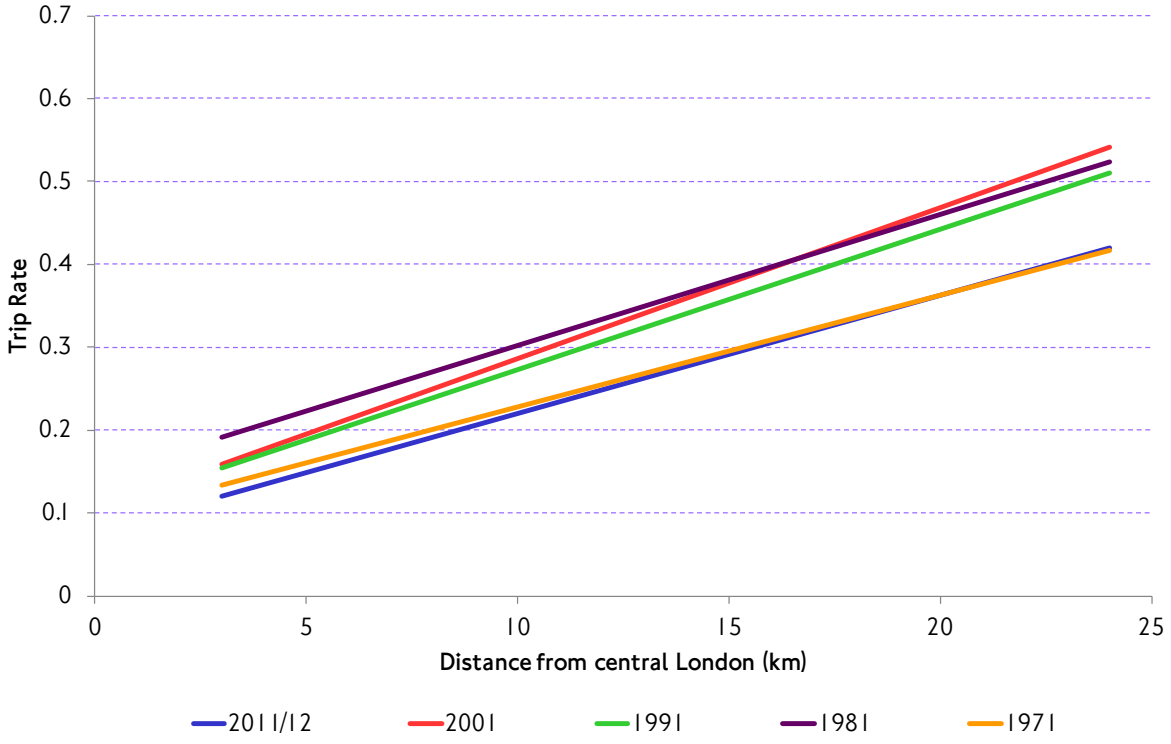
Source: TfL Planning Strategic Analysis.

Notable is the observation that car driver trip rates increased for households further from central London between 1981 and 1991 while decreasing for households closer to central London over the same period. Between 1991 and 2011/12, the relationship between trip rate and distance from central London remained the same, with trip rates showing negligible changes between 1991 and 2001 before falling uniformly albeit fairly dramatically irrespective of distance from central London between 2001 and 2011/12.

Turning to car passenger trip rates (figure 7.30), as would be expected, there is the same basic linear relationship between distance from central London and trip rate. As for car driver trips, trip rates rise between 1971 and 2001 before falling dramatically in 2011/12. Similar to car driver trips, trip rates increased for households further from central London between 1981 and 1991 while decreasing for those closer to central London, although the scale of the difference is smaller than for car driver trips.

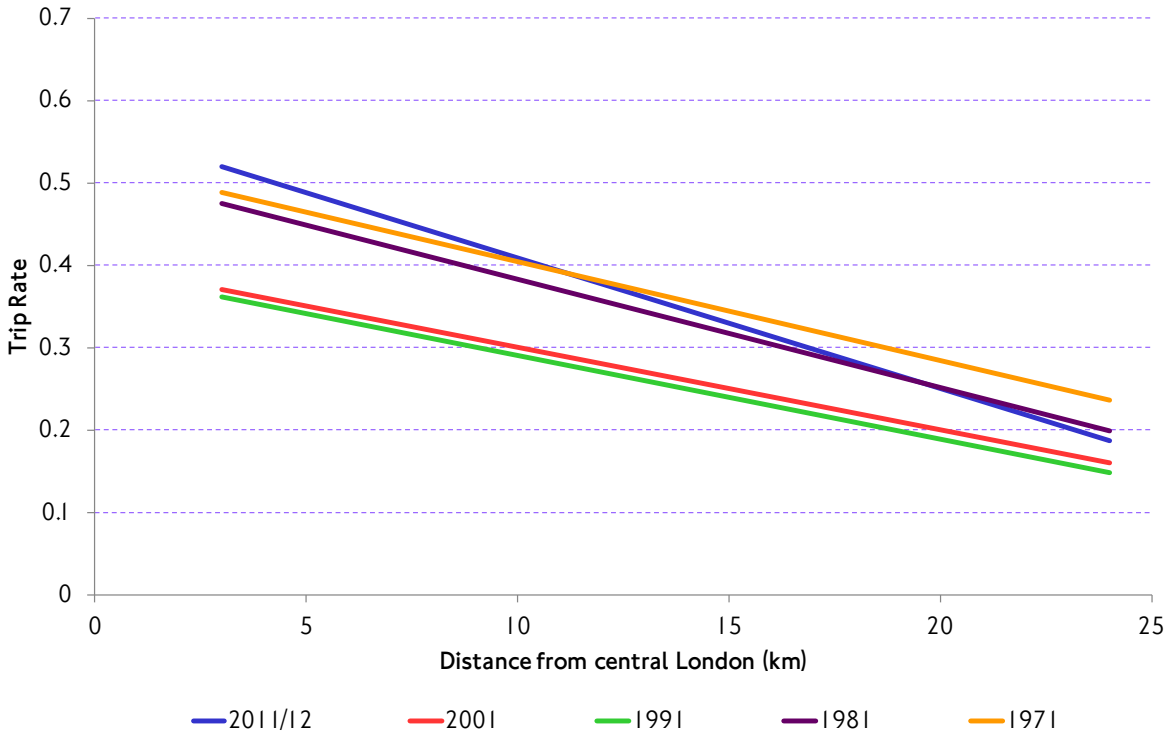
Figure 7.31 shows the equivalent pattern for bus trips. Here, there is an inverse relationship between bus trip rate and distance from central London, with people living in inner London making much greater use of the bus, typically between two and three times, those living in outer London. There was a substantial drop in trip rates between 1981 and 1991 with trip rates remaining low in 2001. Trip rates rebounded to levels similar to the period 1971-81 in 2011/12, increasing at a notably higher rate for households closer to central London.

Figure 7.30 Trip rate by distance from central London (car passenger).



Source: TfL Planning Strategic Analysis.

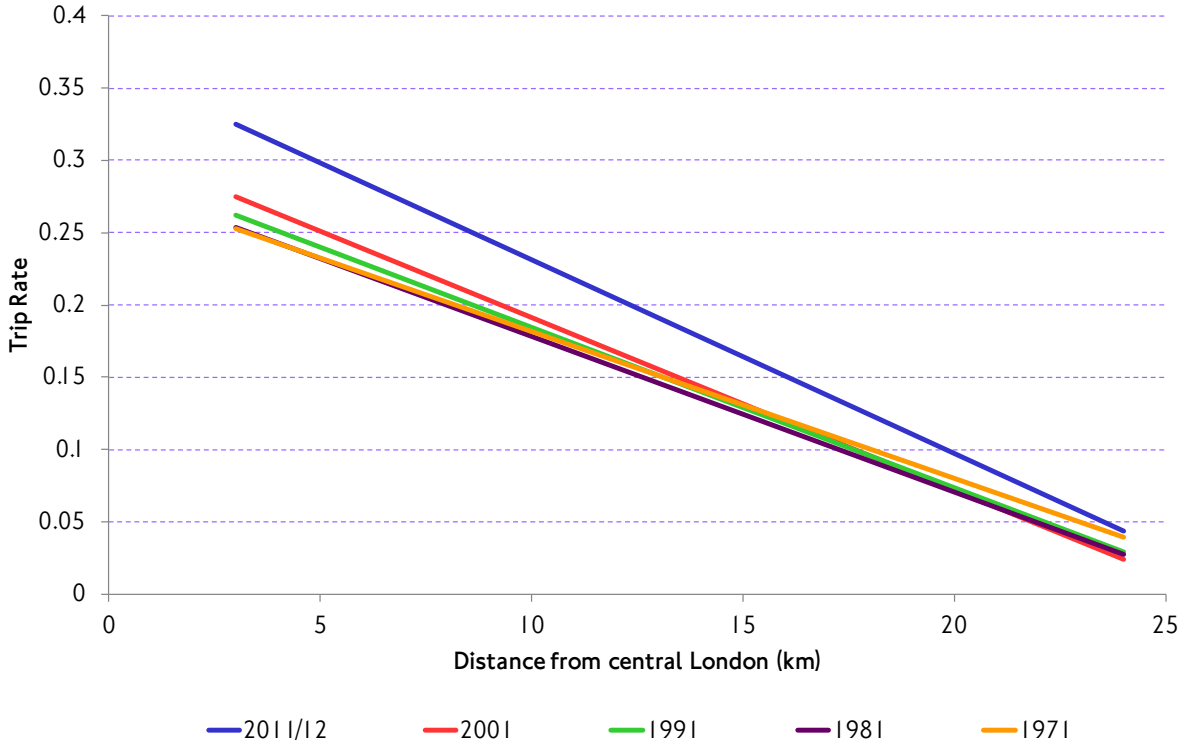
Figure 7.31 Trip rate by distance from central London (bus).



Source: TfL Planning Strategic Analysis.

Finally, figure 7.32 shows that the relationship between trip rate and distance from central London for London Underground and DLR trips (noting that the DLR was not part of London's transport networks for the earlier surveys). The relationship has been relatively stable up until 2011/12 when trip rates increased at a considerably faster rate closer to central London.

Figure 7.32 Trip rate by distance from central London (Underground/DLR).



Conclusions

Large-scale household-based surveys of London residents travel have been undertaken on a broadly comparable basis each decade since 1971, allowing trends in several key travel variables to be analysed across a 40-year time series.

Over this time there have been substantial changes to the drivers of travel demand at a societal level (for example, the role of women), a geographic level (for example, population density) and in terms of transport policy (e.g. increased investment in public transport following the establishment of the London mayoralty). By and large these are clearly reflected in the observed travel trends, through which it is possible to make an approach to quantifying their relative impact.

From the perspective of this limited analysis, and as an input to the wider TfL study looking in detail at the role of changing social, economic and supply-side factors in driving travel demand levels in future years, there are perhaps two key emerging pointers.

First, demographic change, most notably the relative shift to a younger, more 'footloose' population, is associated with a range of travel outcomes, such as lower driving licence holding, car ownership and car travel. Similarly, although different age groups are associated with different 'typical' travel propensities, for example modal preferences, a 'cohort' effect may also be in play whereby erstwhile younger generations, and indeed ethnic groups, 'carry with them' their travel preferences

throughout the age range. In addition, different parts of London are associated with distinctive travel mixes, which in part reflect provision, but also reflect wider social and cultural preferences. All of these factors mean that understanding the geographic and demographic components of projected future population increases in London is crucial to projecting future travel demand.

Second, in terms of structural changes to the workforce and wider economy, the increased travel by women, particularly between 1971 and 1981, reflecting among other things increased participation in the workforce, is unlikely to be repeated. However, further fundamental change, such as the long-expected shift to remote working or the 'internet economy', cannot be ruled out in the future – even if there is little evidence so far that such developments as have happened in society more generally have fed through to reduced travel. Indeed, the converse seems to be the case, with evidence of increased leisure and shopping/personal business travel.

Notes and references

(1) Changing Patterns of Travel in the London Area (1971-1991). Transport Research Laboratory, for the Government Office for London. 1996 (unpublished report).

8. Monitoring progress towards Olympic transport legacy outcomes

8.1 Introduction and content

Securing the longer-term transport legacy of the 2012 London Olympic and Paralympic Games is an important part of the Mayor's Transport Strategy (MTS). Transport improvements are a fundamental facilitator of the wider Games legacy, which seeks to work towards social and economic convergence between the six Olympic host (now 'growth') boroughs (Barking and Dagenham, Newham, Tower Hamlets, Greenwich, Waltham Forest and Hackney) and the rest of London over a circa 20-year period.

This chapter describes how TfL is monitoring achievement of the transport legacy, focusing on transport outcomes or conditions 'on the ground'. It briefly looks back at some of the key transport features of the highly successful 2012 Games and the period since. It then reports updates to a range of quantitative outcome indicators that are being used to track progress with the transport legacy over the coming years, focusing this year on indicators of personal travel behaviour in the six Olympic growth boroughs.

This chapter builds on and updates the commentary and monitoring baselines previously set out in Travel in London report 4. It is part of a specific evidence base through which stakeholders will be able to assess how transport conditions and behaviours are changing over the longer term in response to legacy initiatives and wider developments. It is therefore complementary to other publications that will track wider aspects of the Games legacy, for example the sporting aspects, over the coming years.

8.2 The legacy of the 2012 Games

London's hosting of the 2012 Olympic and Paralympic Games provided a major opportunity to enhance the Capital's physical transport infrastructure, to promote positive changes to the ways in which people travel, and to contribute to the lasting wider regeneration of east and south-east London. This commitment to support regeneration was an important part of the bid to host the Games. Parts of east and south-east London are some of the most deprived areas in the UK. A Strategic Regeneration Framework was published by the six growth boroughs in 2009 [1]. This set out a vision and associated actions, using the 2012 Games as a catalyst, to improve the quality of life of residents so that, within 20 years, these communities would enjoy the same social and economic opportunities as the rest of London (this being social and economic convergence).

The transport legacy is an opportunity for TfL and its partners to continue to deliver improved transport services, maximising new infrastructure and ways of operating, sustaining the lessons learnt and behavioural and cultural changes that happened during the Games, to the benefit of London.

The Games legacy in the literature

The Mayor published the Olympic and Paralympic Transport Legacy Action Plan in early 2012 [2], describing how TfL would build on the Games to achieve specific transport outcomes and to support the aspiration of social and economic

convergence. These included a substantial **transport infrastructure legacy** – new physical infrastructure provided in connection with the Games that will provide lasting benefits in terms of improving connectivity in east and south east London – as well as a **transport behavioural legacy**, with the Games being used to develop and embed beneficial changes to the ways that people travel – for example promoting healthier, active travel through more walking and cycling.

Working with the relevant boroughs and other partners, TfL prepared the East and South East London Sub-regional Transport Plan (SRTP) [3]. This acts as a link between the MTS and borough Local Implementation Plans (LIPs). The plan considers the specific transport challenges facing the sub-region, and supports the growth and regeneration of the area.

Two recent (July 2013) reports give an update on the Olympic legacy one year after the Games. 'Inspired by 2012', a joint UK Government and Mayor of London report, updates progress 'one year on' with all aspects of the Games legacy [4]. TfL's report, 'London 2012 Olympic and Paralympic Games: The transport legacy – one year on' [5] gives a comprehensive description of how improvements to the physical transport infrastructure and Games-related behavioural and operational changes are being taken forward. Both of these documents provide wider context for the consideration of specific indicators in the remainder of this chapter.

Figure 8.1 Examples of recent reports on the Games legacy.

8.3 Key developments during the 2012 Games and the period afterwards

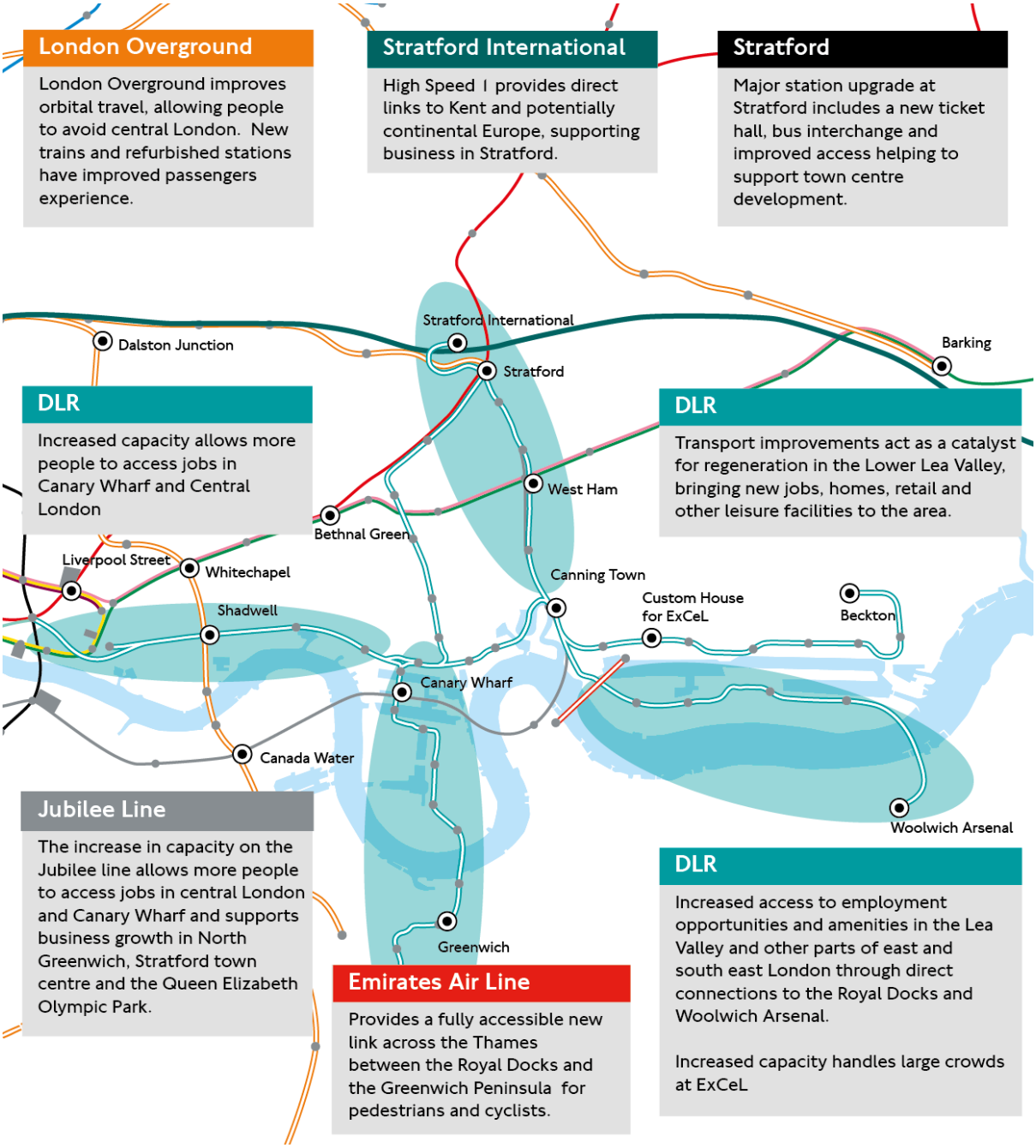
This section gives a brief summary of developments during the Games and in the period afterwards that are essential to understand the developing transport operational and behavioural legacy. Further details of these can be found in the referenced literature as appropriate.

The physical transport legacy

The most visible aspect of the Games transport legacy is the £6.5bn invested in new and improved transport infrastructure, improving connectivity to and from many parts of east London and providing greater capacity and reliability. Figure 8.2

shows the infrastructure improvements that were completed ahead of the Games in and around the Olympic Park at Stratford. All of this new transport provision will help to facilitate the wider social and economic regeneration in east and south-east London in future years.

Figure 8.2 TfL transport legacy infrastructure in east and south-east London.



Travel and transport during Games time

The 2012 Games are now regarded as having been a major success, both as sporting events and in the way that the transport networks operated to support them. TfL and its transport delivery partners rose to the challenges presented by the Games, and London's travellers co-operated to ease the pressure on critical parts of the transport networks to help accommodate the extraordinary travel demands of the Games. Full details can be found in Travel in London report 5, which provides

extensive commentary on travel behaviour and the operational performance of the transport networks during Games time [6].

Travel demand management during Games time

Despite the scale of the Games and the possibility of overcrowding and disruption, particularly to the road network as a result of the Olympic and Paralympic Route Networks, TfL forecast that around 65 per cent of public transport travel and about 70 per cent of road traffic in London would be substantially unaffected. TfL's travel advice was therefore targeted – emphasising avoidance of the busiest times and places on both the road and public transport networks. Travellers in London were encouraged, through the high-profile 'Get Ahead of the Games' publicity campaign, to adapt their travel so as to reduce pressure on travel 'hot-spots' by reducing the amount they travelled, by re-timing their journeys to avoid the busiest times on the networks, by re-moding to other, less-busy modes of transport, and by re-routing to avoid the busiest locations (known as the 'four R's). The evidence suggests that this campaign was a major success. London's travellers and businesses adapted their travel to an almost optimal degree. Reports of severe overcrowding were few, and pre-identified travel 'hot-spots' were largely trouble-free, despite the presence of several hundred thousand additional 'Games travellers' on many days.

It was estimated that 'background' travel (that not directly related to the 2012 Games) across Greater London reduced by five per cent during the Olympics, and by three per cent during the Paralympics, over and above what would normally be expected for the summer holiday period. These were relatively small amounts in the whole-London context, but almost exactly enough, when focused on anticipated hot-spots, to provide the correct margin of extra capacity to accommodate Games travellers while minimising inconvenience to non-Games travellers.

Survey evidence suggested that these aggregate reductions reflected relatively small adaptations by a large number of people – perhaps up to two-thirds of Londoners making generally small changes to their daily travel – suggesting a sophisticated response by the public to the publicity campaign. Understandably, TfL wished to learn as much as possible from this success with a view to deploying similar techniques in future – in connection with other large-scale events, large-scale disruptions, such as the current rebuilding of London Bridge station, or simply to develop ways to better manage demand at peak times or on particularly busy parts of the networks, as is being trialled at the time of writing on the southern part of the Northern line [7].

However, the large scale of the Get Ahead of the Games publicity campaign and the generally small scale of adaptations made in response at the individual level also illustrated the scale of effort likely to be required to realise future travel demand management initiatives designed to spread demand, which additionally may not have such a high-profile event as a justification.

Travel behaviour change in the period after the Games

Pursuing this idea, and in order to understand the extent to which travel adaptations seen during Games time had been sustained afterwards, in June 2013 TfL published two reports [8,9] that looked at results from the later phases of TfL's Games travel

behaviour survey programme, conducted after the Games with individuals and with freight operators and businesses.

Overall, the reports found little evidence that specific Games-related adaptations were being widely sustained. This was as might have been expected, given the ending of the Games, the return – for many people – to 'business as usual', and the absence of a continuing publicity campaign or other motivation to encourage such changes.

