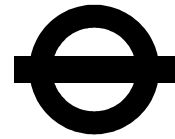


Transport for London



**Analysis of the Transport Programme
to Support the Draft London Plan**

Technical Report

January 2003

MAYOR OF LONDON

The analyses reported here should be seen as broadly indicative of the expected outcomes. The work is based on the current state of knowledge on the timing and content of the transport programme, which will continue to evolve.

Analysis of the Transport Programme to Support the London Plan – Technical Report

Table of contents

0	Executive Summary
1	Background
2	Transport Challenges
3	Programme of Transport Improvements
4	Analysis of Programme Outcomes
5	Conclusions

0 Executive Summary

- This document is a report on the contribution of the programme of transport improvements to support the growth set out in the Mayor's Draft London Plan. Judgements on the consequences of the results of the TfL analyses will be dealt with elsewhere.
- TfL strongly supports the objectives of the London Plan and is committed to playing its part in ensuring the transport system supports London's development.
- The London Plan identifies significant growth in London's population and jobs by 2016, of 10% and 14% respectively. It is estimated that this will lead to an increase in transport demand of over 2 million trips per day by 2016. The central and east London sub-regions experience most of the growth, with over 75% of the additional jobs concentrated in these areas. This will result in more pressure on the most crowded parts of the transport system.
- A programme of transport improvements has been developed which will deliver an increase in rail capacity of 44% and an increase in bus capacity of 50% by 2016. Major new infrastructure projects are a key part of the increase in capacity - Crossrail line 1 will provide two fifths of the additional rail capacity. The transport improvements also improve accessibility to many areas across London, including key regeneration areas such as Thames Gateway.
- Overall, the planned schemes will provide sufficient capacity to support the expected growth in jobs and population in London. They will also provide relief in crowding on sections of the network. The proportion of the rail network experiencing crowded conditions will reduce if the planned schemes are implemented, although some sections of the network will continue to be very crowded. Accessibility is also improved across London.
- If significant elements of the programme of transport improvements, such as Crossrail line 1, are not implemented then crowding on the transport system will intensify compared with current conditions.

1 Background

1.1.1 The draft London Plan (DLP) was launched by the Mayor on 21st June 2002. Transport for London (TfL) was consulted as part of the process and submitted its response to the Greater London Authority (GLA) on 30th September 2002. The main points in TfL's response at the time were as follows:

- TfL strongly supports the objectives of the Plan and the desired outcomes for London. TfL is committed to playing its part in ensuring the transport system is in place to support London's development.
- Without the necessary expansion of services and infrastructure, the expected growth in the London Plan will result in increased crowding and congestion on transport networks.
- A transport investment programme has been identified to support the Plan. It includes five different measures, namely maintenance of the existing system, demand management, improving operations and expanding services, providing local infrastructure including walking and cycling, and major infrastructure projects.
- It was noted at that time that TfL was carrying out transport modelling and analysis to assess the relationship between transport demand and capacity. The results of this analysis are reported in this document.

1.1.2 This document is a technical report focusing on the results of analyses carried out by TfL on the contribution of the programme of transport improvements to support the growth described in the London Plan. Judgements on the consequences of the results of the TfL analyses will be dealt with elsewhere.

2 Transport Challenges

2.1.1 The TfL response to the DLP identified two key transport challenges, namely:

- Having the necessary transport infrastructure and services; and
- Having the necessary resources to deliver the system and implement the programme of improvements.

2.1.2 A key factor underlying the transport challenges is the significant growth in jobs and population that is forecast to occur over the next 15 years. **Table**

1 shows the expected growth in population and jobs in each sub-region. Over 75% of the growth in jobs occurs in the central and east sub-regions. Population growth is spread more uniformly across the sub-regions.

Table 1: Growth in population and jobs in London sub-regions

	Population				Total Employment			
	2001 '000s	2016 '000s	Chan ge '000s	Chan ge %	2001 '000s	2016 '000s	Chan ge '000s	Chan ge %
Central sub-region	1,488	1,648	160	11%	1,644	1,883	237	15%
East sub-region(1)	1,963	2,189	225	11%	1,087	1,336	248	23%
West sub-region	1,395	1,516	122	9%	780	866	87	11%
North sub-region	1,025	1,135	110	11%	386	412	27	7%
South sub-region	1,317	1,439	122	9%	587	623	36	6%
Total London	7,188	7,926	738	10%	4,484	5,120	636	14%

Source: Draft London Plan

(1) The east sub-region includes the City of London and Docklands.