Furthermore, the surveys confirmed previous evidence that 'normal' levels of day-to-day change in travel behaviour, for example in response to various 'life changes', such as moving house or changing job, are such as to rapidly overtake and obscure any long-term effects resulting directly from the Games (perhaps one-fifth of Londoners experience a 'life change' substantial enough to affect their travel patterns each year). However, there were indications from the surveys that the Games experience had left people and businesses better informed as to the travel options available to them, and more likely to be flexible in their response to specific planned or unplanned disruptions to the transport networks in the future.

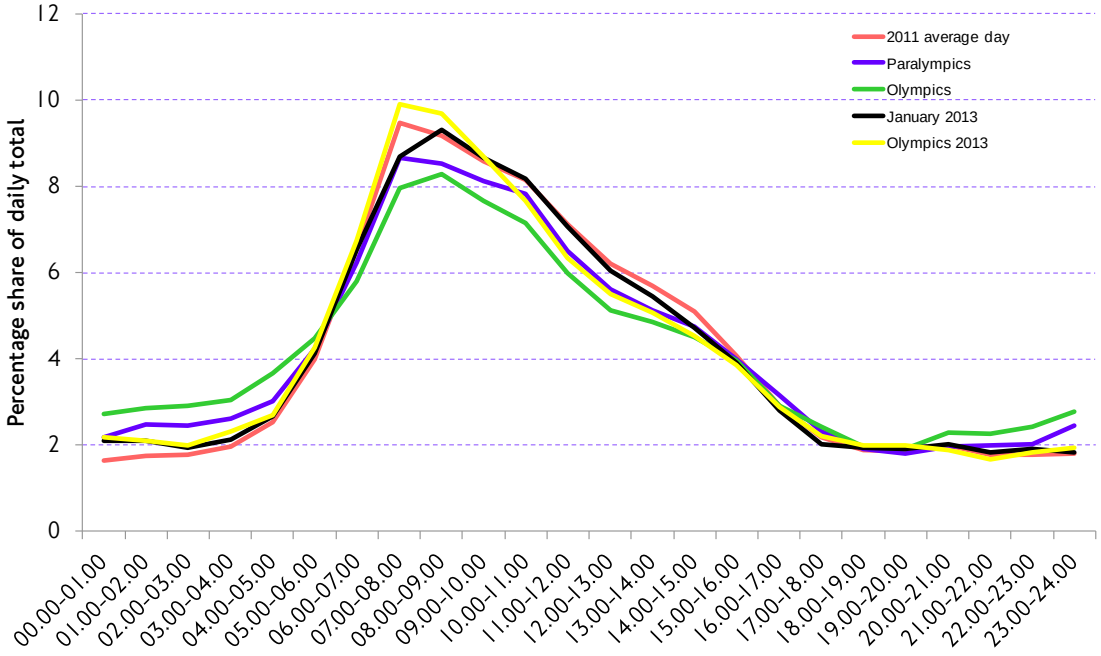
Freight

In the run up to the 2012 Games, it became increasingly clear that many of TfL's priorities were shared with the freight industry, including improving road safety and making best use of the road network to minimise congestion and ensure reliable journey times.

The Games also showed that, through positive engagement and collaboration, the freight industry is able to change the way it operates for the wider benefit of London. The Freight Forum became the central focus for improving communication between TfL and the freight industry in the build up to the Games. The Forum's collaborative approach to freight management should continue to help enhance safety, increase efficiency and deliver a number of other improvements within the industry. TfL launched 'Delivering a road freight legacy' in October 2013 [10]. This set out a two-tier programme showing how TfL will work with the freight and fleet industry towards safer, greener and more efficient deliveries in London and the development of a longer-term freight plan for the Capital.

One aspect of travel behaviour change that was demonstrated to beneficial effect during Games time was time-shifting by goods vehicles. Figure 8.3 shows the distribution by time of day for heavy goods vehicle trips crossing into and out of the central London Congestion Charging zone (the areas under each of the curves adds to 100 per cent). Data reflect all days during the relevant period, normalised so as to be representative of a 14-day period (including weekends).

Figure 8.3 Lorries entering and leaving the central London Congestion Charging zone. Percentage of total daily flow by time period. ANPR camera data.



Source: TfL Planning Strategic Analysis.

As previously reported in Travel in London report 5, the differences between the 2012 Olympic and 2012 Paralympic profiles and the 2011 'control' profile were substantial. Less traffic in the middle of the day, counterbalanced by more in the overnight hours – reflecting TfL's travel advice designed to protect the operation of the crucial Olympic and Paralympic Route Networks, which were focused on central London. Looking however at a similar profile for January 2013 (black line), while there is some evidence of marginally more traffic in the overnight period compared to 2011, the profile as a whole is not substantially different. The yellow line, representing the summer 2013 'Games' period, is also broadly similar to that for 2011. However, there is again evidence of marginally more heavy goods vehicle traffic during the overnight hours and a definite tendency towards relatively less traffic in the late morning/afternoon, albeit compensated by a higher 'peak' in the early morning – 10 per cent of daily heavy goods vehicle movements in central London occurring between 07:00 and 08:00.

8.4 Long term quantitative transport legacy outcome indicators

Travel in London's main role in monitoring the long-term transport legacy of the Games will be to understand the extent to which the additional physical infrastructure, the travel behavioural aspects of the Games (including the inspirational effects of 'active travel' sporting events such as cycling) and the wider regeneration activities in east and south-east London contribute to beneficial changes to travel and transport. It would do this by tracking a range of quantitative outcome indicators that address the main strands of the transport legacy, alongside a wider body of data and analysis that would provide essential context to help interpret trends. The wider context of MTS objectives and the over-arching legacy

objective of moving towards social and economic convergence for the six Olympic growth boroughs provide essential background for interpreting these changes.

The three main strands of the transport legacy were set out in the action plan [2]. A number of specific transport outcomes were defined that would support convergence in the Olympic growth boroughs. These covered the following ground:

- Socio-demographic and economic conditions in the Olympic growth boroughs, as compared against equivalent trends in the rest of London (ie 'control' areas). Although validating these 'ultimate' legacy outcomes is not the prime focus of these updates they do provide essential context.
- Travel intensity, mode shares and other travel behaviour related indicators for residents and travellers to/from growth boroughs, compared to equivalent trends in the rest of London.
- Perceptions of transport-related quality of life and the travel environment in the growth boroughs, again compared with the rest of London, including selected quantitative indicators of environmental quality.
- Aspects of public transport and highway network service provision, service quality and accessibility/connectivity in east and south-east London.

Although indicators such as these will be limited in their ability to 'explain' the details of how measured changes in socio-economic conditions have come about, especially given the diversity and magnitude of non-Games-related change expected in the next two decades, they should effectively cover the principal transport legacy objectives as set out in the Olympic and Paralympic Transport Legacy Action Plan.

The following sections update the position with these indicators. As many of the indicators rely on third-party published statistics or large-scale travel surveys, the material presented this year relates largely to conditions in 2012 itself, or early 2013. It does not yet give a long-term view of change, and is therefore most properly seen as an extended 'baseline' set of indicators for the longer-term monitoring, which is expected to span a period of up to 20 years.

8.5 Basic socio-demographic and economic indicators

A wide range of socio-demographic and economic indicators for the growth boroughs are available via the GLA London Datastore [11]. This source also contains comparison totals for Greater London. Tables 8.1 to 8.3 update a sample of these indicators, as previewed in Travel in London report 4 [12].

Basic population indicators

Table 8.1 Basic demographic indicators. Olympic growth boroughs and appropriate comparators.

Borough/area	Resident population 2011 actual	No. of households 2011 actual	Population density 2011 actual, per hectare	Average age (2011) years	% of resident population born abroad (2011)
Barking & Dagenham	185,900	69,700	51.5	33.4	29.2
Greenwich	254,600	101,000	53.8	34.6	35.2
Hackney	246,300	101,700	129.3	32.4	37.2
Newham	308,000	101,500	85.1	31.3	49.6
Tower Hamlets	254,100	101,300	128.5	30.9	30.9
Waltham Forest	258,200	96,900	66.5	34.4	37.0
Inner London	3,231,900	136,3800	101.2	32.4	37.2
Outer London	4,942,100	1,902,400	39.4	36.6	32.9
Greater London	8,173,900	3,266,200	52	35.6	35.9

Source: GLA London Datastore, Borough Profiles: http://data.london.gov.uk/datastore/package/london-borough-profiles . Note that previous estimates for certain quantities have been re-based using the 2011 Census population actual totals which, as described in section 2.5 of this report, differed from the previous Census mid-year estimates.

Table 8.1 updates a selection of pre-Games socio-demographic indicators, based on the recently released 2011 Census of population. In 2011 the six growth boroughs contained 572,100 households and were home to 1,507,300 people. Demographically, however, the six boroughs are far from homogenous, with distinct differences between them in terms of population density, age profiles and ethnic make-up. This is, of course, not surprising given the geographical extent of the growth boroughs, although tracking change in these and related indicators, through Census of population mid-year updates, should give insight into the dynamism and pace of social change in these boroughs compared to the rest of London.

Basic economic indicators

Table 8.2 shows some basic indicators relating to jobs and employment. In contrast to the demographic indicators above it is clear from these data that the growth boroughs as a group currently under-perform other London comparators. Positive change in the relative position of the growth boroughs over the coming years would therefore be a powerful indicator of convergence.

Table 8.2 Basic economic indicators (employment). Olympic growth boroughs and appropriate comparators.

Borough/area	Number of jobs by workplace 2012	Residents gross annual pay 2012 (£)	Employment rate 2012 (%)
Barking & Dagenham	53,000	24,000	62.3
Greenwich	81,000	26,000	69.6
Hackney	112,000	27,000	63.7
Newham	89,000	20,000	60.5
Tower Hamlets	251,000	29,000	61.6
Waltham Forest	72,000	25,000	68.2
Inner London	3,033,000	30,000	67.2
Outer London	1,990,000	27,000	70.1
Greater London	5,023,000	28,000	68.9

Source: GLA London Datastore, Borough Profiles: http://data.london.gov.uk/datastore/package/london-borough-profiles .

A variety of other indicators, such as business two-year survival rates, will help paint a picture of relative economic progress in the growth boroughs over the coming years. Especially notable are the indices of multiple deprivation, which were last updated for 2010. Hackney, Newham and Tower Hamlets are the second, third and seventh (respectively) most deprived local authorities in the UK, with all of the growth boroughs ranking in the top 28 most deprived UK local authorities.

Environment, education, crime/safety and active travel

National-level data, available through the GLA Datastore, provide indices relating to many of the social objectives of convergence. Table 8.3 shows a diverse selection of these, relating to green space, crime, cycling frequency, educational attainment and house prices. These are of both general and specific interest, although again primarily highlight the diversity of the six growth boroughs.

So, for example, reported crime rates in each of the six growth boroughs are in fact lower than the average for inner London, while Hackney has notably high rates of cycling. Average house prices tend to be lower than average for inner London, but this at least in part reflects substantial differences in the nature of the dwelling stock in each borough, and should not of itself be taken as an indicator of relative deprivation.

Table 8.3 Selected indicators relevant to convergence. Olympic growth boroughs and appropriate comparators. Most recent-available year.

Borough/area	% of area that is green space (2005)	Crime rate per 1,000 population (2012/13) (1)	Adults who cycle at least once a month (%) 2010/11 (2)	Children attaining 5 or more GCSEs, inc. English & Maths, Grade A*-C (%) (2011/12) (3)	Median house price (£) 2011
Barking & Dagenham	33.6	92.2	9	58.6	170,000
Greenwich	34.4	82.5	14	63.7	249,950
Hackney	23.2	112.2	22	58.6	312,000
Newham	23.9	102	11	61.2	219,000
Tower Hamlets	15.2	113.4	15	62.1	300,000
Waltham Forest	31.4	94.1	11	56.4	232,000
Inner London	23.2	121.7	18.4	n/a	360,000
Outer London	42.5	75.7	12.7	n/a	250,000
Greater London	38.3	93.9	16	62.6	293,200

Source: GLA London Datastore, Borough Profiles: http://data.london.gov.uk/datastore/package/london-borough-profiles .
Notes:
1. Values are for 2012/13 financial year. Based on Census mid-year population estimates 2010 and consequently subject to change reflecting availability of actual population data from the 2011 Census.
2. From Active People Survey - https://www.gov.uk/government/organisations/department-for-transport/series/walking-and-cycling-statistics
3. Relates to pupils at maintained schools only. By borough of residence.

8.6 Travel behaviour related indicators

Data sources, limitations and their application to discerning transport legacy effects

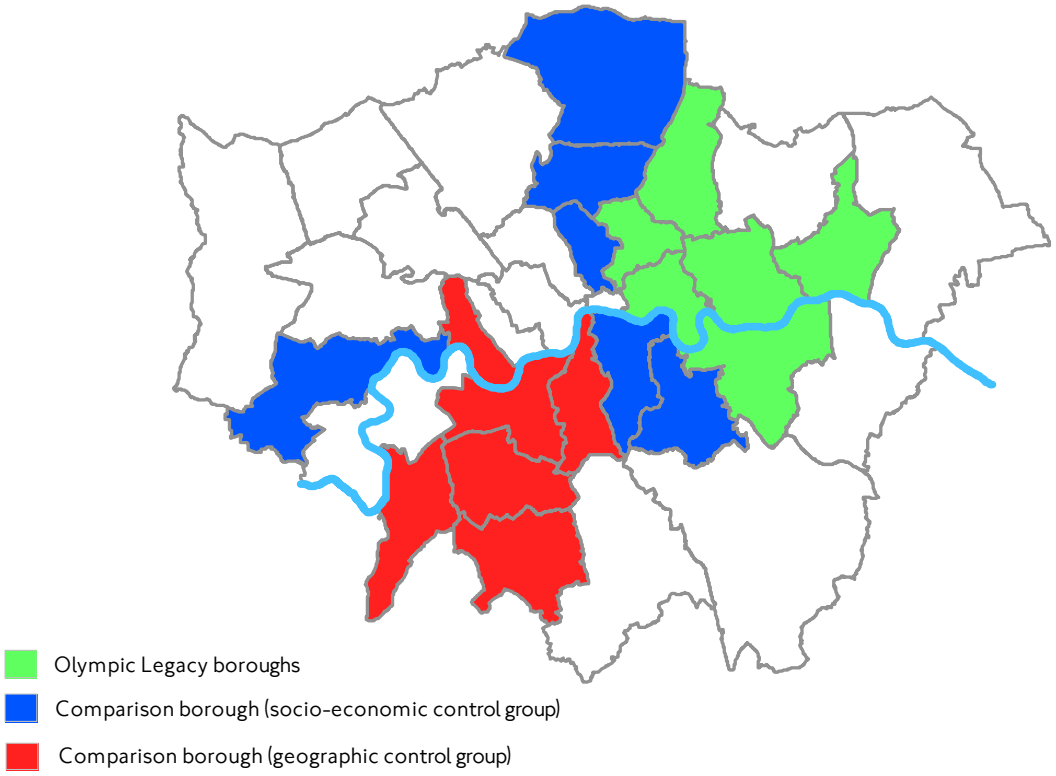
The principal source of data on these aspects is TfL's London Travel Demand Survey (LTDS). This survey provides an annual sample of approximately 1,100 households across the combined six growth boroughs, in the context of a whole-London sample. Whilst usable for assessing aggregate differences across all six growth boroughs on a yearly basis, the limited sample sizes at the level of the individual borough mean that disaggregate annual comparisons of specific aspects of travel behaviour are not advised. TfL's preferred approach for borough-level comparisons over the long term is therefore to use moving average values over several years where possible.

Data from the most recent LTDS survey in 2012/13 includes the period of the 2012 Games. The annual sample of LTDS survey households is spread evenly throughout the year, both geographically and seasonally, and no alterations were made to this practice in 2012/13. Therefore, specific 'during Games' effects will be present in the 2012/13 survey, although in the context of total yearly travel in London (and remembering that the LTDS survey includes London residents only) these will be very small.

Travel in London report 4 described an approach to monitoring and comparisons at the borough level, with observed change in the six Olympic growth boroughs (shown in green in figure 8.4 below) being set against equivalent change in the rest

of London. Various 'control' groupings of boroughs were identified, in particular a 'geographic' control group, which comprised a 'mirror image' set of contiguous boroughs in south and west London (shown in red on figure 8.4), and a 'most similar' non-contiguous set of boroughs (shown in blue), identified as being most similar, across a range of socio-demographic variables, to the growth boroughs. Other 'control' comparisons, including inner, outer and Greater London are also of course possible. Comparing indicators in this way will allow 'differential' change in the growth boroughs to be identified, so that an approach can ultimately be made to separating out the specific impacts of the Games transport legacy from more general 'background' change in the rest of London.

Figure 8.4 Groupings of boroughs for Olympic transport legacy monitoring.



Overall person trip rates and household car availability

Average person trip rates are a basic measure of travel, and are normalised so as to take account of differing absolute levels of population in each borough. Car ownership rates are a similarly basic measure of access to this form of transport, changes to which should be viewed in the context of transport mode share aspirations for London and the growth boroughs specifically. These are of particular interest given the observed trend towards lower levels of car ownership and use observed across London over recent years [13]. Table 8.4 summarises key data for both indicators.

Table 8.4 Person trip rates (all modes) and household car ownership rates for Olympic growth boroughs (residents of boroughs only). Seven-day week.

Borough/area	Baseline resident average trip rate (5 yrs 2006/07-2010/11)	Resident average trip rate (2 yrs 2011/12-2012/13)	Baseline resident households with access to one or more cars (5 yrs 2006/07-2010/11)	Resident average households with access to one or more cars (2 yrs 2011/12-2012/13)
Barking & Dagenham	2.3	2.3	55%	55%
Greenwich	2.0	2.5	59%	58%
Hackney	2.1	2.1	35%	36%
Newham	2.5	2.4	40%	43%
Tower Hamlets	2.3	2.4	36%	31%
Waltham Forest	2.3	2.3	55%	59%
Growth total/average	2.2	2.4	47%	46%
'Geographic' comparison	2.7	2.8	57%	54%
'Most similar' comparison	2.4	2.6	50%	48%
Non-legacy boroughs	2.6	2.6	59%	57%
Inner London	2.5	2.6	42%	40%
Outer London	2.6	2.6	67%	66%
Greater London	2.6	2.6	57%	55%

Source: TfL Planning Strategic Analysis, LTDS Survey.

It is seen from the table that overall person trip-rates tend to be lower than average in the growth boroughs, compared to the various London comparators, as in general do car ownership rates. It should be borne in mind, of course, when interpreting comparisons such as these, that the growth boroughs, whether in inner or outer London, will predominantly tend to share the characteristics of either inner or outer London, and it is in this context that features such as the particularly low person trip rate for residents of Hackney should be seen. Of interest for car ownership is the trend towards increasing levels of household car ownership in Hackney, Newham and Waltham Forest, comparing the five-year and two-year averages, against an overall reduction in car ownership at the Greater London level.

Trip rates by mode for residents of growth boroughs

While foreseeing growing overall volumes of travel in the growth boroughs, reflecting increasing population and economic activity, a key transport goal is that higher proportions of this travel are undertaken on public transport and, in particular, by walking or cycling. The popularity of these latter two 'active travel' modes is expected to benefit from the wider 'sporting legacy' of the Games, as well as substantial investment in facilities designed to encourage their use.

Table 8.5 looks at trip rates for residents (the average number of trips made per person per day) by overall main mode. In interpreting this table it is important to be aware that the criterion for inclusion is being resident in the appropriate area. The trips themselves may however have been made elsewhere.

Table 8.5 Person trip rates for Olympic growth boroughs. Average number of trips per day for residents over five years of age – by main mode. Seven-day week.

Borough/area	Baseline resident trip rate car driver (5 yrs 2006/07-2010/11)	Resident trip rate car driver (2 yrs 2011/12-201)	Baseline resident trip rate PT (5 yrs 2006/07-2010/11)	Resident trip rate PT (2 yrs 2011/12-2012/13)	Baseline resident trip rate walk (5 yrs 2006/07-2010/11)	Baseline resident trip rate walk (2 yrs 2011/12-2012/13)	Baseline resident trip rate cycle (5 yrs 2006/07-2010/11)	Baseline resident trip rate cycle (2 yrs 2011/12-2012/13)
Barking & Dagenham	0.6	0.7	0.6	0.6	0.7	0.6	0.0	0.0
Greenwich	0.5	0.8	0.6	0.7	0.5	0.8	0.0	0.1
Hackney	0.2	0.2	0.8	0.8	0.8	0.8	0.1	0.1
Newham	0.4	0.4	0.8	0.9	1.0	0.9	0.0	0.0
Tower Hamlets	0.3	0.3	0.8	0.7	1.0	1.2	0.0	0.1
Waltham Forest	0.6	0.5	0.6	0.8	0.7	0.7	0.0	0.0
Growth total/average	0.4	0.4	0.7	0.8	0.8	0.8	0.0	0.1
'Geographic' comparison	0.6	0.6	0.8	0.8	0.8	0.9	0.1	0.1
'Most similar' comparison	0.5	0.5	0.8	0.9	0.7	0.9	0.1	0.1
Non-legacy boroughs	0.7	0.6	0.7	0.7	0.8	0.8	0.1	0.1
Inner London	0.4	0.4	0.9	0.9	0.9	1.0	0.1	0.1
Outer London	0.8	0.8	0.6	0.6	0.7	0.7	0.0	0.0
Greater London	0.6	0.6	0.7	0.7	0.8	0.8	0.0	0.1

Source: TfL Planning Strategic Analysis, LTDS Survey.

Table 8.5 reveals a great deal of disparity between person trip rates and mode use across the six growth boroughs. Looking first at car travel, the highest rates among the growth boroughs are found for residents of Barking and Dagenham and Waltham Forest, although these are lower than the relevant comparator for outer London. Hackney is again notable for relatively low car trip rates – an average of just one-fifth of a car trip per resident per day. Public transport trip rates for residents of the growth boroughs however tend to be typical of, or slightly lower than, the relevant comparators.

Looking at trip rates for walking and cycling – the two 'active' modes of travel, table 8.5 shows a very mixed picture. For walking, residents of Newham and Tower Hamlets (particularly) walk considerably more, on average, than the relevant comparators. Remembering that this relates to pre-Games conditions, it is thought to reflect particular socio-demographic and economic factors relating to residents of these boroughs. It is not therefore an 'Olympics effect' itself, and it does not necessarily follow that increasing walk trip rates in boroughs such as these would be a predictable or desirable legacy outcome, despite the health benefits attributed to this mode.

Levels of cycling, on average, across all growth boroughs are low in relation to the use of other modes of transport, and it is not yet very meaningful to resolve them

in this way (ie that the average resident makes about 0.1 cycle trips per person per day, on average), although any dramatic increases in cycle use would be visible in due course. Certainly, however, cycle mode shares do vary considerably between the legacy boroughs. In the context of a London-wide mode share for all trips of two per cent, residents of Hackney, for example, have a cycle mode share of six per cent, whereas that for Barking and Dagenham is just one per cent.

Mode shares for public transport for all London residents making trips that originate in the growth boroughs

It is possible to extend this analysis by looking specifically at public transport mode share, by either growth borough residents or, as in this case, by all residents of Greater London making trips in the growth boroughs (table 8.6). This is a potentially interesting perspective, as it should ultimately be possible to understand the extent to which travel behaviour change is specifically a feature of people who live in the growth boroughs, who may be 'new' to the area, or is reflective more generally of London residents, as a response to changed transport provision in the growth boroughs.

Table 8.6 Mode shares for public transport – Olympic growth boroughs compared. All trips by London residents with an origin in listed boroughs.

Borough/area	Londoners within area baseline trip origin mode share public transport (%) (5 yrs 2006/07-2010/11)	Londoners within area trip origin mode share public transport (%) (2 yrs 2011/12-2012/13)
Barking & Dagenham	21%	24%
Greenwich	25%	24%
Hackney	35%	36%
Newham	31%	34%
Tower Hamlets	36%	35%
Waltham Forest	23%	29%
Growth total/average	29%	31%
'Geographic comparison'	29%	29%
'Most similar comparison'	30%	31%
Non-legacy boroughs	27%	29%
Inner London	37%	38%
Outer London	20%	21%
Greater London	28%	29%

Source: TfL Planning Strategic Analysis, LTDS Survey.

Again there is considerable variety between the growth boroughs, with some considerably above the Greater London average. In this (baseline) context, this variation is mainly thought to reflect the relative intensity of public transport provision. As above, relative change over the legacy period will be a powerful indicator of change.

Mode shares – walking and cycling

Table 8.7 shows similar statistics for walking and cycling trips. The high mode share for cycling in Hackney is apparent, as is a strong trend of increase, from 4 per cent for the years 2006/07 to 2010/11 (five-year baseline) to 7 per cent for the years 2011/12 and 2012/13 (two-year baseline). Walking has a significantly higher mode share in inner London than outer London, 37 per cent compared to 29 per cent.

Table 8.7 Mode shares for walking and cycling – Olympic growth boroughs compared. All trips by London residents with an origin in listed boroughs.

Borough/area	Londoners within area baseline trip origin mode share walking (%) (5 yrs 2006/07-2010/11)	Londoners within area trip origin mode share walking (%) (2 yrs 2011/12-2012/13)	Londoners within area baseline trip origin mode share cycling (%) (5 yrs 2006/07-2010/11)	Londoners within area trip origin mode share cycling (%) (2 yrs 2011/12-2012/13)
Barking & Dagenham	34%	29%	1%	2%
Greenwich	27%	28%	1%	2%
Hackney	39%	39%	4%	7%
Newham	37%	39%	1%	1%
Tower Hamlets	39%	43%	2%	4%
Waltham Forest	34%	31%	1%	1%
Growth total/average	35%	36%	2%	3%
'Geographic comparison'	33%	34%	2%	4%
'Most similar comparison'	32%	35%	2%	3%
Non-legacy boroughs	32%	33%	2%	3%
Inner London	37%	38%	3%	4%
Outer London	29%	29%	1%	2%
Greater London	32%	33%	2%	3%

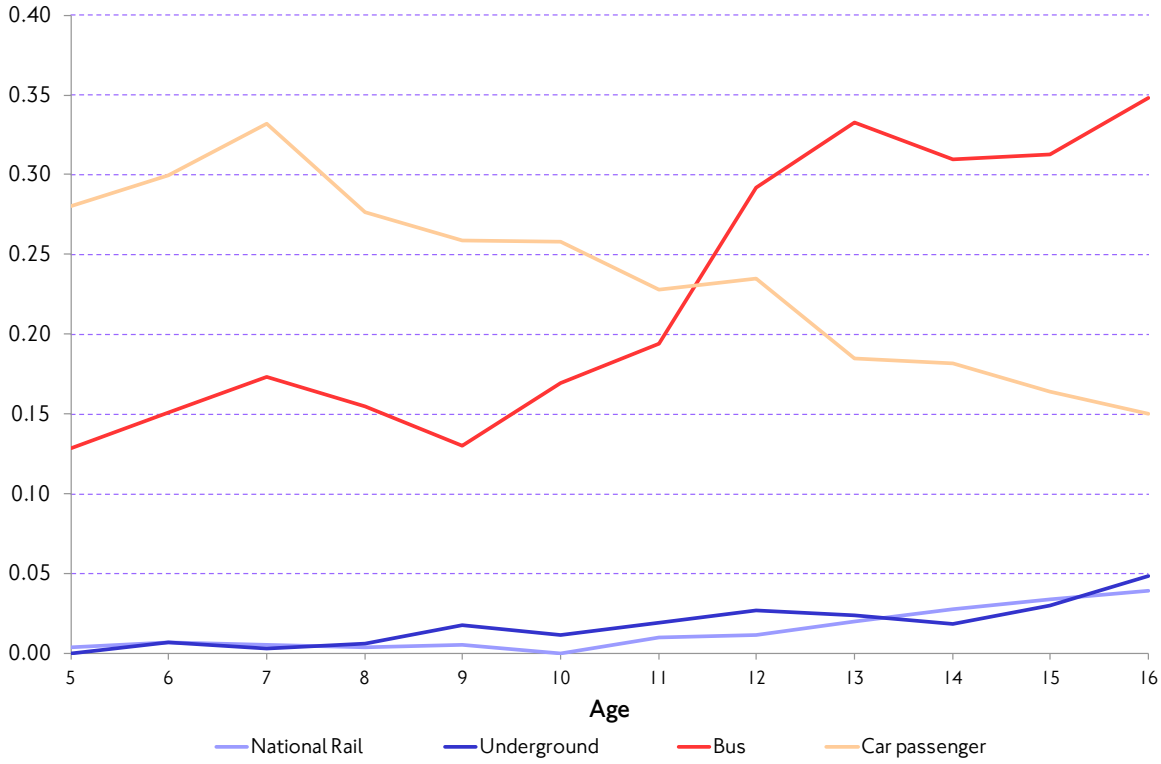
Source: TfL Planning Strategic Analysis, LTDS Survey.

Child travel and activity rates – mechanised modes

TfL's LTDS survey collects travel information for all persons aged over five. Promoting healthier travel among young people is an important legacy aim. It is therefore of interest to see what LTDS can tell us about the ways in which children travel in the six growth boroughs, in comparison with children in the rest of London.

Figure 8.5 shows trip rates by main mode (mechanised modes only) for all children resident in the six growth boroughs. Figure 8.6 is a similar graphic looking at child trip rates for the two 'active travel' modes of walking and cycling only.

Figure 8.5 Trip rates by mechanised modes for children aged 5-16. Residents of six Olympic growth boroughs. Average 2006/07-2012/13.



Source: TfL Planning Strategic Analysis, LTDS Survey.

Figure 8.5 shows that, of the mechanised modes, younger children's travel is dominated by car passenger travel. For example, seven year olds have a car passenger trip rate of 0.33 (average number of trips per person per day), which is around double their bus trip rate (0.17), and substantially more than either National Rail or Underground. As children approach their teenage years, a mode switch occurs which sees a dramatic increase in their bus trip rate, along with a reduction in their car passenger trip rate. Sixteen-year-olds have a bus trip rate of 0.35, with a car passenger trip rate of 0.15. Rail-based modes become increasingly important throughout teenage years, increasing from a negligible level for the under eights. The trip rates for mechanised modes shown in figure 8.5 are, on average, slightly lower than the equivalent for all children resident in Greater London, reflecting the general tendency of lower-than-average (for Greater London) trip rates in the growth boroughs.

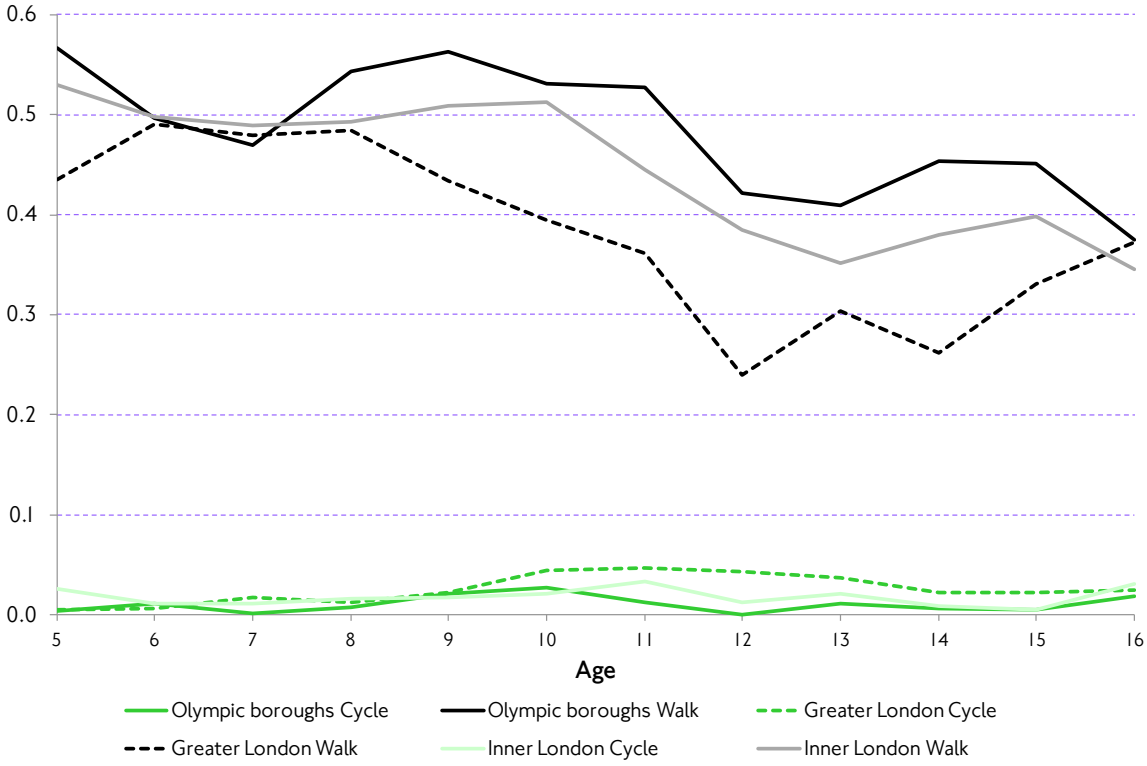
Child travel and activity rates – walking and cycling

On average, younger children resident in the growth boroughs make about 0.5 trips on foot per day. However, this generally reduces as they grow older, with a notable decline corresponding to secondary school age. Cycling trip rates are relatively very low – much less than 0.05 trips on average per child per day (about one–tenth of the walking trip rate). These are the baselines against which progress towards transport legacy objectives will be assessed. Figure 8.6 however reveals many other interesting features.

Looking for example at the relative profiles of the growth boroughs against the averages for inner and Greater London, children living in the growth boroughs are seen to be considerably more likely to walk than those in either of these 'control' areas. Partly, this reflects known socio-demographic and geographical differences. However, it may also reflect relative deprivation, where walking is used 'out of necessity', for example to save paying public transport fares or, less-obviously, deprivation in terms of socio-economic opportunities may mean that there is less need for people to travel longer distances.

Either way, the growth boroughs start some way ahead of other parts of London in terms of children's walk trip rates. Child cycling rates in the growth boroughs, on the other hand, relatively 'under-perform' those typical of other parts of London, particularly for children of secondary school age.

Figure 8.6 Trip rates for walking and cycling for children aged 5-16. Residents of six Olympic growth boroughs compared with inner and Greater London (resident) averages. 2006/07-2012/13 (Seven-year average).

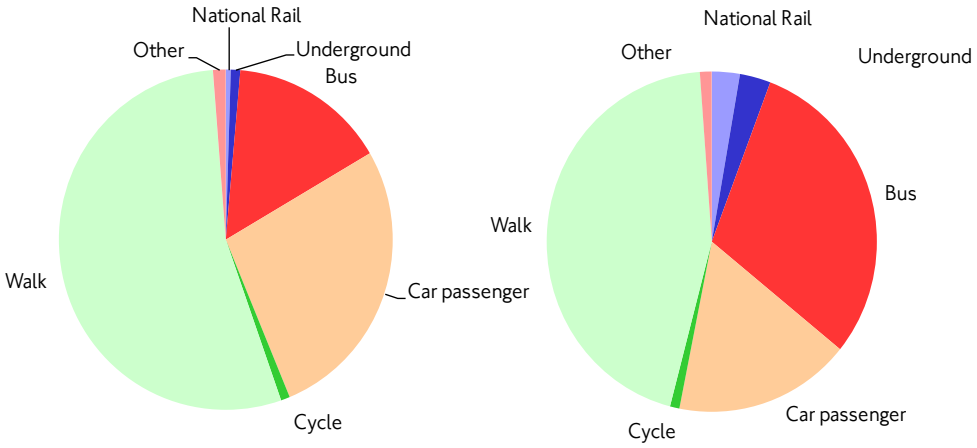


Source: TfL Planning Strategic Analysis, LTDS Survey.

Child travel and activity rates – travel to and from education

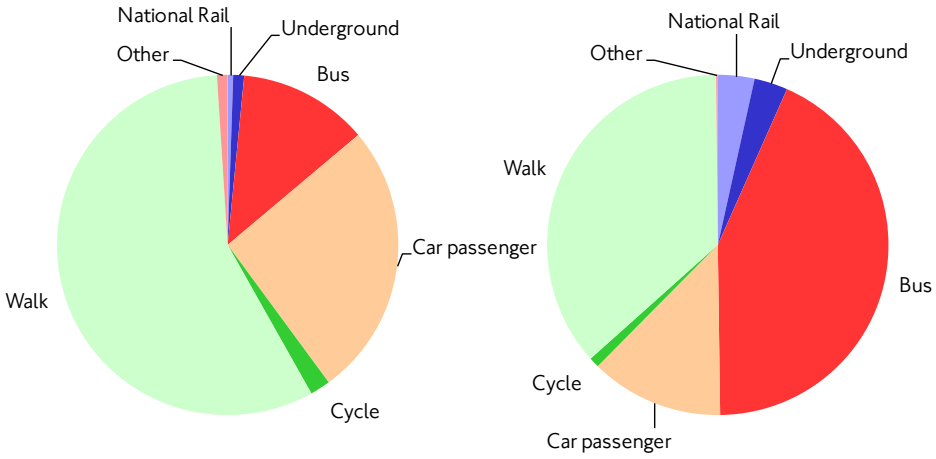
Figure 8.7, for children resident in the six growth boroughs, shows long-term baseline average mode share for education trips for children aged five to 11 (broadly corresponding to primary education), and for education trips for children aged 11-16 (broadly corresponding to secondary education). Figure 8.8 shows the equivalent breakdown for all children resident in Greater London.

Figure 8.7 Mode share for education trips for children aged 5-11 years (left) and 11-16 years (right). Residents of six Olympic growth boroughs. Average 2006/07-2012/13.



Source: TfL Planning Strategic Analysis, LTDS Survey.

Figure 8.8 Mode share for education trips for children aged 5-11 years (left) and 11-16 years (right). Residents of Greater London. Average 2006/07-2012/13.



Source: TfL Planning Strategic Analysis, LTDS Survey.

Looking first at the growth boroughs (figure 8.7), more than half (54 per cent) of trips to or from school by primary school age children are on foot. This reduces to an average of 45 per cent for children of secondary age. The proportion of trips to and from school made as car passenger also falls, from 27 per cent for primary age children to 17 per cent for secondary age children. Secondary age children are relatively more likely to use public transport (37 per cent compared to 18 per cent for primary age children), almost certainly reflecting unaccompanied travel by these (older) children. However, trips between home and secondary school also tend to be longer, on average, than those to primary schools. Of the public transport modes, bus is very much the most popular, accounting for 15 per cent of home-school trips for primary age children, and 30 per cent for secondary age children.

Comparing figure 8.7 with figure 8.8 at the Greater London level shows that the mode share for primary age children is relatively similar for the Olympic growth boroughs and Greater London, with walking trips representing the majority of trips to or from school. The mode shares for secondary age children are, however, substantially different. At the Greater London level, just 36 per cent of trips to or from school are on foot, compared to 52 per cent of trips made by public transport modes (including 43 per cent of trips made by bus) and 13 per cent of trips as car passenger trips.

Overall conclusions about baseline personal travel behaviour for the Olympic growth boroughs

The Olympic growth boroughs are very diverse, comprising often quite different geographic, transport network and socio-demographic features. It is therefore difficult and potentially dangerous to generalise. The main interest here will be in how the 'baseline' patterns in the growth boroughs change, relative to change in other parts of London, in the coming years.

Perhaps the one feature that clearly stands out is the relatively greater use of walking by residents of the growth boroughs. More walking is seen as bringing health benefits, as well as potentially freeing up capacity on public transport where it substitutes for a short-distance public transport trip. Certainly, residents of the growth boroughs are already 'above average' on the basis of this indicator, although it is not clear from this analysis to what extent this reflects relative deprivation, cultural preferences, a positive preference for healthier modes of travel, or simply geographic features of the boroughs themselves.

If it mainly reflects the first two of these possible factors, then improved economic conditions in the growth boroughs might, perversely, result in less walking in future years.

8.7 New cordon-based survey of travel demand and mode shares for trips to and from the Olympic Park area

TfL's LTDS survey only captures travel by London residents. Although this group, particularly those living in the six growth boroughs, would be expected to respond most directly to transport legacy initiatives, it is of interest as well to characterise travel in the area most immediately affected by Games-legacy-related developments by all people, including groups like those visiting for business or for leisure activities in the Queen Elizabeth Olympic Park. This will assume increasing relevance over the coming years as economic activity grows in the vicinity of the park. TfL has therefore developed a new two-cordon count survey that will provide periodic estimates of total travel and mode shares.

Description of the new Olympic legacy counting cordons

The survey is similar in concept to TfL's long-standing CAPC (Central Area Peak Count) and Isle of Dogs Cordon Surveys [14], consisting of two cordons (lines enclosing areas across which movements are counted). The 'outer' cordon broadly corresponds to the Olympic Legacy Supplementary Planning Guidance (OLSPG) boundary that was set out in the OLSPG [15] in July 2012. The OLSPG explains that this area has the potential to provide 32,000 new homes and 1.35 million square metres of new and improved commercial floor space over the legacy period, thus generating a substantial number of additional trips. The 'inner' cordon tightly

encloses the Queen Elizabeth Olympic Park itself, which is currently undergoing conversion to a high quality sporting and leisure destination, and also encloses the Stratford City complex, including the Westfield Stratford City shopping centre.

Figure 8.9 Olympic legacy area counting cordons.

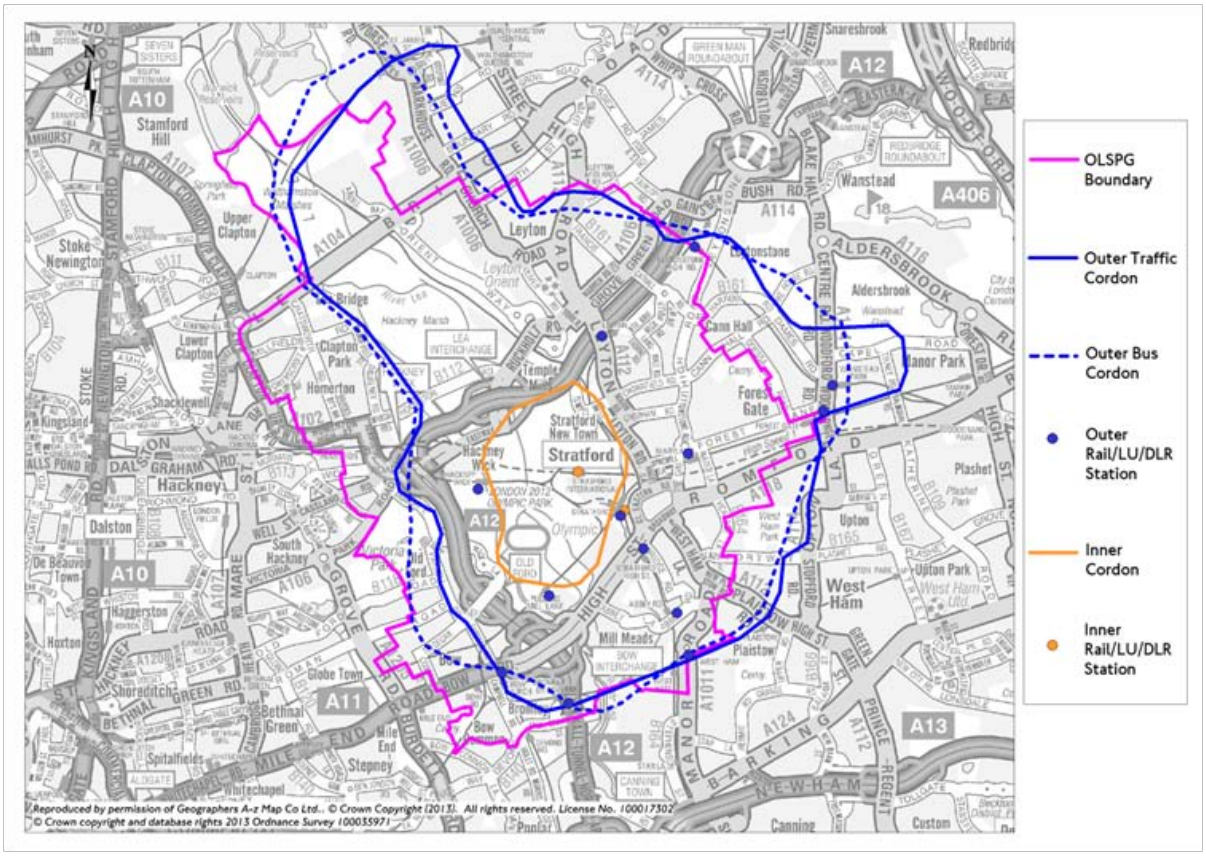


Figure 8.9 shows the extent and location of these two cordons. The outer cordon roughly traces the OLSPG boundary and enables enumeration of all people movements in and out by road vehicle. It is counted between 06.00 and 20.00 hours. As passengers can typically only board and alight buses at designated bus stops, a modified cordon was defined for counting bus passengers. In addition, the 13 National Rail, London Underground, London Overground and DLR stations inside the cordon were surveyed to estimate people movements crossing the cordon by rail modes. Rail data was collected from several sources, including Oyster data and manual station counts. This data covers the period 07:00 – 19:00. Baseline surveys were conducted in spring 2013, the first year after the Games, and representing 'neutral' traffic/demand conditions.

This cordon therefore gives estimates for all people entering or leaving the area, excluding those making wholly through trips (and not interacting with the area), for example international passengers on High Speed One (HS1) or travellers making 'through trips' on the Central line (for example, Holborn to Epping). Persons in road vehicles making 'through' trips would be counted on entering the cordon, and counted again a short time later upon exiting it.

The inner cordon surrounding the Olympic Park adopts a similar methodology, although Stratford station partly straddles the inner cordon. This means that people exiting the station to Stratford City enter the inner cordon, whilst those exiting via

the main ticket hall and bus station do not enter the inner cordon but enter the area circumscribed by the outer cordon.

Totals and mode share

Table 8.8 below provides a 12-hour baseline figure for total inbound and outbound volumes for both cordons. Table 8.9 provides a baseline mode share breakdown.

Table 8.8 Numbers of people entering and exiting the OLSPG cordon (07:00 – 19:00).

	Thousands of people			
	Inner cordon inbound	Inner cordon outbound	Outer cordon inbound	Outer cordon outbound
All modes	62.3	49.9	402.1	422.1
National Rail	11.8	8.2	20.6	21.7
LUL and DLR	15.1	13.5	40.5	52.8
Bus	2.7	2.0	69.8	73.1
Coach/ minibus	0.4	0.2	7.9	8.7
Car	9.6	7.0	191.4	193.7
Taxi	0.2	0.2	1.1	1.1
Goods vehicles	1.4	1.2	58.0	57.7
Two-wheeled motor vehicles	0.1	0.1	5.1	5.2
Cycle	0.2	0.1	7.7	8.1
Walk	20.8	17.5	n/a	n/a

Source: TfL Planning Strategic Analysis.

Table 8.9 Mode share of people entering and exiting the OLSPG cordon (07:00 – 19:00).

	Percentage			
	Inner cordon inbound	Inner cordon outbound	Outer cordon inbound	Outer cordon outbound
All modes	100	100	100	100
National Rail	18.9	16.4	5.1	5.1
LUL and DLR	24.3	27.0	10.1	12.5
Bus	4.4	4.0	17.4	17.3
Coach/ minibus	0.6	0.4	2.0	2.1
Car	15.4	14.0	47.6	45.9
Taxi	0.2	0.3	0.3	0.3
Goods vehicles	2.2	2.3	14.4	13.7
Two-wheeled motor vehicles	0.2	0.2	1.3	1.2
Cycle	0.3	0.3	1.9	1.9
Walk	33.4	35.0	n/a	n/a

Source: TfL Planning Strategic Analysis.

It will always be the case that the patterns revealed by cordon surveys such as this will reflect the particular geography of the area that they seek to measure. It is not therefore meaningful to make comparisons between results from this survey and those from the similar surveys for central London and the Isle of Dogs. The main interest at this initial (baselining) stage of the work is to explore the patterns shown in relation to the characteristics of the area. In future years the main interest will be on how these patterns change, especially in terms of the legacy outcomes relating to economic vitality (total demand) and mode shares.

Inner cordon (Queen Elizabeth Olympic Park)

In total, more than 112,000 people entered or exited the inner cordon during the period 07:00 – 19:00. For the inner cordon, the most popular mode is walking, although as the cordon boundary is located on the bridge between Stratford bus station and Westfield Stratford City shopping centre, a substantial proportion of pedestrians may have taken the bus en-route to the cordon boundary. The bus figure is relatively low as at the time of the survey, only four bus routes crossed the cordon to serve the smaller Stratford City bus station. The high mode shares for rail-based modes reflect the dedicated entrance to Stratford station from within the cordon. Overall, slightly less than half of people crossing the cordon do so by public transport. The relatively low total for road-based modes reflects the limited vehicular access to the inner cordon at the present time (via Warton Road and Montfichet Road only at the time of the survey).

Outer cordon (OLSPG area)

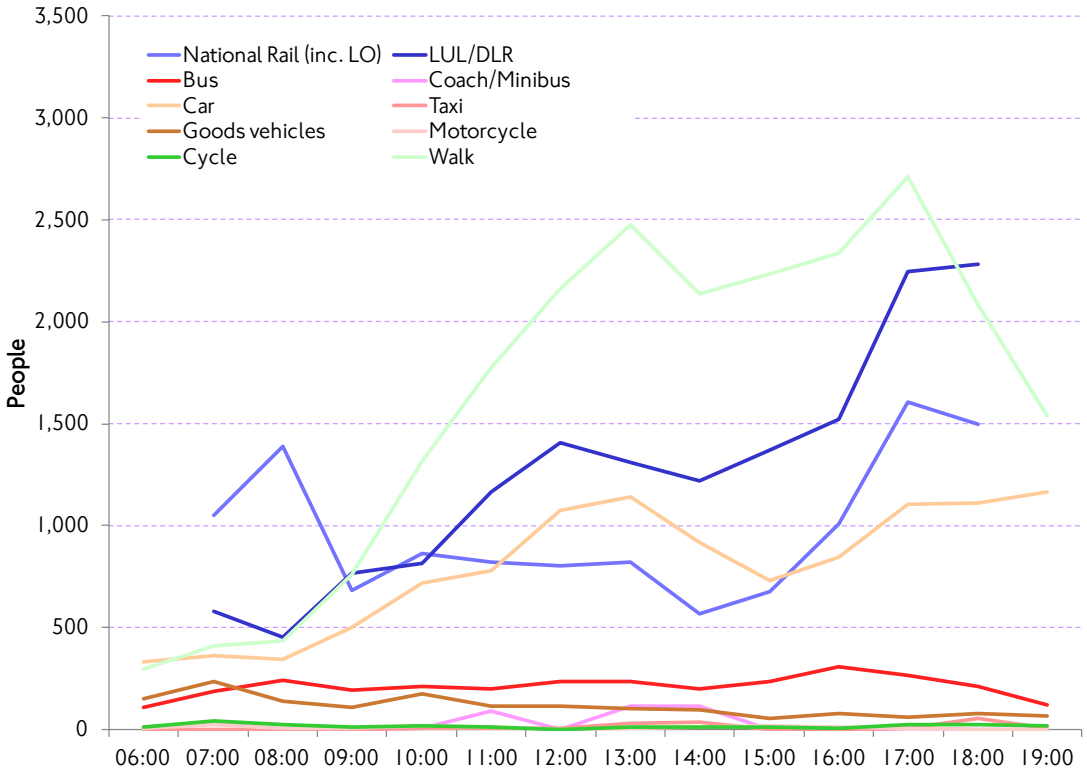
The outer cordon encloses a relatively large area and is therefore more representative of travel in the broad Games legacy area. The most prevalent mode is car. About one third of people cross the cordon by public transport in either direction. One reason for a high mode share for road based modes is that there are several busy arterial roads transiting the cordon (A12, A11/A118 and A104) which carry a substantial volume of people *through* the cordoned area, meaning that people would be counted as inbound and then later as outbound without necessarily having stopped within the cordoned area. The relatively high share for people travelling in goods vehicles reflects both the industrial land uses within the cordon area and the important arterial routes linking inner London with the M25 motorway, which cross the cordon.

Notable for both cordons are the mode shares for cycling – particularly low at 0.3 per cent for the inner cordon, yet similar to the Greater London average of 2 per cent at the outer cordon.

Hourly distribution – inner cordon

The distribution of people movements over the course of a day is strongly linked to land use. For example, major employment centres tend to see a peak in inbound movements in the AM peak and a peak in outbound movements in the PM peak. As redevelopment occurs across the area enclosed by the OLSPG boundary, it is likely that the temporal distribution of people movements will change as the land use mix changes. Figure 8.10 and figure 8.11 show the distribution of people movements (inbound and outbound respectively) by mode and by hour for the inner cordon.

Figure 8.10 People entering the inner cordon by hour and mode of travel.



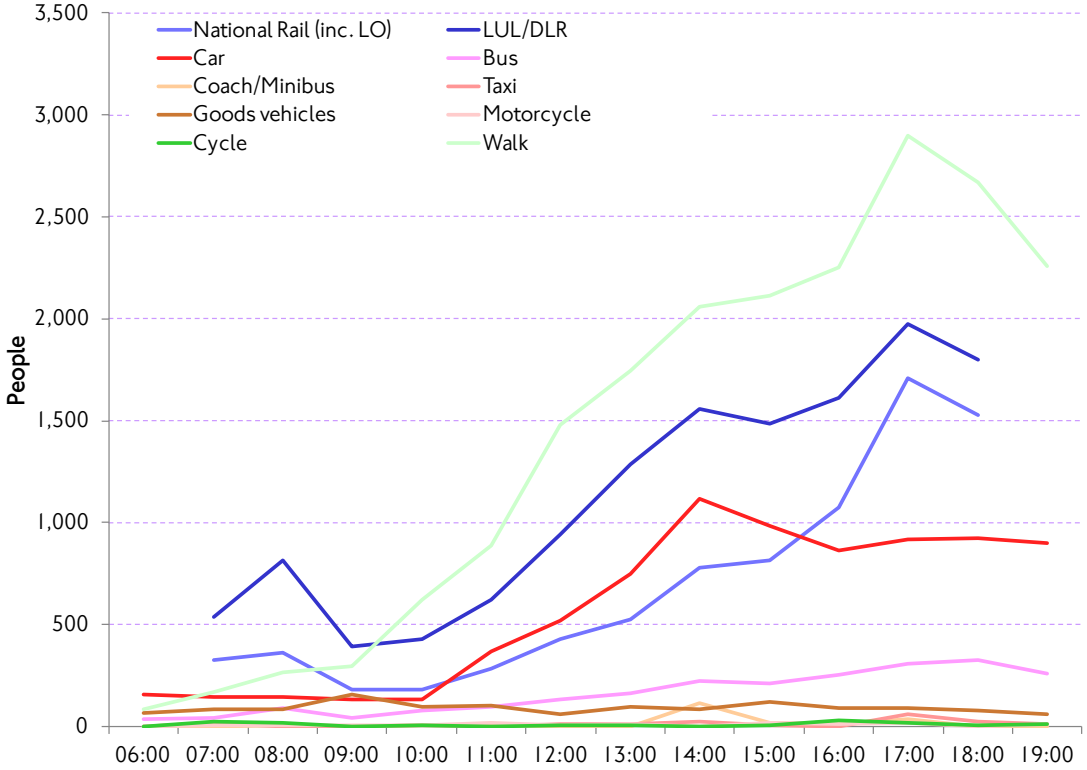
Source: TfL Planning Strategic Analysis.

The temporal distribution of inbound and outbound passengers at this cordon reflects the current land use within the cordon, which is predominately retail and leisure. Inbound flows take-off for pedestrians and cars at 09:00 as shops and cafes open. This is preceded by a peak in goods vehicles at 07:00 (reflecting early morning deliveries as well as the servicing of local construction sites) and a peak for bus passengers at 08:00. It should be noted that anyone travelling into the cordon from Stratford bus station would cross the cordon on foot and would therefore be counted as a pedestrian.

The patterns for rail-based modes are broadly similar to those for other modes with the exception of a high inbound flow on National Rail between 08:00 and 09:00. This is driven by high counts from Stratford International station and corresponds to the peak arrival period for westbound trains on HS1 (eight trains per hour). The corresponding spike in outbound flow by London Underground and DLR may be indicative of some passengers interchanging between High Speed One and London Underground and DLR services to Canary Wharf and the City (which would involve entering the inner cordon at Stratford International, walking the short distance to Stratford station and then exiting the inner cordon at Stratford station).

Outbound flows are low until mid-morning as there are few people currently residing within the bounds of the cordon. There is a peak in overall outbound flows between 17:00 and 18:00 although flows remain high through to the end of the survey period. This reflects the later opening hours of retail and leisure businesses.

Figure 8.11 People exiting the inner cordon by hour and mode.

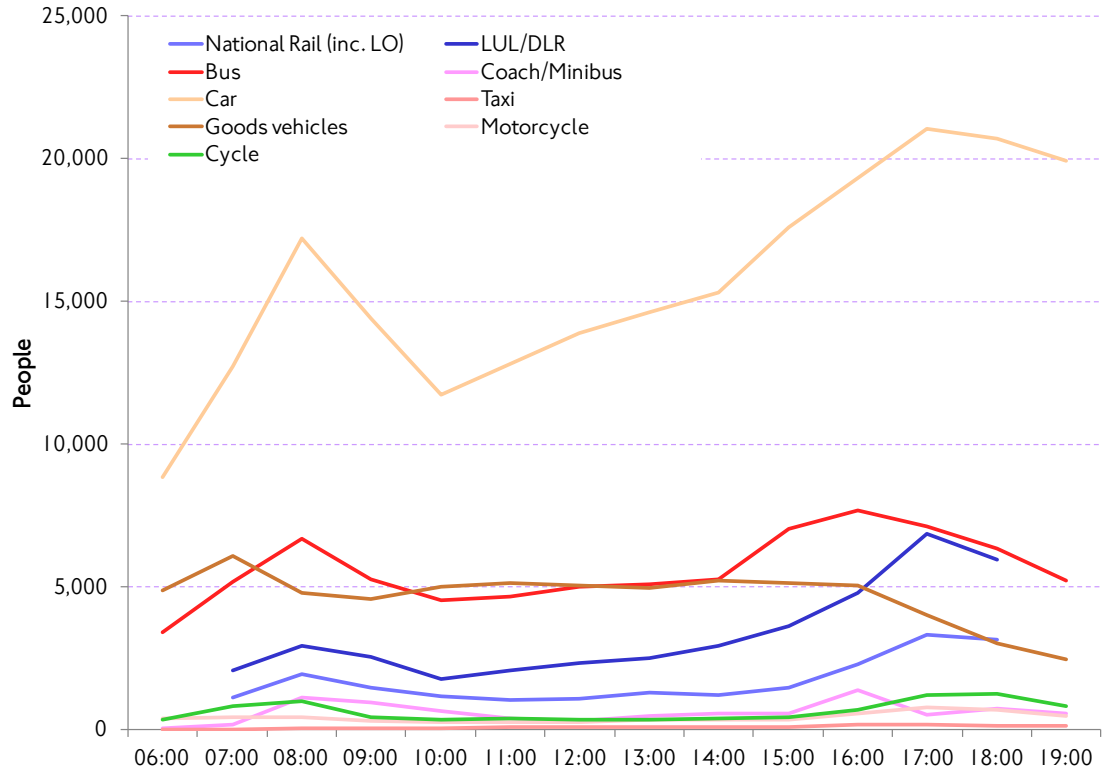


Source: TfL Planning Strategic Analysis.

Hourly distribution – outer cordon

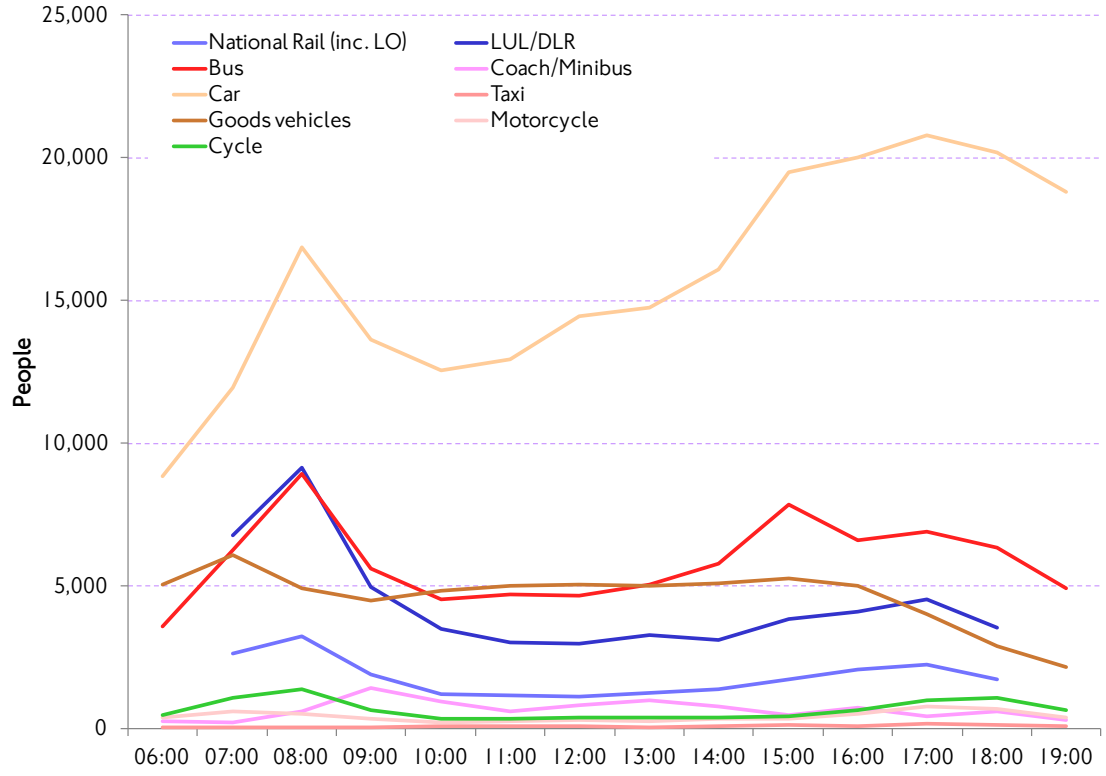
Figure 8.12 and figure 8.13 show the hourly total passengers crossing the outer cordon inbound and outbound. Strong AM and PM peaks are apparent in both directions, particularly for cars, public transport and cycles. This reflects the wider mix of land uses (both residential and commercial/industrial) within this cordon compared to the inner cordon. Also, these patterns are influenced by the wider 'tidal flow' to and from central London

Figure 8.12 People entering the outer cordon by hour and mode.



Source: TfL Planning Strategic Analysis.

Figure 8.13 People exiting the OLSPG outer cordon by hour and mode.



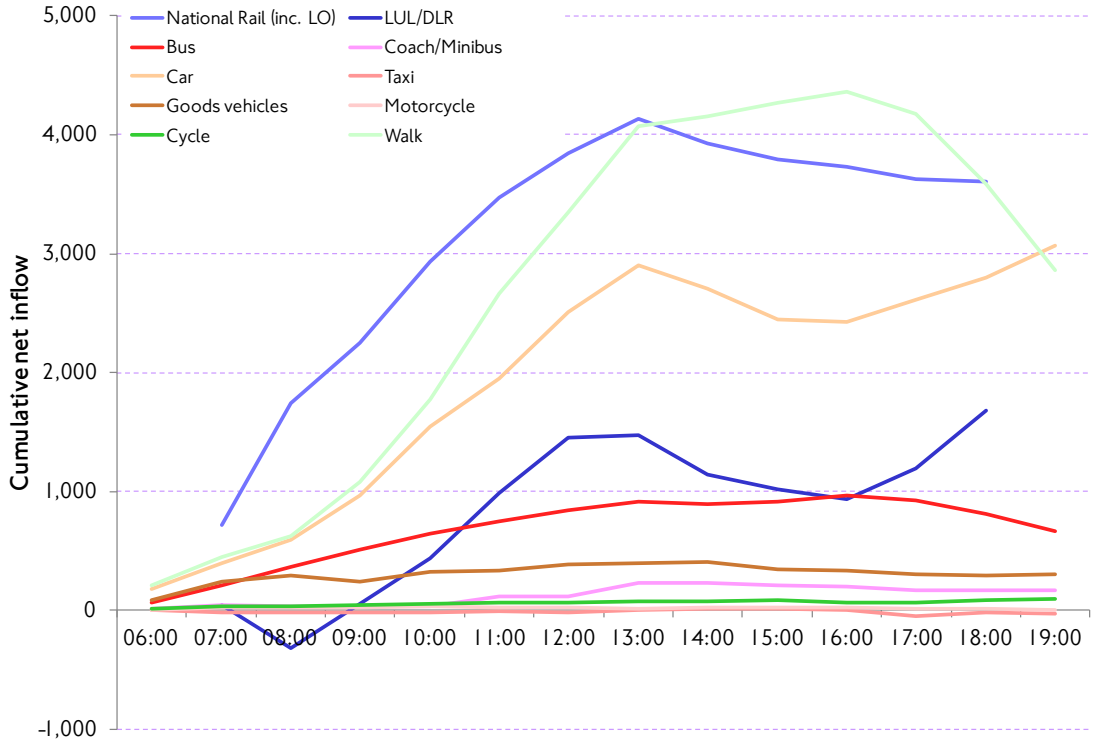
Source: TfL Planning Strategic Analysis.

Cumulative net inflows

Another way of presenting this data is to look at cumulative net totals (inbound minus outbound movements). In an idealised case, inbounds should equal outbounds over the course of a 24-hour day. Figure 8.14 and figure 8.15 show however that, at least for the limited hours surveyed by these cordons, this is not the case.

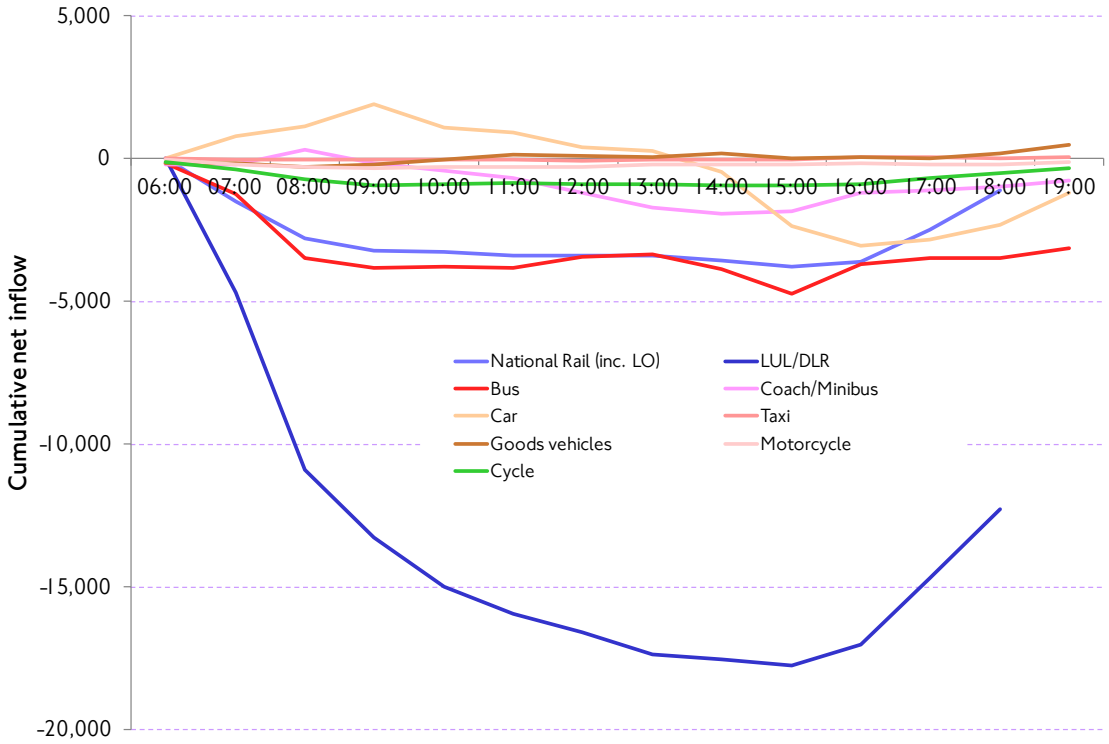
Looking first at figure 8.14 for the inner cordon, the graph demonstrates the strong attraction nature of the land uses within the inner cordon. Most modes show a consistent increase in net inbound flows throughout the morning. This falls in the afternoon for several modes as people begin to leave the area, but then rises again in the late afternoon. This suggests the existence of a second wave of visitors, most likely shoppers visiting Westfield Stratford City after work. At the end of survey hours (20.00), there are over 10,000 extra people within the cordon compared to first thing in the morning. These will dissipate over the later evening hours (not surveyed this year) as attractions close. The net outbound flow by London Underground and DLR between 08:00 and 09:00 may be indicative of interchange between High Speed One at Stratford International and other services from Stratford station.

Figure 8.14 Cumulative net inbound people inner cordon by hour and mode.



Source: TfL Planning Strategic Analysis.

Figure 8.15 Cumulative net inbound people OLSPG outer cordon by hour and mode.



Source: TfL Planning Strategic Analysis.

In contrast to the inner cordon, the area enclosed within the outer cordon is predominately residential. This is reflected by the rapid outflow of people by public transport in the AM peak and the gradual inflow from about 15:00 onwards. This pattern is matched (albeit on a much smaller scale) for cycles. The pattern for cars is more mixed. This can be partly attributed to people transiting the zone on key radial routes (applies to road only) rather than having an origin or destination within it.

In contrast to the inner cordon, at the end of survey hours the outer cordon shows a 'deficit' of people – in the region of 20,000 or so, mostly LU/DLR travellers. In this case, people commuting by rail and other modes out of the area in the morning have yet to return – they will likewise return progressively after survey hours. Given that the outer cordon wholly contains the inner cordon, the relative 'deficit' at the outer cordon at the end of survey hours will be (largely, but not in the case of residents within the outer cordon) net of the relative 'excess' at the inner – meaning that the 'true' shortfall of people for the outer cordon would be rather larger than implied by figure 8.15.

This is the first time that these travel patterns have been explored and, again, the principal interest will be in assessing relative change over the period of the transport legacy. Given the interesting cumulative inflow patterns suggested by this first count, consideration will be given to extending the survey hours for future surveys.

8.8 Perceptions of quality of life in the Olympic growth boroughs

TfL's perception of the travel environment survey explores customer satisfaction with aspects of the travel environment and its wider contribution to quality of life.

The main survey operates at the London-wide level, but since 2011 a substantial 'boost sample' has been conducted with circa 500 individuals in the six growth boroughs. When looked at individually or set against the relevant London-wide trends, this survey should provide evidence of differential change in the growth boroughs, broadly reflecting transport legacy initiatives.

Travel in London report 4 set out pre-Games baseline comparisons for 2011. This showed that, on average, residents of the growth boroughs were somewhat less satisfied with the travel environment than those of London as a whole. For example, when asked about their level of satisfaction with their overall journey experience, taking everything into account and considering travel by all modes, residents of the growth boroughs gave a mean score of 63 out of 100, compared to a London-wide average of 66 out of 100 [16].

Table 8.10 looks at mean scores across the range of key indicators, updated with data from the 2012 and 2013 surveys, for residents of the growth boroughs and with the Greater London average shown.

Table 8.10 Customer satisfaction with aspects of the travel environment. Residents of Olympic growth boroughs compared with Greater London average.

Indicator	2010/11	2011/12	2012/13	TfL's assessment (2012/13)
Perception of journey experience GLA	66	67	70	'fairly good'
Perception of journey experience growth boroughs	63	66	71	'fairly good'
Perception of the urban realm GLA	66	65	65	'fair'
Perception of the urban realm growth boroughs	62	66	65	'fair'
Perception of transport-related noise GLA	74	76	75	'fairly good'
Perception of transport-related noise growth boroughs	72	76	71	'fairly good'

Source: TfL Group Customer Research.

Looking at these scores across the three years currently available, the most obvious feature is the strong improvement in scores for the overall journey experience for those living within the growth boroughs (from 63 to 71). A similar but less-pronounced improvement is also seen in this score for all London residents, although the growth boroughs saw perhaps the most dramatic improvements during the run-up to the Games and were the focus of attention during the Games themselves. Urban realm perception scores for residents of the growth boroughs have also improved markedly, this against a stable trend for this score for residents of the rest of London, although the scores for transport-related noise in the host boroughs have been variable over the period.

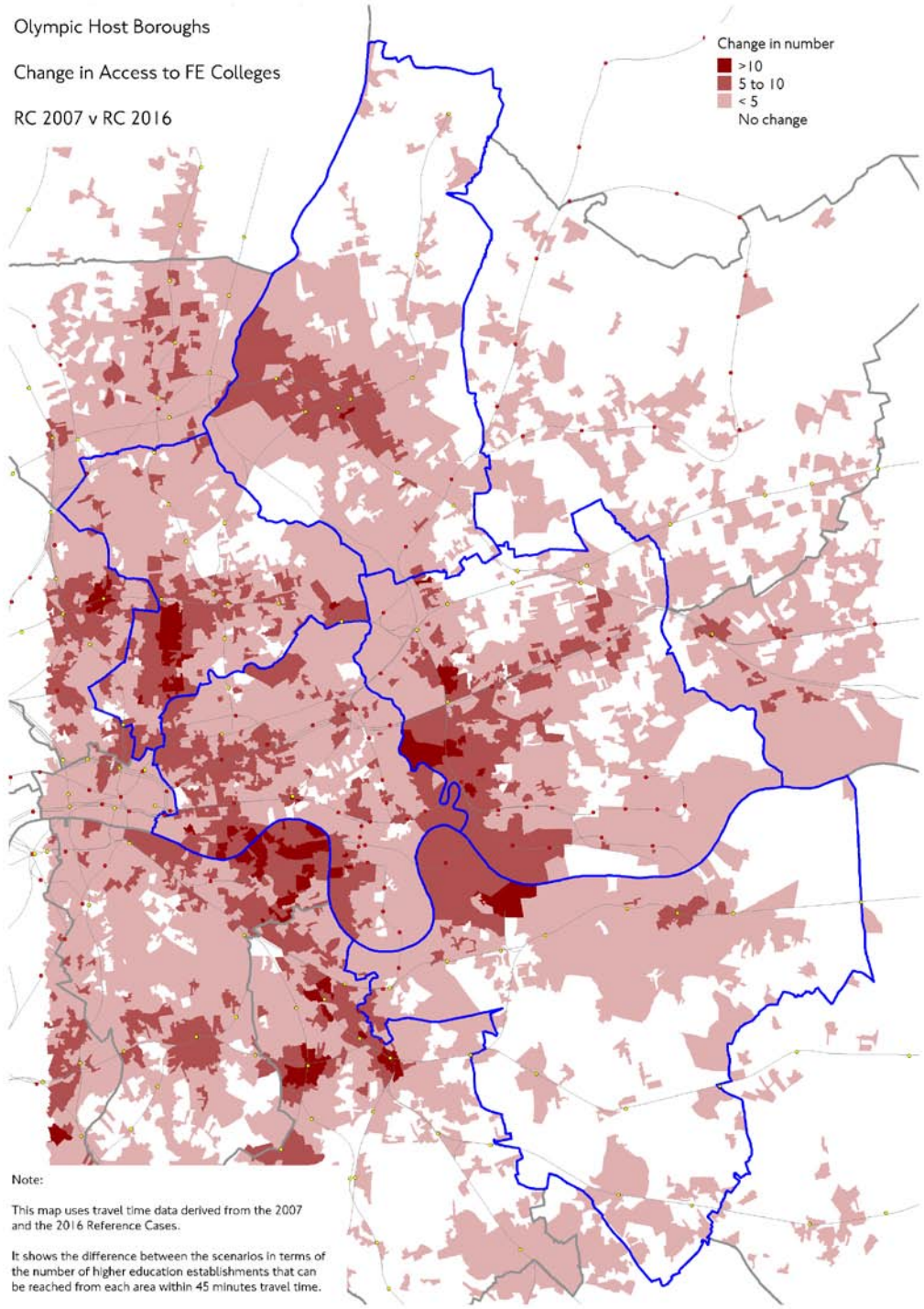
8.9 Access to opportunities and services through improved connectivity

Improved transport links will contribute to convergence by increasing connectivity to a range of opportunities and services in the local area and further afield. In addition to improving access to jobs the Olympic Legacy Action Plan specifically targets improved access to education, sport and healthcare.

TfL can periodically benchmark levels of accessibility/connectivity based on comparisons of computer models of the transport networks that reflect improvements. The frequency with which this can be done reflects the availability of transport model updates, which are typically updated on a five-year cycle. Figure 8.16 shows one such comparison, using the example of changed connectivity to establishments of further education from the six growth boroughs. The figure shows the change in the number of establishments that can be accessed within a 45 minute travel time, at Census Output Area level, comparing the position in 2007 with that expected, given past and up-coming transport improvements, in 2016.

It is clear from the figure that there are widespread gains across the growth boroughs, residents of some areas gaining access to 10 or more additional establishments within the 45 minute travel time threshold. Areas of greatest improvement reflect the geography of improved connectivity afforded by new transport links, with particular improvements in the Greenwich Peninsula and Lower Lea Valley. It is also clear from the map that, as would be expected, improvements extend to areas beyond the immediate six growth boroughs.

Figure 8.16 Change in connectivity to establishments of further education. Change in number of establishments that can be reached within 45 minutes by public transport. Olympic growth boroughs, 2007 versus 2016.



Source: TfL Planning Strategic Analysis.

Table 8.11 quantifies these improvements, in terms of average travel times, for residents of each of the growth boroughs, to higher education establishments, and in terms of number of higher education establishments that can be reached within 45 minutes. The growth boroughs typically see average travel times to these establishments reduce by between 4 and 5 per cent, which might be thought of as

being relatively small – given the scale of infrastructure improvements put in place in the area. However, this particular analysis assumes a London-wide catchment for higher education establishments. It must also be recognised that the increases in population expected in these boroughs will bring many more education (and other) trips than are currently present on the transport networks.

Looking more locally at the number of higher education establishments accessible within 45 minutes, this perhaps reflecting a typical travel time, the gains are much greater, with accessibility/connectivity on this measure typically increasing by between 15 and 20 per cent.

Table 8.11 Access to establishments of further education in Olympic growth boroughs.

Average travel time to all higher education establishments in London (minutes)

Borough	2007	2016	% change
Greenwich	76.8	73.3	-4.5
Hackney	61.5	58.9	-4.2
Newham	66.7	63.7	-4.5
Tower Hamlets	55.7	53.7	-3.7
Waltham Forest	71.0	68.1	-4.0
Barking & Dagenham	78.0	74.3	-4.8

Average number of higher education establishments accessible within 45 minutes travel time

Borough	2007	2016	% change
Greenwich	5.6	6.4	+15.3
Hackney	6.1	7.2	+16.5
Newham	21.9	25.3	+15.3
Tower Hamlets	11.3	13.7	+21.3
Waltham Forest	31.7	35.4	+11.4
Barking and Dagenham	9.7	11.5	+18.0

Source: TfL Planning Strategic Analysis.
Note: Aggregations of individual results for each Census Output Area result in 'fractional' estimates of the number of further education establishments that can be reached at the whole-borough level.

8.10 Physical accessibility to the transport system

The Mayor made a commitment that the 2012 Games would be the most accessible ever, and many provisions that were put in place specifically for the Games have been retained in day-to-day operational practice. Although London's transport heritage means that universal accessibility will necessarily be a long-term and incremental process, London's public transport is nevertheless among the most accessible in the world.

- All of London's 8,500 buses are low-floor step-free, with 72 per cent of bus stops now meeting DfT accessibility standards, and TfL continues to invest in vehicles that have more accessibility features.
- London's Rail network – including London Underground, Docklands Light Railway and London Overground now have 95 stations that are step-free.

- Manual boarding ramps and platform humps were introduced at key stations during the Games where there was a step up to the train. These have been retained and by 2014/15 a third of the Tube network will have level access platforms.
- Access to journey information and real time information made the Games transport a success – TfL's Journey Planner allows users to input their access needs and customers can chose to receive daily updates on travel disruption. TfL has also launched @tflaccess Twitter feed and is working with app developers to make more real time accessibility information available through smartphones.
- Highly effective accessibility signage introduced for the Games has been re-branded with distinctive permanent signs, which highlight step-free routes and accessible boarding points.

Staff and volunteers were key to the success of the Games transport, and TfL has built on the feedback and enhanced its accessibility training in a number of ways.

- The TfL travel ambassadors (now referred to as operational volunteers) have been retained and are used at busy times such as Notting Hill Carnival, London Marathon and other major events.
- Staff helpfulness is the key to making a journey accessible or not. Since the Games, TfL has worked with disabled peoples' organisations to enhance its training for frontline staff. For example, a new video for bus drivers was developed with the aid of Age UK and Transport for All, in which disabled people talk of the impact that good and bad service has on their ability to get around
- On the Underground, a pilot programme of five Accessibility Centres of Excellence on the Tube network has produced very positive feedback and TfL hopes to roll this out to other major stations across the network.

TfL has completed a wide-ranging review of all its accessibility information. This included what customers needed to know, what formats they would like and where they would expect to find it. Disabled people, particularly visually impaired, mobility impaired and those with learning difficulties, plan their journeys carefully. Information provision was seen as a key success of the Games and TfL has ensured a legacy in a number of ways:

- Re-designing the accessibility section of its website and enhanced the Journey Planner.
- Working with the Association of Train Operating Companies (ATOC) and Network Rail on a new 'accessibility' Tube and rail map – to show the extent of step-free rail across Greater London.
- Providing real time information at every bus stop through a text-based service (text 87287) and through next generation 'Countdown' signs at more than 2,000 bus stops.

However, TfL's research and engagement shows that many disabled people still don't know about all the accessibility improvements TfL has made. In 2014 TfL will launch a new engagement campaign to promote the accessibility of London's transport networks.

8.11 Air quality in the six Olympic growth boroughs

Why this is important

Given the increases in population and economic activity that are envisaged in the six growth boroughs, trends in ambient air quality will be an important check to ensure that the quality of the local environment is not adversely affected. Air quality in

London has broadly improved over the last decade, with general achievement of EU limit values for particulate matter (PM_{10}) – a pollutant thought to be responsible for about 4,270 'excess' deaths in London each year [17] – now generally achieved at roadside locations across Greater London. However, despite considerable efforts and policies such as the London Low Emission Zone, ambient levels of nitrogen dioxide (NO_2) still widely exceed EU limit values at roadside locations throughout central and inner London. Emissions of carbon dioxide – London's major greenhouse gas – are subject to large-scale reduction targets at the local and national level, and are strongly related to the levels of activity, such as road traffic, in an area.

Progress with improving air quality can be assessed in three main ways, each of which has a particular utility in this context: through emissions to the atmosphere from local sources (in this case principally from road traffic); by assessing ambient concentrations of pollutants in the air as calculated by computer models; or by measuring actual ambient concentrations of pollutants. The following section sets out 'baseline' indicators for all three indicators.

Air quality and greenhouse gas emissions from road traffic in the Olympic growth boroughs

Tables 8.12 to 8.14 show estimated emissions for the three main air pollutants from identifiable road traffic sources (only) in each of the six growth boroughs. Equivalent values for the whole of Greater London are also given for comparison.

Looking first at carbon dioxide – London's principal greenhouse gas – the six growth boroughs contributed 15.2 per cent of the Greater London road traffic total in 2012, roughly in proportion to their share of the total kilometres driven by road vehicles in London. Between 2010 and 2012 all boroughs reduced their CO_2 emission, although the amount of reduction ranged from -3.2 per cent to -9.3 per cent. All but one of the growth boroughs saw CO_2 reductions larger than the average for Greater London (table 8.12), although this is thought primarily to reflect falling traffic levels in inner London relative to outer London (see section 3.10 of this report).

Table 8.12 Olympic growth boroughs - emissions of carbon dioxide (CO_2) from road traffic, 2010-2012.

Source	2010	2011	2012	% change 2010-2012
Barking and Dagenham	139,800	134,900	134,300	-3.2%
Greenwich	217,000	208,700	204,000	-6.0%
Hackney	130,700	125,100	121,700	-6.9%
Newham	189,500	181,200	175,800	-7.2%
Tower Hamlets	172,400	164,900	160,100	-9.3%
Waltham Forest	176,100	168,700	163,700	-7.0%
Greater London total	6,643,300	6,413,300	6,307,200	-3.5%

Source: TfL Planning Strategic Analysis, based on data from Kings College London.

For Nitrogen Oxides (NO_x), table 8.13, the growth boroughs contributed 15.6 per cent of London's total road traffic NO_x emission in 2012. All growth boroughs saw double-digit reductions between 2010 and 2012, this largely paralleling the Greater London trend, and primarily reflecting the infiltration of vehicles built to higher (cleaner) Euro emissions standards over that period.

For particulate matter (PM_{10}), table 8.14, the growth boroughs contributed 15 per cent of London's total road traffic PM_{10} emissions (vehicle exhaust emissions only – PM_{10} also arises from tyre and brake wear). The pace of reduction for PM_{10} has been appreciably faster than that for NO_2, as vehicles built to higher Euro emissions standards are known to have reduced PM_{10} emissions more effectively than NO_x. Reductions for the individual growth boroughs were about, or slightly higher than, the average Greater London reduction of 22 per cent.

Table 8.13 Olympic growth boroughs - emissions of nitrogen oxides (NO_x) from road traffic, 2010-2012.

Source	2010	2011	2012	% change 2010-2012
Barking and Dagenham	495	458	437	-11.7
Greenwich	758	698	659	-13.1
Hackney	513	474	453	-11.7
Newham	684	622	586	-14.3
Tower Hamlets	634	584	557	-12.1
Waltham Forest	592	542	509	-14.0
Greater London total	23,361	21,644	20,535	-12.1

Source: TfL Planning Strategic Analysis, based on data from Kings College London.

Table 8.14 Olympic growth boroughs - emissions of particulate matter (PM_{10}) from road traffic, 2010-2012. Vehicle exhaust emissions only.

Source	2010	2011	2012	% change 2010-2012
Barking and Dagenham	12	11	9	-23.5
Greenwich	19	17	15	-22.7
Hackney	12	10	9	-25.1
Newham	17	15	13	-24.6
Tower Hamlets	17	14	12	-25.3
Waltham Forest	16	14	12	-22.9
Greater London total	599	525	467	-22.0

Source: TfL Planning Strategic Analysis, based on data from Kings College London.

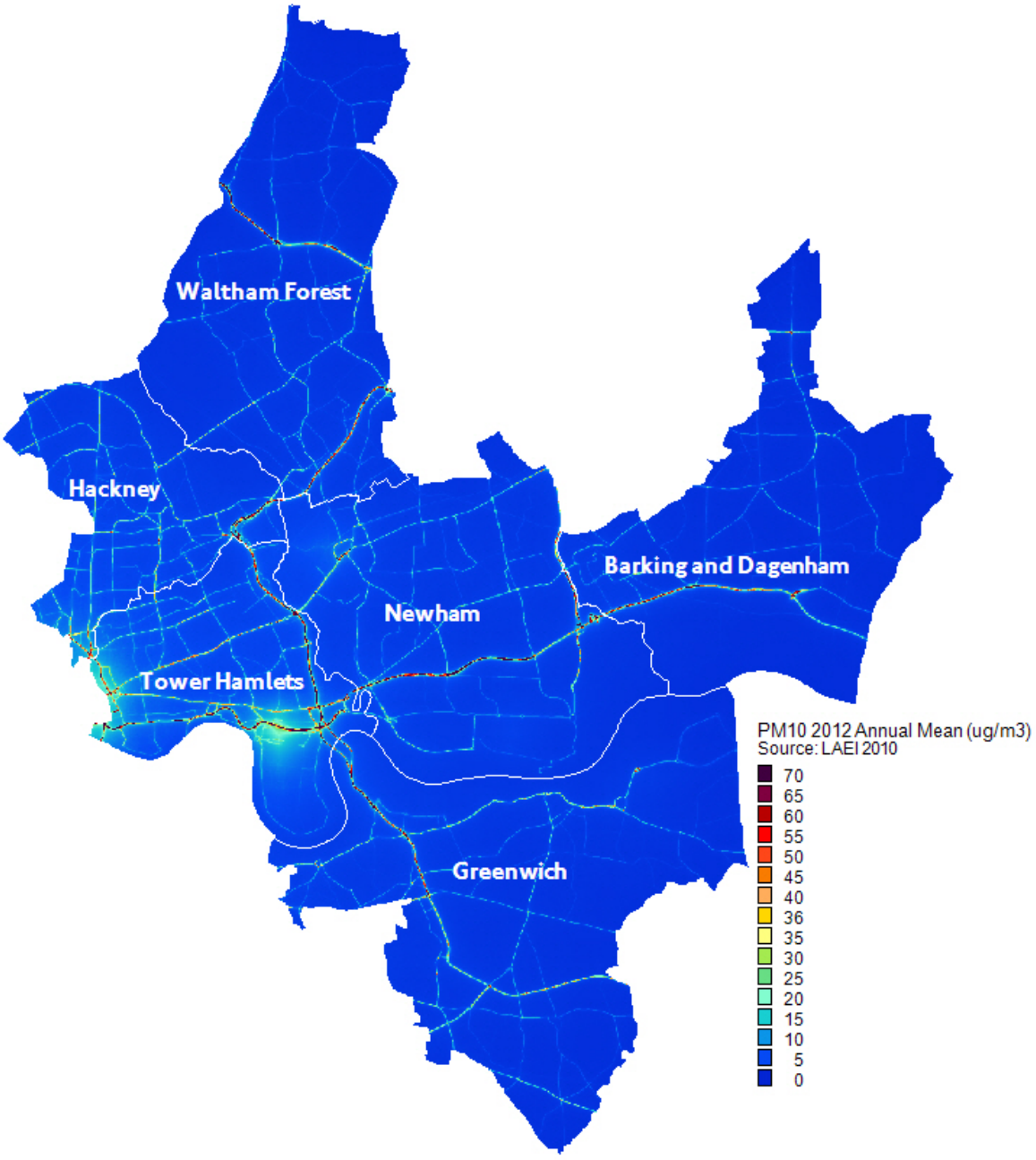
Pollutant concentrations - modelled

Outputs from air quality models allow an assessment to be made of pollutant concentrations across large areas, taking into account emissions from all sources (not just road traffic), and other factors such as the formation of secondary pollution through chemical reactions in the atmosphere, and the 'importation' of pollution from sources elsewhere.

A general picture of contemporary air quality in the growth boroughs can thus be gained through the maps at figures 8.17 (for PM_{10}) and 8.18 (for NO_x). The patterns for both pollutants clearly identify the road network, showing the importance of road traffic to local pollution concentrations. Major roads such as the A12, running southwards to the river, are clearly visible, as is the North Circular Road. The Lea Valley – including large areas of predominantly open space, is also an obvious feature of the maps, as is the general tendency for concentrations of pollution to increase with proximity to central London – as the density of traffic and other activities increase.

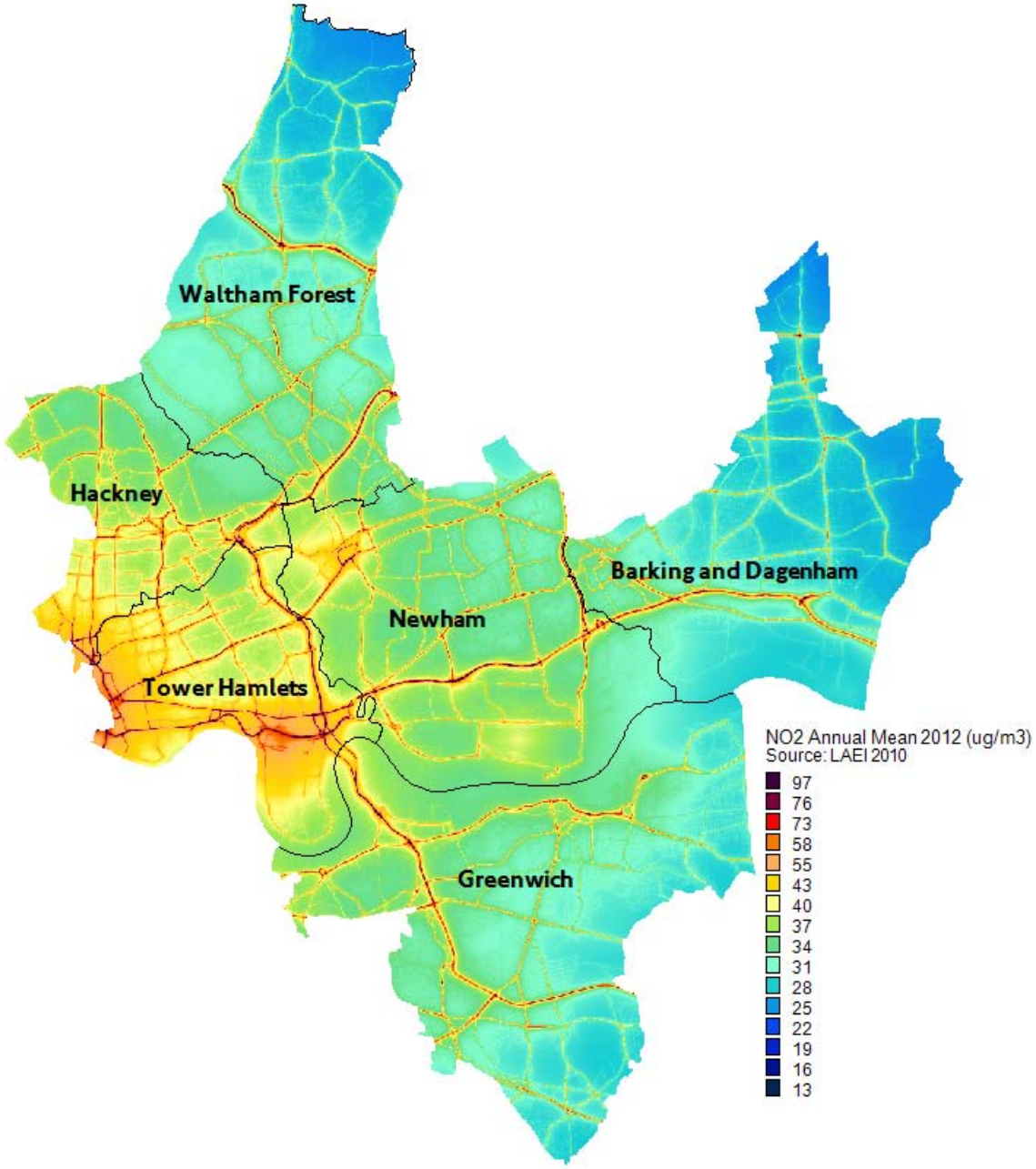
These patterns are however broadly representative of patterns in other quadrants of London. In terms of meeting EU limit values [18] for concentrations, the growth boroughs also share common features with other parts of London. So, the maps show that PM_{10} limit values (specifically the 'daily mean concentration value') are generally met across the entire area, although it is important to note that in public health terms, there is no 'safe' level for PM_{10}. By contrast, exceedances of the NO_2 limit value are seen to be widespread over the area, focusing on the area in the immediate vicinity of busy roads, but also becoming more widespread with increasing proximity to central London.

Figure 8.17 Olympic growth boroughs – representative concentrations of PM_{10} in 2012 (all sources). Annual mean concentrations.



Source: TfL Planning Strategic Analysis, based on data from Kings College London.

Figure 8.18 Olympic growth boroughs – representative concentrations of NO_2 in 2012 (all sources). Annual mean concentrations.



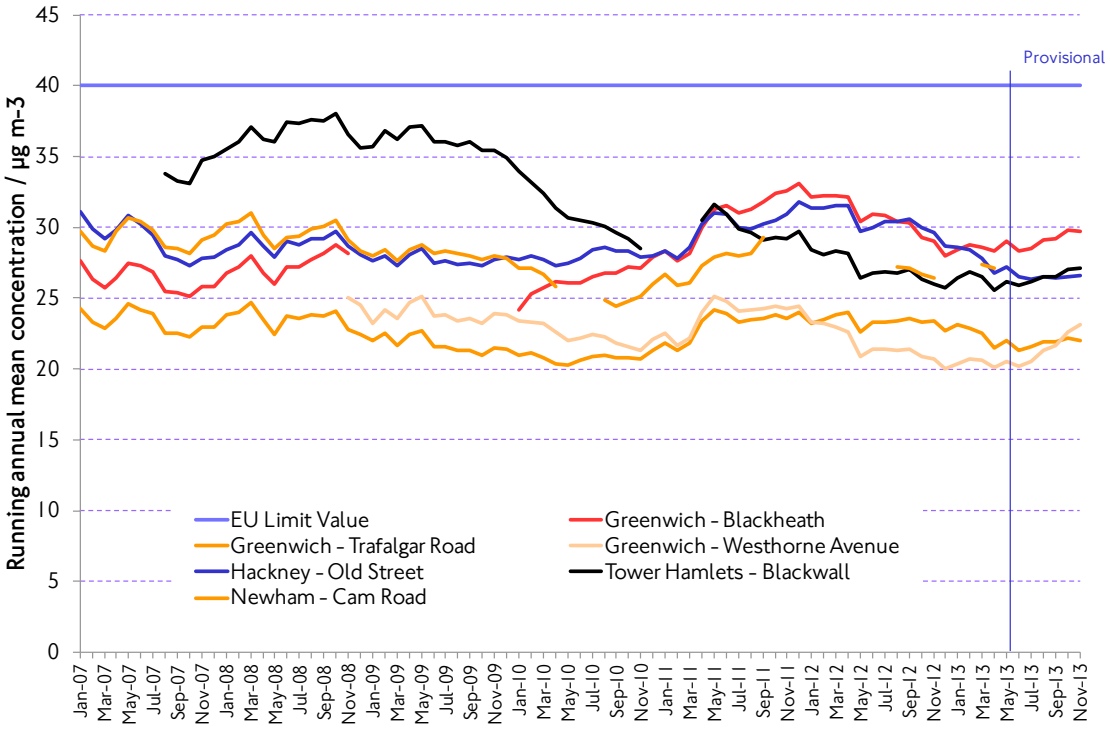
Source: TfL Planning Strategic Analysis, based on data from Kings College London.

Pollutant concentrations – ambient/measured

Concentrations of these two pollutants, which have adverse effects on human health, are measured at a number of sites, sponsored by the London boroughs, and collated through the London Air Quality Network (LAQN [19]). Figure 8.19 shows the long-term trend for particulate matter (PM_{10}) at available roadside sites in the six boroughs. It is seen that concentrations (on a running annual mean basis) are below the EU limit value, shown by the blue horizontal line, and have declined slowly overall across the period covered. It is interesting to note, as commented on in

Travel in London report 5, that it is not possible to see any specific effects from the actual Games themselves in summer 2012.

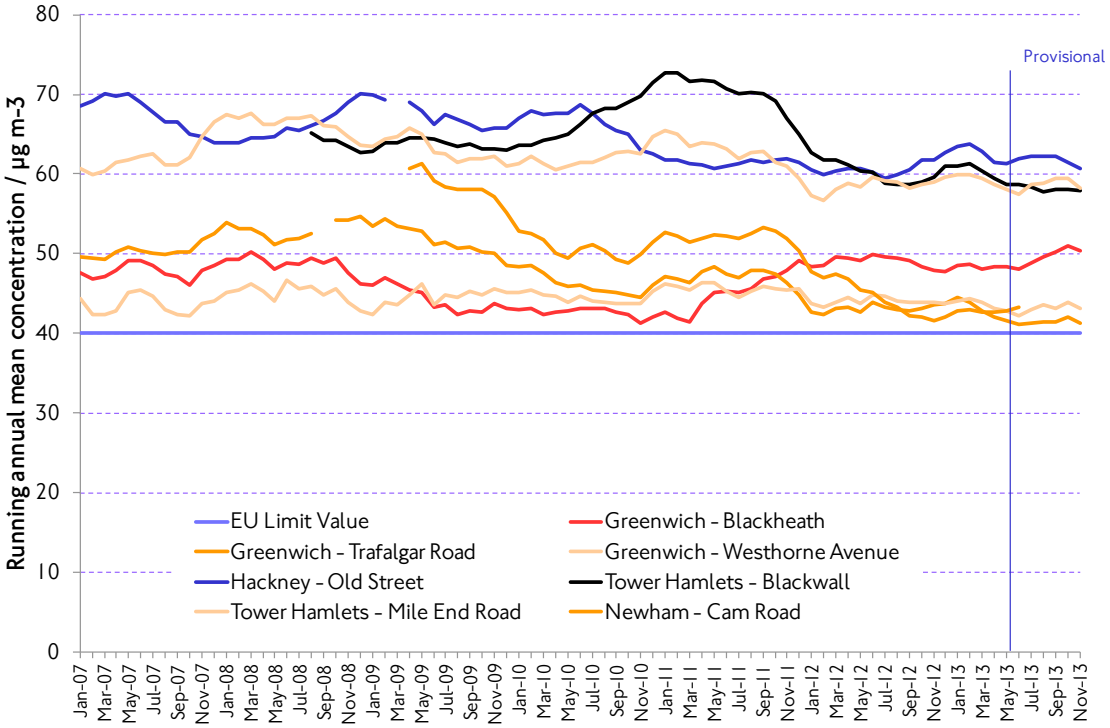
Figure 8.19 Running annual mean concentration of particulate matter (PM_{10}). Air quality monitoring sites in Olympic growth boroughs area.



Source: TfL Planning Strategic Analysis, based on data from Kings College London.

Figure 8.20 shows the equivalent trend for nitrogen dioxide (NO_2), at available roadside monitoring sites across the six growth boroughs. Here, concentrations are generally above the applicable EU limit value (blue horizontal line). While overall the trend is one of slow decline over the review period, in common with similar sites throughout the rest of London, there is still much to be done before EU limit values can be achieved. Growth in this area over the coming years could make this harder than in other parts of London, and future analyses should reveal if there are differential adverse trends in the growth boroughs that suggest this is the case.

Figure 8.20 Running annual mean concentration of nitrogen dioxide (NO_2). Air quality monitoring sites in Olympic growth boroughs area.



Source: TfL Planning Strategic Analysis, based on data from Kings College London.

8.12 Summary and conclusions

The legacy of the 2012 Games is multi-faceted and long-term. At its core it is directed towards achieving social and economic convergence between the six Olympic growth boroughs and the rest of London. Transport will be a major facilitator of this, most obviously by providing for the anticipated population and economic growth and providing access to opportunities and services for those who live and work in the area. A number of other specific transport goals were also set as part of the 'transport legacy', including aspirations to increase the participation in 'active travel', such as walking and cycling, in the area.

This chapter has set out an extended baseline of quantitative indicators that will be used to track achievement of these goals over the coming years. While it is too early to see obvious effects subsequent to the actual Games themselves, many elements of the enhanced transport networks in the area are already in place. The beneficial effects of expansion of the Docklands Light Railway, for example, in providing for growing demand can clearly be seen in double-digit annual increase in patronage (see section 3.5 of this report).

By and large quantitative indicators of social and economic well-being and travel behaviour primarily reflect the unique social and geographical context of each borough. While it is certainly evident that the growth boroughs are relatively disadvantaged economically, it is not necessarily the case that travel behaviour differs from what might otherwise be expected, given the geographical context, or is in any sense 'bad', given the recent infrastructure investment in the area, although more recent improvements will take time to become apparent in the data.

Rates of car ownership and use are relatively low, for example. Children resident in the growth boroughs are already significantly more likely to walk than other children in London. However, this is probably more reflective of social and economic conditions, rather than any positive desire (in terms of these pre-Games baseline measurements at least) to walk more to improve health. Tracking relative change, looking for differential change in these indicators against 'control' areas in other parts of London, and understanding the wider context of growing population and economic activity will be key to understanding the developing legacy in future years.

TfL's new cordon surveys of the OLSPG area and Olympic Park will certainly help understand the dynamic of this unique and rapidly changing part of London. While of largely intrinsic interest at this stage, interpreting change over the coming years will be key. Customer satisfaction and perception-based indicators of aspects of the transport system and the wider urban realm, alongside other indicators of environmental quality – such as air quality and, potentially, indicators relating to aspects such as road congestion, will act as an important check in the context of this area where rapid and extensive development is expected, to help ensure that this development is not at the expense of general quality of life.

Notes and references

(1) http://www.growthboroughs.com/convergence/

(2) http://www.london.gov.uk/sites/default/files/leaving-a-transport-legacy.pdf

(3) http://www.bexley.gov.uk/CHttpHandler.ashx?id=94&p=0

(4) https://www.gov.uk/government/publications/the-olympic-and-paralympic-legacy-inspired-by-2012

(5) http://www.tfl.gov.uk/assets/downloads/london-2012-transport-legacy-one-year-on-report.pdf

(6) http://www.tfl.gov.uk/assets/downloads/corporate/travel-in-london-report-5.pdf. See chapter 10.

(7) http://www.tfl.gov.uk/corporate/media/newscentre/archive/28847.aspx

(8) http://www.tfl.gov.uk/assets/downloads/corporate/olympic-legacy-personal-travel-report.pdf (for adaptations to personal travel)

http://www.tfl.gov.uk/assets/downloads/corporate/olympic-legacy-freight-report.pdf (for adaptations by businesses and for deliveries)

(9) http://data.london.gov.uk

(10) http://www.tfl.gov.uk/assets/downloads/delivering-a-road-freight-legacy.pdf

(11) http://www.tfl.gov.uk/assets/downloads/travel-in-london-report-4.pdf. See chapter 5.

(12) See, for example: http://www.tfl.gov.uk/assets/downloads/corporate/technical-note-12-how-many-cars-are-there-in-london.pdf

(13) When a trip involves more than one form of transport, 'main mode' is defined as the mode for which the longest distance is travelled as part of that trip. So, for example, a trip involving walking from home to a station nearby, taking a

train into town, and walking a short distance from the central station to a workplace, would have a main mode of rail.

(14) See, for example: http://www.tfl.gov.uk/assets/downloads/corporate/central-london-peak-count-supplementary-report.pdf

(15) http://www.london.gov.uk/priorities/planning/publications/olympic-legacy-supplementary-planning-guidance

(16) See Travel in London report 5, pages 109-110 for a description of how TfL measures and interprets these customer satisfaction scores.

(17) https://www.london.gov.uk/priorities/environment/clearing-londons-air/air-pollution-and-public-health

(18) See, for example, the Mayor's Air Quality Strategy, page 8: https://www.london.gov.uk/sites/default/files/archives/Air_Quality_Strategy_v3.pdf

(19) http://www.londonair.org.uk/LondonAir/Default.aspx

9. Monitoring progress towards the Roads Task Force vision for London's roads and streets

9.1 Introduction and content

The Roads Task Force (RTF) was set up by the Mayor in July 2012 to consider the challenges facing London's roads and streets. Its report, 'The Vision and Direction for London's Streets and Roads' was published in July 2013 and sets out a comprehensive new vision for London's roads. TfL simultaneously published a response that sets out the approach that TfL, as strategic highway authority for London, will take to implement the RTF's recommendations. Both reports can be found at: http://www.tfl.gov.uk/corporate/projectsandschemes/28187.aspx.

This chapter focuses on how TfL will monitor the implementation of the various measures proposed in the RTF report, and assess the success of these initiatives over the longer term. The aim of this work is to arrive at a set of monitoring indicators, to be measured in future years, along with the supporting data and intelligence that underlie them, that will enable stakeholders to take stock of progress, and that will provide genuine on-going insight to help refine the policy approach for London's roads and streets over the coming years.

As just a few months have passed since the reports were published, the emphasis of this chapter is on setting out a broad analytical approach, drawing where possible on existing sources of information, and on shaping proposals for the longer-term monitoring of those aspects of the RTF vision that require new monitoring initiatives. This chapter therefore takes forward the proposals set out in annex 1 of the RTF report – 'Checking things are on track'. The monitoring approach will be developed in collaboration with key stakeholders over the coming year. Progress towards these goals will be reported as appropriate in future editions of TfL's Travel in London reports.

Figure 9.1 Roads Task Force report and TfL's response.

9.2 The Roads Task Force vision for roads and streets in London

Context

London's road network is the backbone of the transport system, directly supporting 80 per cent of passenger journeys and more than 90 per cent of freight movements in the Capital, and playing at least some role in virtually all journeys. London's roads also account for around 80 per cent of public space in the Capital.

London's population is expected to increase to circa 9.8 million by 2030, a higher figure than that envisaged only a year or so ago, bringing with it increased demand pressures to a network facing both historic capacity constraints and a wide and increasing range of public realm priorities. These different priorities require a new approach to managing London's roads.

The RTF vision

The RTF report clearly articulated the challenges facing London's roads, highlighting the need to address traffic congestion and meet growing demand for travel whilst accommodating more walking, cycling and the provision of better public space. The RTF vision therefore focuses on three core aims:

- To enable people and vehicles to move more efficiently on London's streets and roads.
- To transform the environment for cycling, walking and public transport.
- To improve the public realm and provide better and safer places for all the activities taking place on the city's streets, and provide an enhanced quality of life.

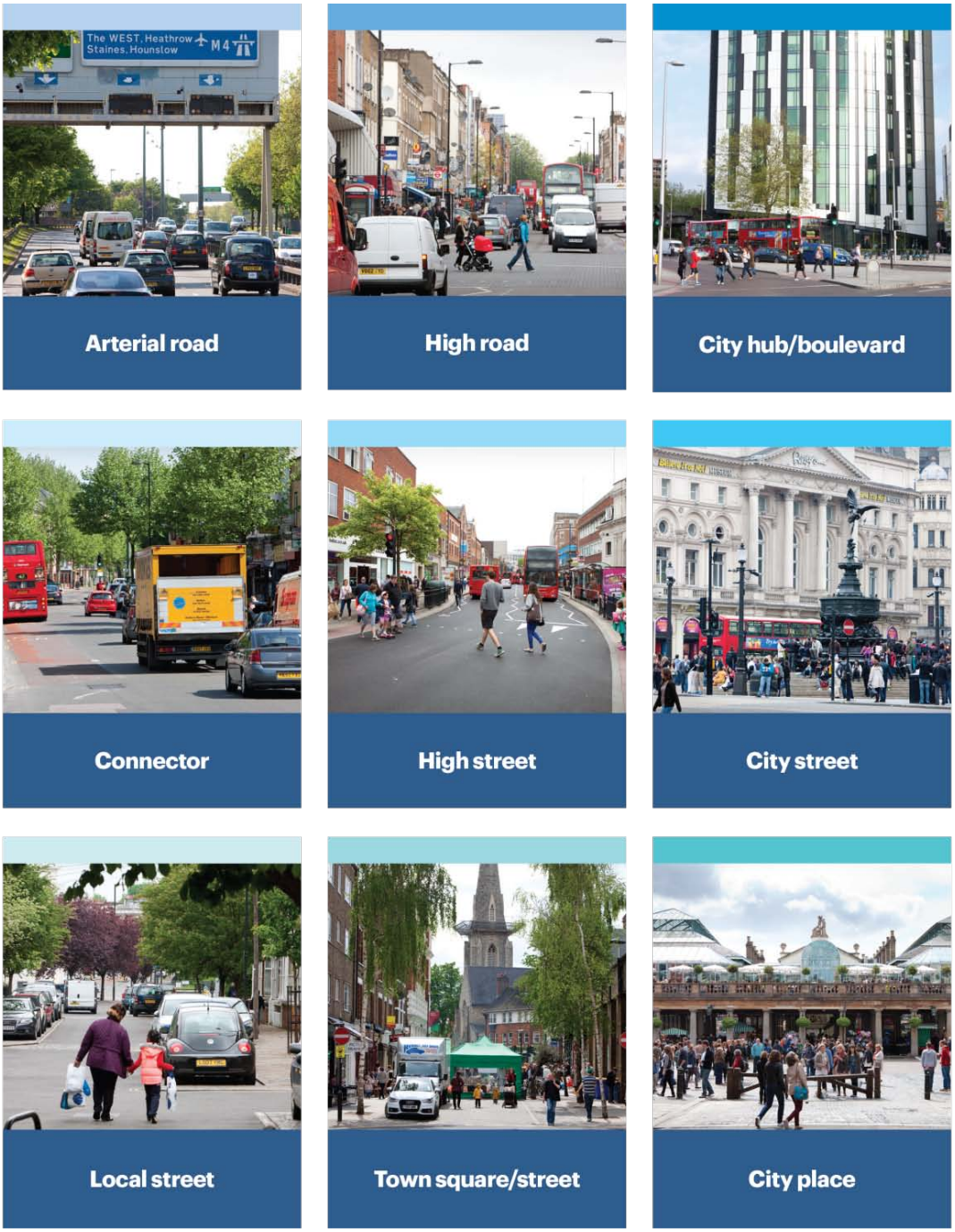
Achieving this difficult balance will require new approaches and a sharper focus on optimising the role of individual roads and streets to operate better in their own particular contexts.

The Streets Family and Toolbox

Key to addressing these challenges is the identification of street types for classifying London's roads, together with a 'toolbox' of improvement measures that could be applied to roads across the types according to present and anticipated future needs. The street types recognise and facilitate the idea that individual roads can serve different priorities at different times, potentially enabling London's roads to 'work harder' to meet the diverse requirements placed on them.

The RTF recognise nine street types. These are identified in figure 9.2, which also provides a visualisation of each.

Figure 9.2 Visualisation of the RTF street types.



Functions for London's roads

The six broad 'functions' that London's roads need to perform are described in the RTF document. They are:

- **Moving:** Efficient and reliable movement, supporting access for people and goods.
- **Living:** Inclusive streets and neighbourhoods, vibrant town centres and world class places.

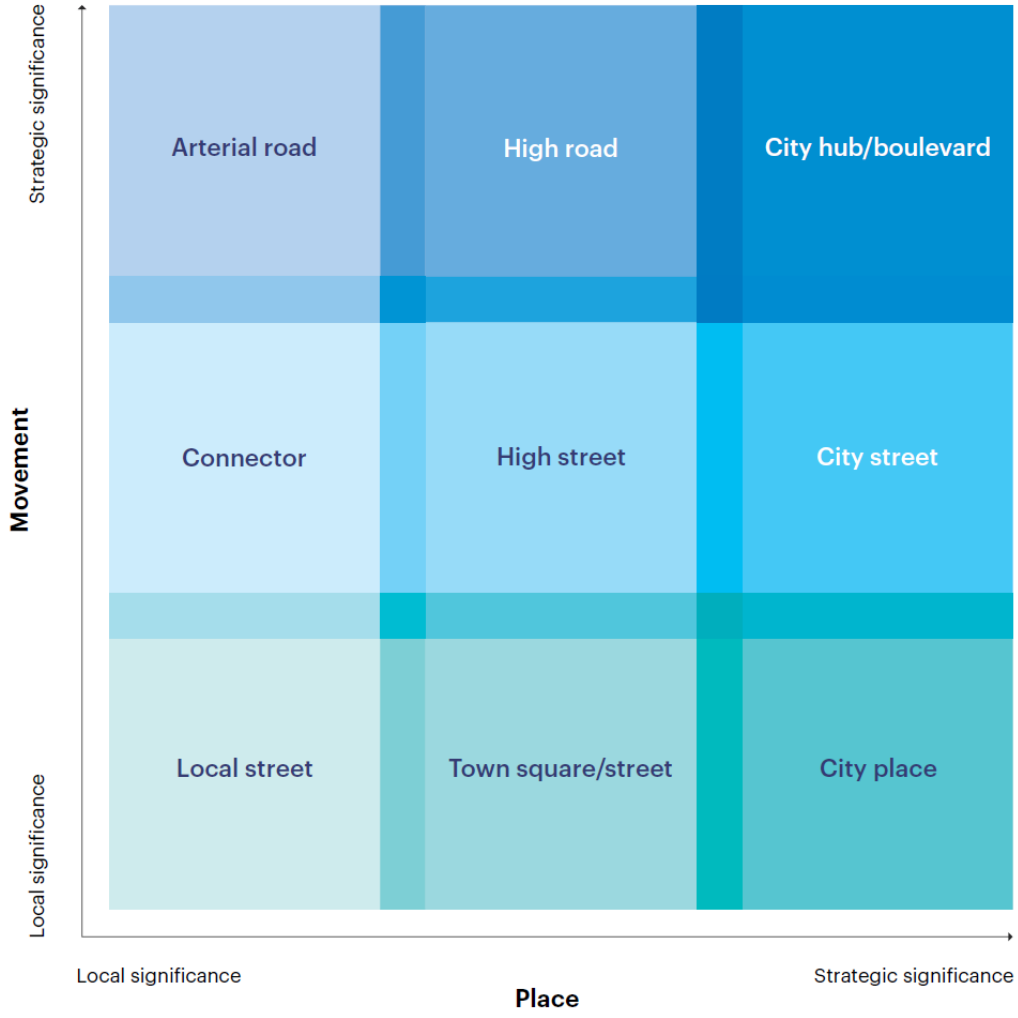
- **Unlocking:** Accessibility/connectivity to growth areas and enhanced development potential.
- **Functioning:** Essential access to frontages for loading and 21st century utilities.
- **Protecting:** Safer and secure streets, particularly for vulnerable users.
- **Sustaining:** Greener, cleaner, quieter streets and a healthier, more active city.

How the tools will be used to better provide for the RTF functions in the context of different street types

Conceptually, each of the street types can be associated, to differing extents, with each of the above functions. For any particular street type, some of the functions will be more important, in that context, and others less important. For example, policies for arterial roads would typically focus on the 'moving' function; those for city places would typically focus on 'place' functions such as living or unlocking. Functions such as protecting and sustaining are of more general applicability.

It follows that London's roads can be allocated to street types on the basis of current or, where change is required, future characteristics. This leads to the definition of priorities for improvement in each case, and the identification of measures in the toolbox to either improve current functioning (the majority of cases), or move towards the preferred future role for that road (where change is required). This idea is illustrated by figure 9.3.

Figure 9.3 RTF movement/place classification of roads.



A long-term vision and strategy for London's roads and streets

The timetable of the RTF vision is long-term - up to 2031 and beyond - with visible progress expected by 2020, and with an estimated total cost of circa £30bn.

9.3 Principles underlying the monitoring programme

The following section sets out some of the basic guiding principles that will underlie the development of a monitoring programme. Results from the monitoring will be reported in future editions of Travel in London reports.

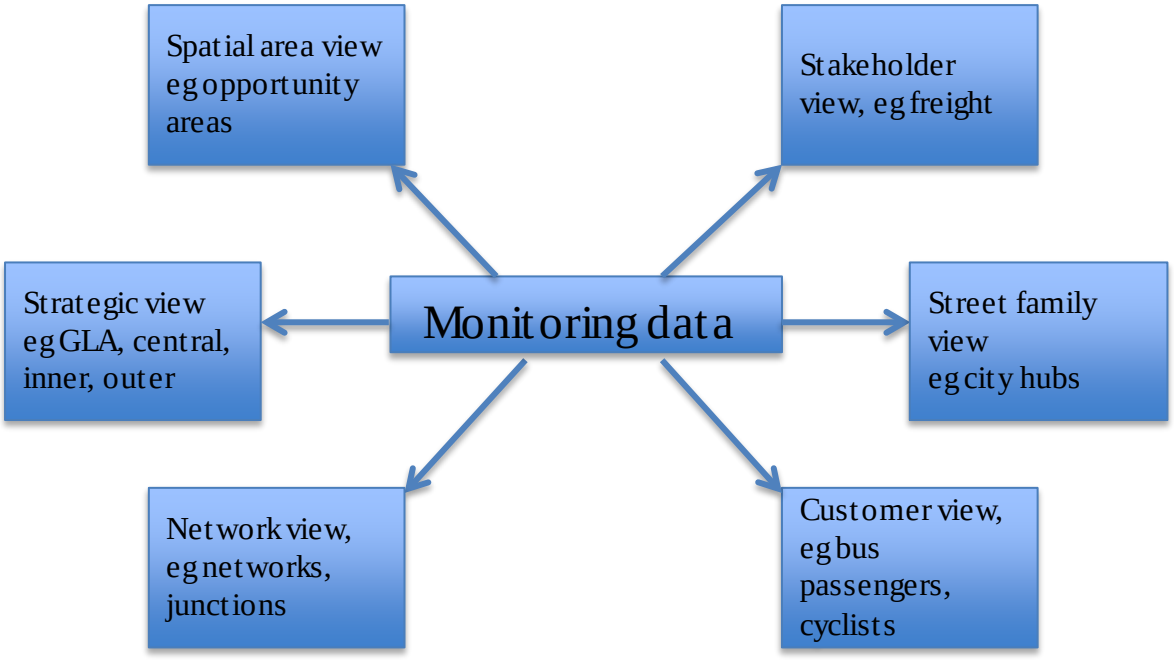
The monitoring requirement The RTF report outlined the requirement to monitor progress towards RTF goals (annex 1). It envisaged a collaborative monitoring approach between TfL and the London boroughs, looking both at the effectiveness of specific measures and progress towards the overall vision. This is to be supported by a programme of research to improve the understanding of road user behaviour, their perceptions and their needs, and their likely responses to a range of interventions.

Definition of service levels for different roads – current and future. The process for taking the RTF vision forward will involve the definition of appropriate 'service levels' for different parts of the road network, according to street type. Different parts of the road network will then be assessed in terms of how well they meet their functional requirements, before identifying what changes are required to help achieve the vision for that particular road. The indicators and data used for this 'definition' phase would typically be a subset of those used for the longer-term monitoring of outcomes.

Since RTF interventions will be guided by the street types, **the monitoring should seek to identify the achievement of the desired outcomes by street type**. For each street type, the RTF report identifies a set of 'priorities' applicable to that group, and also a set of provisions for other users (referred to here as 'secondary priorities'). These effectively represent the balance that is being sought in each street type context, and can be thought of in terms of quantifiable outcomes to which monitoring indicators should be aligned. Table 9.1 sets out these RTF priorities by street type, and gives examples of proposed indicators that would be aligned to each.

The RTF work will require new views of traditional monitoring data. Established 'views' of monitoring data, such as traffic levels, relating to traditional geographies such as central, inner and outer London, or road networks such as the Transport for London Road Network (TLRN) will need to be supplemented by new 'views' that are better aligned to RTF requirements. This idea is illustrated by figure 9.4, which shows a central repository of data that can be organised on the basis of six (or more) different 'views', including views that accommodate customer and stakeholder interests. Organising the monitoring work to align with street types (in terms of things like sample size and coverage) will be crucial, so that differential change between street types can be identified, that would reflect the differential application of Toolbox policies in each case. This should allow an approach to be made to an overall assessment of RTF policies at the strategic or London-wide level. For example, has an intensification of the predominant characteristics of key road links led to an increase in overall network impedance for general traffic, with implications for levels of traffic congestion?

Figure 9.4 Six conceptual 'views' at which a core set of monitoring data can be organised and analysed.



Potentially, these requirements could imply significant re-working of existing road network and related monitoring in London, although new technologies such as mobile phone data and SCOOT traffic control technology are increasingly able to resolve effects at the level of the individual road link, and thus this requirement aligns well with the technical progress of monitoring methodologies.

The monitoring should make full use of existing data sources where possible, and should relate closely to other related monitoring work within TfL and elsewhere. This is a prerequisite, given the limited funds available for new monitoring initiatives. These limitations will mean that it is not possible to meet 'ideal' monitoring requirements in each case, and a key imperative will be to maximise the value derived from information that is already collected. Cost-effective solutions will be sought for new monitoring requirements identified, and the use of third-party data, for example that held by the London boroughs, will be maximised.

RTF monitoring also needs to be aligned to similar monitoring underpinning related initiatives, such as the Mayor's Vision for Cycling. The 33 London boroughs would potentially have a large role in the case study elements of the monitoring, and it is important that mutual interest in this work is maximised. Defining and exploiting these organisational and stakeholder synergies will therefore be a priority.

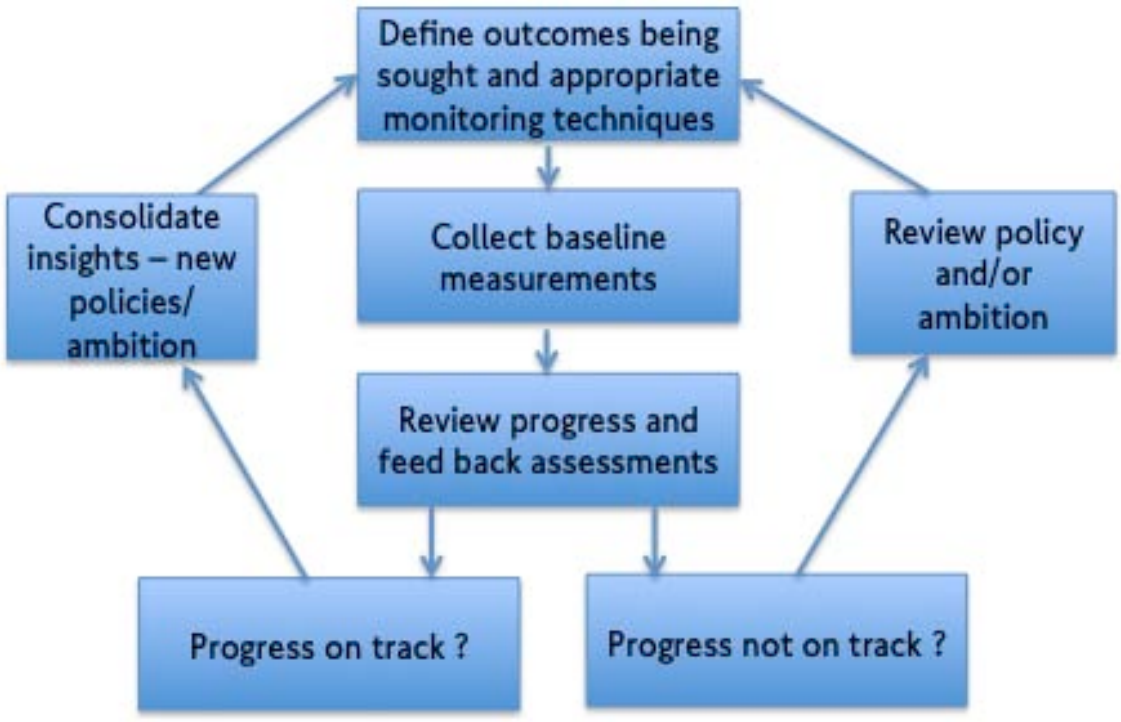
What will 'success' look like and how will we know whether it is being achieved or not? TfL's response summarises expected progress under each of the six 'functions' of London's roads, albeit often in qualitative terms and from TfL's own perspective. These expected outcomes, along with the priorities in table 9.1, taken from the RTF report (annex 2) can be taken as a starting point for defining a set of indicators that would have sufficient discriminatory or explanatory power to track

and describe progress against these outcomes with an appropriate level of statistical confidence.

At the strategic (whole London) level, it is important that the net effect of the different interventions in their different street type contexts are understood, and also the relationship of measured trends to exogenous influences such as the economy, which will in part determine traffic demand levels. At the level of the street type, it is likely that different benchmarks for the quantities being monitored will be 'acceptable', for example, the expectation for traffic speeds or pedestrian footfall on 'arterial roads' would be different to those for traffic in 'city streets'. These 'service levels' are being defined in parallel with the development of the monitoring programme.

The monitoring should focus on 'outcomes', ie the net change in conditions 'on the ground' that are meaningful in the context of people's daily lives. For example, has air quality improved; have road journeys got more reliable; do people feel safer? But it also needs to understand 'inputs', such as incremental infrastructure improvements made by TfL and others, so that the success of specific interventions can be judged. This idea is illustrated by figure 9.5, which describes an iterative process of measurement, analysis/interpretation, policy feedback, policy adjustment in the light of evidence, and so on.

Figure 9.5 The role of monitoring and interpretation in policy refinement.



A set of indicators will be defined and monitored, and a sub-set of key indicators published on a regular basis along with appropriate interpretation of progress. These indicators should be supplemented by a wider body of supporting data and intelligence that would assist with interpreting trends. Case studies would be used to monitor progress with particular aspects of the RTF vision that do not immediately lend themselves to London-wide quantification, such as urban realm improvements in specific locations, or other aspects having a particularly local

dimension, for example freight and servicing facilities in town centres. All of this would be supported by a programme of research to improve the understanding of road users' behaviour, their perceptions and their needs, and their likely responses to a range of interventions.

9.4 The monitoring proposals – overall approach and example indicators

This section summarises TfL's initial proposals for the more quantitative aspects of the RTF monitoring in terms of the framework described above. Travel in London report 7, due to be published towards the end of 2014, will contain an update to these proposals, and will more fully describe and base-line recent trends for the key indicators, as well as the broad analysis plan for the data.

The basic framework for the proposed indicators (below) is organised around the six RTF 'functions'. The key commitments in TfL's response is taken as the basis for illustrating quantitative outcomes that will need to be measured, although a variety of other priorities not explicitly identified in the response also need to be taken into account. Example indicators are cross-referenced, in terms of examples under each heading, to the RTF priorities for each street type, as given in table 9.1.

9.4.1 Moving

'Helping people, goods and services to get from A to B, and enabling efficient and reliable movement by a range of different modes'.

The RTF 'moving' function requires extensive coverage through the monitoring and a relatively large number of example indicators are proposed below. Many of these are covered by TfL's existing monitoring, although not always organised spatially in a way that is appropriate for RTF monitoring needs. It is however important to note that many of these have direct applicability under the other RTF functions. So, for example, classified traffic counts by time of day will give information relating to the relative change in the numbers of cyclists or goods vehicles – key indicators under 'living' and 'functioning' headings respectively. Most of the indicators exemplified in this section therefore have more general applicability across the RTF functions.

M1. Traffic volumes and composition: *The RTF does not set targets or give quantified expectations for the impact of policies on the amount and composition of traffic. Clearly however the policies put forward are likely to affect the total volume of traffic, the composition of traffic, and the distribution of traffic by time of day – particularly by street type. It is crucial that these 'out-turn' effects are clearly understood, since they provide basic evidence with which to understand the 'utility' that is being derived from the road network, even though they are not stated or quantified RTF goals.*

TfL's proposed general approach: TfL already sponsors an extensive programme of traffic counts, and has a good understanding of historic trends. TfL's existing traffic counting programmes will form the basis of RTF monitoring, supplemented where necessary by equivalent counts from third parties such as the DfT and/or boroughs, and where necessary new counts, in order to understand specific trends or issues.

Since different toolbox elements will be applied to each of the street types, it will be necessary to analyse traffic trends separately across each of the street types, in order to understand the differential effects of each of the toolbox combinations (for example, where 'movement' is prioritised). This will require some revision to existing TfL traffic counting programmes, in particular validating the use of

infrastructure such as Split Cycle Offset Optimisation Techniques (SCOOT) loops and number plate reading cameras for extending the geographic scope of traffic volume counts at low cost. Note that movements of specific vehicle types, in particular freight/servicing vehicles and cycles will be characterised in detail through these measurements, so that differential trends resulting from RTF interventions on these modes can be resolved.

The following are **examples of indicators** that can be used for this aspect of the monitoring:

- Total vehicle kilometres in London by vehicle type;
- Traffic volumes or vehicle populations by street type;
- Traffic volumes crossing existing strategic or new local traffic counting cordons, for example around town centres or opportunity areas.

M2. Assets in good state of repair: *By 2021/22 the percentage of the TLRN in a good state of repair will be greater than current levels.*

TfL's proposed general approach: TfL regularly monitors the condition of its assets, which include condition of the road surface, age and performance of traffic control technologies, street lighting etc. Available measures will be reviewed and a small 'core set' of asset condition indicators most relevant to the RTF goals will be identified and reported. The emphasis of this set of indicators would also be aligned to 'liveability' and 'usability' aspects of street infrastructure, for example the condition of pavements and signage, and some development work will be required here to reflect these less-tangible aspects of the street environment.

The following are **examples of indicators** that can be used for this aspect of the monitoring:

- Percentage of TLRN and borough principal road network (BPRN) in a good state of repair;
- Condition of key 'operational' elements of infrastructure;
- Condition of highway authority assets that contribute to the quality and safety of the urban realm;
- People's perception of the quality of streets infrastructure and their assessment of how it contributes to the overall 'liveability' of the street environment.

M3. Tackling congestion: *Congestion, measured as an 'excess delay', will remain a feature of the road network, and is projected to increase in line with population and economic growth. However, gains are expected from better network management and other initiatives, meaning that the road network is expected to be less congested than currently forecast by the Mayor's Transport Strategy.*

TfL's proposed general approach: Traffic speed and congestion in London are relatively well understood, as are the recent historic trends (see, for example, section 4.9 of this report). The primary source of data is GPS-based speed measurements supplied to TfL via the DfT. These data support a relatively disaggregate level of analysis, and they will be supplemented by similar data from London's ANPR number plate reading camera networks, which is particularly useful for looking in-depth at specific corridors.

As with traffic volumes, disaggregate analysis of trends by street type will be important to understand differential impacts resulting from particular combinations

of toolbox measures. Arranging the monitoring in this way could therefore lead to improved understanding of the relationship between the available effective capacity provided by the road network for general traffic, and resulting traffic demand and network performance.

The following are **examples of indicators** that can be used for this aspect of the monitoring:

- Excess delay (minutes per kilometre) for general motorised traffic;
- Average traffic speeds or average journey times for general motorised traffic;
- Bus speeds and reliability.

M4. Improved journey time reliability for general traffic: *It is expected that journey times will become universally more reliable, with 90 per cent of average 30-minute journeys during the AM peak being completed within 35 minutes in 2021/22.*

M5. Improved journey time reliability for walkers and cyclists: *Technology such as pedestrian and cycle SCOOT will help improve journey time reliability for pedestrians and cyclists.*

TfL's proposed general approach: TfL's quantitative measurement for journey time reliability for general traffic has been described and base lined in previous Travel in London reports. This measurement, derived from ANPR number plate reading cameras, currently applies only to the TLRN network and to motorised traffic. The extent of the network covered by cameras should therefore be incrementally increased, particularly on parts of the network that are undergoing substantial change. Public perception of journey time reliability is important, and TfL's established customer surveys will provide several supporting indicators on this, although a review of content to ensure alignment to RTF priorities will be required. Journey time reliability for freight/servicing vehicles will be captured through these measures, looking at aspects such as the reliability benefits of re-scheduling deliveries to outside of peak hours. Further work will be required with freight businesses, probably case-study-based, to explore the impact of these changes on their ability to do business in London.

The following are **examples of indicators** that can be used for this aspect of the monitoring:

- Journey time reliability – percentage of motorised journeys completed within five minutes of a standard average journey time;
- Perception/customer satisfaction-based indicators relating to journey time reliability (for example, ability to accurately predict how long a road journey will take);
- Journey time reliability and related aspects for freight traffic specifically;
- Perception-based surveys of journey time reliability for pedestrians and cyclists (these are not immediately amenable to quantitative measurement);

M6. Bus reliability maintained despite growth in population: *Achieved through a focus on present and future bus reliability pinch points. However, indicators of the wider role and operation of the bus network will also be important to understand the key role of the bus in achieving the RTF vision.*

TfL's proposed general approach: The role of the bus in meeting London's transport needs will continue to be understood using largely existing sources,

covering service provision, patronage, journey times and journey time reliability. Examples of these measures and the historical trends applicable to each can be found in chapter 3 of this report. As with traffic volumes and congestion, it will be important to look at differential trends for aspects of bus operations across each of the street types, and differentially against those for other vehicular modes, for example reflecting modal priority measures, which may require some realignment of the existing bus monitoring data.

The following are **examples of indicators** that can be used for this aspect of the monitoring:

- Bus service provision (vehicle or place kms);
- Bus patronage and mode shares;
- Accessibility/connectivity provided by bus network;
- Physical accessibility of the bus network;
- Bus reliability (excess waiting time etc.);
- Customer satisfaction with aspects of bus services.

M6. Higher cycling and walking mode shares: *By 2021/22 TfL expect to be well on track to achieving the Mayor's target for cycling to represent five per cent of the modal share in London by 2025. The significant improvements to London's urban realm and streetscapes should encourage more journeys to be made on foot.*

TfL's proposed general approach: TfL has already put in place new and enhanced monitoring to track progress towards the Mayor's cycling target (see section 3.11 of this report). This should prove sufficient for RTF monitoring needs. However, walking is relatively less well understood. It is certainly possible to improve upon current practice for estimating pedestrian volumes and mode shares in specific small areas, and it is expected that new and upgraded pedestrian counting infrastructure will need to be deployed, particularly in connection with local-area case studies.

The RTF Moving function relates to all road network users – not just those in private vehicles. So, in considering the movement capacity provided by the road network, it will be necessary to include suitable measurements of bus passengers and pedestrians, alongside estimates of average occupancies for private vehicles. Quantifying these aspects requires different methodologies to conventional traffic counts, for example the use of mobile telephone data to estimate pedestrian flows. The following are **examples of indicators** that can be used for this aspect of the monitoring:

- Cycle volumes and share of all journeys, of road traffic and of total people throughput;
- Pedestrian volumes and mode shares (as appropriate), for example, footfall-based indicators;
- Bus occupancy and origin/destination measurements;
- Average vehicle occupancies;
- Destination-based surveys of characteristics of travel/mode used to get to location.

M7. Improved walking and cycling environment and improved perception of the journey experience: *Improvement in how customers perceive aspects of their*

journeys by road will be an important indicator of the overall success of RTF initiatives.

TfL's proposed general approach: TfL's customer surveys include several indicators relating to how road users perceive their journey experience. These allow segmentation by mode (for example, car drivers, cyclists, pedestrians) and socio-demographically. The content and coverage of these surveys will be reviewed and aligned with the specific requirements of the RTF monitoring. These will form important indicators for interpreting the wider results from the monitoring. A realignment of existing indicators, to facilitate monitoring of customer satisfaction by 'users' of the various street types, will be explored.

The following are **examples of indicators** that can be used for this aspect of the monitoring:

- Perception/customer satisfaction-based indicators of the cycling environment, for example, safety, facilities, etc;
- Perception/customer satisfaction-based indicators of the pedestrian environment;
- Perception/customer satisfaction-based indicators of road users behaviour (different modes);
- Perception/customer satisfaction-based indicators of the overall quality of the road travelling environment – in particular by different user groups;

9.4.2 Living

'Providing welcoming and inclusive places for all which support vital economic, cultural and community activities'.

This section sets out proposed indicators that are particularly aligned with the RTF 'living' function. Indicators described under other RTF functional headings, particularly 'moving' (above) will also have applicability here.

L1. Streets that are welcoming and accessible for everyone: *The application of 'better streets' guidelines, improved design and a commitment to ensure that 95 per cent of all bus stops are adapted for mobility needs by 2016 will help create a more attractive, less cluttered and inclusive environment for all users.*

TfL's proposed general approach: Improving the 'liveability' of London's streets will require significant and diverse infrastructure investment. In terms of outcomes, the most appropriate indicators are those that monitor customer perception of/satisfaction with these aspects of transport in London. TfL's customer surveys already provide many measures that will be of interest. Examples of these indicators include: overall satisfaction with streets in London and satisfaction with specific aspects of the street environment, for example the provision of signage and the condition of pavements. These existing indicators will be reviewed and supplemented as necessary. However, it will also be necessary to keep careful track of 'inputs', ie investment in improvements and assets, and track through the impact that this has on levels of customer satisfaction. An indicator will be developed to quantify the increasing use of streets as a venue for public events, as specifically envisaged by the RTF.

L2. Revitalised/new city destinations: *Improved urban realm design placing sustainable modes of travel at its heart will ensure that residents and visitors are*

able to access and enjoy town centres and other destinations currently dominated by private vehicular traffic.

TfL's proposed general approach: This element of the monitoring does not lend itself particularly well to quantified, strategic-level indicators, principally because each improved city destination will be unique. The approach will therefore be based on exemplification through case studies, with appropriate 'control' locations, of destinations where specific improvements have been made. In each monitored location, more readily quantifiable aspects such as high street performance (for example, footfall), property values and aspects of customer perception of the urban realm (focusing on accessibility, cohesion, quality and liveability) will be used to develop an understanding of relative performance and relative improvement, given the nature of the inputs (interventions) in each case.

The following are **examples of indicators** that can be used for this aspect of the monitoring:

- Existing perception/customer satisfaction based indicators of quality of urban realm - including all people, not just those who currently use the streets – reviewed and supplemented as appropriate.
- Traffic volumes (all aspects), as described above;
- Mode shares for travel to specific locations;
- Perceptions of businesses and other users of streets relating to quality and liveability aspects;
- Indicators of street activity (non-vehicular);
- Economic performance of health of town centres, for example, footfall, rental voids;
- User perceptions of effectiveness and value for money of infrastructure interventions designed to improve liveability.
- Exemplification of change through case studies of specific locations experiencing significant change.
- Provision of information and ease of way-finding.

9.4.3 Unlocking

'Improving accessibility, connectivity and quality of areas earmarked for major growth to deliver the homes, jobs and new economic sectors that London needs as it grows'.

U1. Better road connections to support housing and commercial development in major growth areas: *The £300m TfL Growth Fund (of which £170m is assumed for the road network) and TfL's work with developers will help support more than 120,000 new homes and more than 250,000 new jobs in major growth areas through new connecting roads, the transformation of new city quarters, and re-creating vibrant, accessible but inclusive town centres and high streets.*

Within the broad category of 'unlocking' it is possible to identify several distinct types, requiring different approaches and potentially leading to different outcomes. The first of these relates to regeneration areas, where improved road connectivity would be an integral part of a package of measures aimed at improving the attractiveness of the area to businesses, residents and other activities. A second type relates to 'iconic new city quarters', which would be 'unlocked' primarily by improving the quality of place. Finally, there are measures in relation to growth

hubs, such as Brent Cross, where improvements to connectivity would be a major facilitator of the growth envisaged.

TfL's proposed general approach: Improvements to road connectivity can be described quantitatively using TfL's roads network modelling tools, and qualitatively in terms of the contribution to facilitating specific developments. However the 'value' of specific improvements, such as their contribution to relative property price trends, and the valuation of urban realm improvements in general, is a more complex topic on which third-party advice will need to be sought to develop appropriate indicators. It is proposed that this aspect of the monitoring will largely be case-study-based.

The following are **examples of indicators** that can be used for this aspect of the monitoring:

- Measures of road network connectivity in relation to new developments;
- Mode share change in 'unlocked' areas;
- TfL's existing quantitative accessibility indicators, adapted for RTF needs as appropriate;
- Indicators of change in aspects of the urban realm that can be valued economically, in relation to improved connectivity and related new infrastructure;
- Measures of retail and other business performance (for example, footfall, jobs, rental yields).
- Exemplification of all of above aspects through intensive case studies of 'unlocked' areas.

9.4.4 Functioning

'Ensuring essential access for deliveries and servicing, and upgrading utilities under the roads, to serve London's growing needs and ensure a digital city'.

Efficient access for freight/servicing and goods facilities for loading and unloading: *Provision of loading facilities and more flexible timing controls will better support delivering and servicing activity in London. By 2021/22 it is the intention of the RTF that a much greater proportion of delivery and servicing activity will be re-timed to avoid busier periods on the road network. Where possible, TfL will seek to encourage the use of alternative modes of transport for freight.*

TfL's proposed general approach: Note that many indicators identified under the 'moving' function above will be applicable to this function, specifically in relation to freight/servicing traffic. The RTF goals sought would be reflected through top-level indicators such as volumes of freight traffic, their distribution across the hours of the day, and mode shares for freight. The first two of these are relatively easily approached by developing TfL's existing traffic counting programmes.

Establishing and tracking mode shares for freight in transit is more difficult, but potentially aligns with another requirement – that of knowing more about how the different types of freight and servicing vehicles are used. These requirements could potentially be approached through a new goods vehicle survey, involving roadside-interview-type methodologies. This would allow observation 'on the ground' of many aspects of goods and servicing practice, alongside how these change in response to specific RTF interventions.

The following are **examples of indicators** that can be used for this aspect of the monitoring:

- Volumes by vehicle type for freight traffic;
- Road freight mode share (road-based);
- New 'freight survey' (details to be defined), looking at aspects of freight operations relevant to RTF concerns, for example timing, length of haul, nature of goods carried, loading facilities provision and usage, etc;
- Through stakeholder engagement and customer surveys, the views/experiences and requirements of freight operators as a road user group.

U2. Good quality visitor parking: *Appropriate development policies will demand adequate parking for accessible and sustainable modes in new developments, including 80,000 new cycle parking spaces by 2016.*

TfL's proposed general approach: Provision of parking in new developments can be monitored directly through the planning process. However, knowledge and data relating to wider aspects of the adequacy of parking more generally and, in particular, its impact on mode choice decisions, is relatively poor. One way of achieving this would be through a new strategic parking survey, focusing on both parking supply as well as demand, relating to the street types and targeting areas specifically undergoing change. The content of TfL's customer perception surveys will also be reviewed to improve the extent to which they can characterise the relationship between parking supply and mode choice, perhaps specifically in relation to town centres and other developments where coherent parking policies will need to be applied.

The following are **examples of indicators** that can be used for this aspect of the monitoring:

- Planning process-based statistics relating to parking provision;
- New surveys relating to parking supply and demand, probably locally-based and specifically in collaboration with the boroughs;
- Cycle parking provision, either in general or in relation to specific locations/developments;
- User-based surveys of specific locations, for example TfL's existing TRAVL surveys, probing relationship between parking supply and mode share.

U3. Modern utility infrastructure and well-managed works: *By 2021/22 the Mayor's road works code of conduct will be well established, with a significant reduction in disruption caused by road works. Improved utility infrastructure should reduce the need for utility access to the road carriageway.*

TfL's proposed general approach: TfL has specifically targeted more efficient and less disruptive utility and other works over recent years. This has resulted in a range of indicators that are currently in use for monitoring these aspects. These indicators would need to be extended to cover the condition of utility infrastructure, in particular its accessibility for maintenance and works.

The following are **examples of indicators** that can be used for this aspect of the monitoring:

- Hours of disruption attributable to utility works;
- Time-of-day based indicators of utility activity;

- Measures of compliance with stated works durations;
- Efficiency-based indicators of utility works (for example, work done by hours of disruption caused);
- Characteristics of utility assets, particularly in relation to accessibility for maintenance.

9.4.5 Protecting

'Improving safety and reducing collisions, particularly for vulnerable users, and ensuring streets where people feel secure'.

P1. Forty per cent reduction in KSIs by 2020: *By 2021/22 London will have achieved its target to reduce the number of KSIs on London's roads by 40 per cent.*

P2. Improved safety for vulnerable users (pedestrians, cyclists and powered two wheelers): Further progress will have been made to reduce the rate of casualties for people walking, cycling or motorcycling in London.

TfL's proposed general approach: Road casualties are comprehensively monitored through TfL's existing procedures (see, for example, section 5.2 of this report). These allow breakdowns by the various types of injury and the modal (vehicle) involvement. Since collisions occur at specific points in space and time, it is also possible to examine trends spatially (for example, by network, location) and temporally (for example, day, night). This feature will allow casualty trends to be understood by street type, such that differential improvements related to the different policy mix in each can be identified. Future updates to this existing dataset should therefore allow both the general trend for casualties, as well as specific aspects such as trends for vulnerable road users, to be comprehensively assessed.

The following are **examples of indicators** that can be used for this aspect of the monitoring:

- Road casualties by mode, severity, location etc;
- Road casualties by users of vulnerable modes;
- Impact of targeted road safety improvements in specific locations;
- Perception-based indicators of road safety (casualty-based).

P3. Streets that feel safe and secure – reduced street crime: *Incidences of crime will be much reduced by 2021/22. In particular, there will be less than eight crimes for every million passenger journeys on or around the bus network. Targeted enforcement will mean more widespread compliance and more considerate behaviour by all road users.*

TfL's proposed general approach: Existing statistics on crime on the road network, including vehicle-related crime, do have shortcomings and the datasets and underlying procedures will therefore be reviewed. Perception-based surveys will be most appropriate for assessing general standards of driver/road-user behaviour and considerateness, and how the public perceive these are changing.

The following are **examples of indicators** that can be used for this aspect of the monitoring:

- Reported crime (all categories);
- Reported crimes (vehicle related offences specifically);
- Perception-based surveys of road user behaviour (all modes).

9.4.6 Sustaining

'Reducing emissions from the road network and supporting greener, cleaner, quieter streets and a healthier, more active city'.

S1. Improved environment for walking and cycling: *The Mayor's target of one million additional walking trips per day by 2031 will be facilitated through various improvement measures, such as Pedestrian Countdown and targeted reductions to speed limits. The significant funding allocated to delivering the Mayor's Vision for Cycling will transform the experience of cycling in London.*

TfL's proposed general approach: Achievement of the Mayor's vision for both walking and cycling will require significant and diverse infrastructure investment, and the connection between this investment and observed trends will need to be properly understood. In terms of outcomes, the most appropriate indicators are those that monitor customer satisfaction with these aspects of transport in London, and TfL's customer surveys already provide many measures that will be of interest. Examples of these indicators include: the perception of London as a 'city for cycling', the satisfaction of cyclists with facilities provided on the TLRN, satisfaction with aspects of the urban realm, including factors such as crime and fear of crime. These existing indicators will be reviewed and supplemented as necessary.

The following are **examples of indicators** that can be used for this aspect of the monitoring:

- Investment in improved facilities for pedestrians (including case study exemplification);
- Investment in improved facilities for cyclists (including case study exemplification);
- User perception of quality of facilities/urban realm – in particular cyclists, pedestrians and businesses;
- Pedestrian footfall and corridor-based measures of throughput.

S2. Reduction in local air quality and carbon dioxide emissions – measured on a person-km basis: *Achieved through developments such as a continued shift to more sustainable transport modes and more bus journeys on an increasingly cleaner bus fleet.*

TfL's proposed general approach: The existing London Atmospheric Emissions Inventory provides good, spatially disaggregate information on pollutant emissions from the various types of road transport, alongside emissions from all other identifiable sources, and these can be readily normalised to a per person kilometre measure using the modal patronage and mode share statistics described in chapter 3.

The following are **examples of indicators** that can be used for this aspect of the monitoring:

- Emissions of key local air quality and greenhouse gas pollutants – NO_x, PM_{10} and CO_2.
- Ambient concentrations of local air quality pollutants.

S3. Reduced impacts of noise: *Quieter fleet and privately owned vehicles will become more commonplace, and there will be increased use of low-noise road surface materials.*

TfL's proposed general approach: It is fairly straightforward to quantify the increased use of low-noise vehicles and road surfaces, but attention also needs to be given to possible countervailing effects such as an increase in deliveries during the night hours and the possible safety implications of low-noise vehicles. This suggests a combination of limited quantitative measurement of noise levels and perception-based surveys of noise should also be used. Disaggregating these measurements by street type will be useful.

The following are **examples of indicators** that can be used for this aspect of the monitoring:

- Fleet penetration of low-noise vehicles and application of low-noise road surfacing;
- Limited measurement of ambient noise levels in selected key locations;
- Indicators relating to the perception of transport (specifically traffic) related noise; and noise related to changed functions of places (for example public events).

S4. More trees and greenery: *The TLRN will be populated with over 1,000 more trees than today.*

General approach: New tree plantings will be recorded annually, alongside an inventory of existing roadside trees.

9.5 Summary of proposed indicators and mapping to service provision for each street type

Table 9.1 below summarises the RTF priorities (ie outcomes) for each street type. Under each, examples of the indicators proposed above are given to illustrate how the monitoring proposals might work to cover each of the priorities. This is not an exhaustive list and, in practice, it is almost universally the case that several of the indicators proposed would be used to monitor and assess progress.

Table 9.1 Key Roads Task Force objectives for each street type and mapping of example indicators.

Street type	Priorities (key service standards)	Secondary priorities	Example indicators
Arterial roads	Reliable vehicular journey times	Reducing severance	• Journey time reliability. • Streets permeability indicator.
	Congestion	Good parallel routes for local traffic and cycling	• Average traffic speeds and delays. • Journey time reliability. • Ability to predict journey times. • Traffic volumes (including walk/cycle) on alternative routes.
	Sufficient capacity for private vehicles and freight	Reducing air quality and noise impacts/more greenery	• Traffic volumes by type. • Vehicle emissions. • Number of trees.
High roads	Reliable journeys for vehicles	Controlled pedestrian crossings at regular intervals	• Journey time reliability. • Streets permeability.
	Bus priority		• Bus reliability. • Bus patronage. • Perception of aspects of bus services.
	Safer, inclusive and higher quality pedestrian environment		• Infrastructure investment. • Customer satisfaction. • Highway asset condition.
	Accessibility of local shops/services for freight		• Traffic volumes (freight). • Changes to aspects of road freight operations.
High streets	A high quality environment for pedestrians, with good, frequent (and informal) crossings	To get the right balance at high streets journey times might increase for some users but this should be offset by increased reliability and improved road safety	• Reported crimes. • Perception of road user behaviour. • Streets permeability index. • Active streets index. • Ease of way-finding. • Bus service reliability.
	Good facilities for service vehicles to ensure that local businesses can easily receive deliveries		• Changes to aspects of road freight operations. • Low noise vehicles/road surfacing. • Traffic volumes by time of day.
	Road safety and a slower speed environment		• Road traffic casualties. • Average traffic speeds. • Traffic volumes.
	Accessibility for sustainable modes, for example buses and cycling		• Traffic volumes. • Bus service reliability. • Vehicle emissions. • Investment on infrastructure.
City hubs and boulevards	Access for buses	Goods vehicles accommodated out of hours as much as possible	• Traffic volumes by time of day. • Low noise vehicles/road surfaces. • Bus service reliability. • PTAL-type connectivity scores.

City hubs and boulevards (continued)	High quality environment for pedestrians and cyclists	Targeted demand management can help ensure that private vehicle trips are high-value/essential trips only	• Footfall. • Reported crimes. • Perception of urban realm. • Traffic volumes by vehicle type and time of day.
	Urban realm to support revitalised city quarters		• Active streets index. • Commercial property values. • PTAL/CAPITAL-type accessibility/connectivity measures. • Measures of retail activity/performance.
	Improved safety and environmental quality		• Road traffic casualties. • Vehicle emissions. • Perception of safety/security.
	Sufficient movement for network functioning		• Traffic volumes. • Journey time reliability.
Connectors	Providing reliable journeys for motorised vehicle journeys	Accessible, safe and well-lit pedestrian routes	• Traffic volumes. • Footfall. • CAPITAL-type accessibility/connectivity indicators.
	Good environment for pedestrians and cyclists	Alternative effective arterial routes for freight	• Traffic volumes, for example, freight, cycle. • Footfall. • Journey time reliability. • Asset condition.
	Reliable bus journeys where bus routes pass through connectors	Greening to enhance environmental quality for residents	• Bus service reliability. • Number of trees. • Streets permeability index.
	Road safety (collisions)		• Road traffic casualties (esp. vulnerable users).
City streets	A world-class public realm	Flexible use of space to cater for demand at different times of the day	• Perception of urban realm. • Reported crimes. • Property values. • Footfall. • Traffic volumes by time of day.
	Free pedestrian movement with the ability to cross the road along desired lines	Diversion of traffic on to more efficient routes	• Streets permeability index. • Traffic volumes by vehicle type. • Traffic speeds and delays.
	Bus priority measures to allow reliable journeys as buses are important to get people to these locations	Provision of coach and taxi access	• Streets permeability index. • Traffic volumes by vehicle type. • Perception of urban realm.
	High footfall and visitor satisfaction		• Footfall. • Perception of urban realm. • Commercial development and property prices.
Local streets	Accessible and safe pedestrian environment		• Footfall. • Crime rates. • Vehicle emissions.

Local streets (continued)	Parking for residents and car clubs/car sharing		• Parking standards, provision and utilisation. • Vehicle emissions. • Infrastructure investment (for example, electric vehicle charging points).
	Providing an environment serving the diverse needs of local residents, including children and older people	Through movement of traffic should be discouraged, with connectors providing better alternative routes	• Streets permeability index. • Footfall. • Commercial/residential property prices. • Traffic volumes, for example, by origins/destinations.
Town squares/ streets	Free pedestrian movement in a good-quality environment	Town squares need to be well-connected to be effective – through good transport facilities at the edges	• Streets permeability index. • Footfall. • PTAL-type accessibility indicators. • Commercial/residential property prices.
	Safe and secure urban environment	Access can be provided through these streets for other modes out of hours	• Perception of urban realm. • Perception of crime. • Road traffic casualties. • Road traffic volumes by time of day. • Pedestrian volumes.
	User satisfaction/footfall	Providing adequate delivery/servicing facilities through inset loading bays, servicing plans and timed access	• Footfall. • Perception of crime. • Freight infrastructure investment. • Vehicle type by time of day.
City places	High quality, safe and secure pedestrian environment	Motorised traffic is not generally catered for in these areas; however provision should be made to allow access for delivery and servicing vehicles, ideally out of hours	• Footfall. • Perception of urban realm. • Traffic volumes by vehicle type. • Traffic volumes for freight. • Traffic volumes by time of day.
	Footfall/ambience/user satisfaction		• Vehicle emissions. • Active streets index.

9.6 Programme of supporting research

The quantitative indicators described above will be supported by a programme of research to improve the understanding of road user behaviour, their perceptions and their needs, and their likely responses to a range of interventions.

An initial view is that understanding of the following areas would particularly benefit from such a programme of research:

- Identifying user groups and their needs, particularly relating both to Movement and Place functions, on the different street types. London is a crowded and challenging road environment. It is important to gain a deeper understanding of how users experience their daily travel on the road network – what does it feel like, and how does this affect their behaviour and choices – to guide the most workable new interventions and give early warning of good ideas that might not

work in practice. We also need to know more about motorcyclists as a group, and the factors that determine people's propensity to use buses.

- Generating innovative policy solutions to recognised issues with London's roads, and also to extract more 'utility' from the road environment and road infrastructure.
- Determining and refining the most appropriate combination of 'toolbox' interventions for different street family contexts – in this respect early feedback from the quantitative monitoring will be crucial. For example, establishing priorities, through evidence, for how space and capacity should be allocated in constrained situations in different contexts.
- Investigating the wider benefits (economic, environmental and social) of improving conditions on different types of streets. Who benefits, what are the relative priorities, how can this be valued? In particular, how and through what perceptual mechanisms do improvements to the urban realm and travel environment for pedestrians and cyclists feed through to changed travel behaviour?