2.2 TRANSPORT DEMAND

2.2.1 Overall, it is estimated that the growth in jobs and population will result in an additional 2 million trips per day across all modes between 2001 and 2016. The growth in trips on each motorised mode of travel in the peak period, and the geographical distribution of trips is shown in **Tables 2 and 3** below.

Table 2: Growth in demand in Greater London on motorised modes, person kilometres in morning peak period 0700-1000 hours, '000s

	2001 (share %)	2016 (share %)	Change
Rail (1)	20300 (46%)	28200 (51%)	39 %
Bus (2)	3500 (8%)	4600 (8%)	31%
Highway (excl. bus) (3)	19900 (45%)	22200 (40%)	11% (see note 3)
Total	43800 (100%)	55000 (100%)	26%

Source: LTS transport model. Assumes implementation of major infrastructure projects.

(1) Rail includes London Underground, Docklands Light Railway and National Rail.

(2) A significant proportion of bus use is outside the peak period. Bus capacity is being assumed to accommodate an overall growth in demand of 50% by 2016.

(3) Previous periods of strong growth in jobs and population, for example in the 1990s, did not lead to a growth in traffic of this scale. Therefore it is considered that the model is being over-sensitive in the way it allocates growth to highway modes (excluding bus) in the morning peak period, and would not reflect effects such as avoiding long commutes by road or peak spreading.

Table 3: Geographical distribution of trips to each Sub-Region in peak period (0700-1000 hours)

	2001	2016	Change
Greater London	4,233,000	4,699,000	11.0%
Central sub-region	1,291,000	1,444,000	11.9%
East sub-region	1,085,000	1,268,000	16.8%
West sub-region	747,000	818,000	9.5%
North sub-region	460,000	488,000	6.1%
South sub-region	648,000	681,000	5.1%

Source: TfL transport model

2.2.2 **Table 3** shows the number of morning peak trip ends, or destinations, in each sub-region in 2001 and 2016. The trip patterns largely reflect the pattern of job locations across London. The central and east sub-regions have the largest number of trip ends in 2001, and are also subject to the strongest growth to 2016. The impact of this growth in demand on the transport system is explored in this report.

2.2.3 A programme of improvements to the transport infrastructure and services over the next 15 years has been developed to improve current conditions and in the light of the forecast increase in demand. The programme of schemes is summarised in **Table 4**. The way in which this programme supports the DLP is examined in this report. This is explored in terms of:

- additional capacity delivered by the transport programme
- the extent to which the additional capacity will accommodate the growth in demand
- impact of the programme on containing crowding to manageable levels
- scale of improvements in accessibility
- extent to which transport capacity and accessibility improvements support the development and regeneration aims of the DLP

2.2.4 This report also addresses the impact of these improvements on the sub-regions and the key opportunity and intensification areas identified in the DLP.

3 Programme of Transport Improvements

3.1.1 The Mayor's Transport Strategy and the DLP set out the transport projects needed to meet the Mayor's objectives. Progress has already been made on many of these projects, whilst other key infrastructure projects are at a pivotal stage awaiting decisions from Government on funding and powers. The programme shown in **Table 4** is a balanced one across modes over the next 15 years, matched to the population and employment patterns. It is an integrated package balancing five different measures, namely:

- maintaining the existing network to a higher standard of reliability and safety;
- managing travel demand and behaviour to make best use of available capacity;
- improving operations and expanding services;
- providing local infrastructure for walking, cycling, and road based travel; and
- providing major infrastructure to increase capacity and accessibility.

3.1.2 **Table 4** includes transport schemes developed by TfL and schemes supported by Government. In its Regional Planning Guidance for the South East (RPG9), the Government noted that improvements to the public transport network were necessary to support its spatial strategy, and identified several of the major transport schemes which were considered to make a significant contribution. These schemes are asterisked in the table.

Table 4: Summary of planned transport improvements

Transport Improvement	Contribution to the London Plan	Status
Maintaining and operating the existing infrastructure network to a high standard of safety and reliability	<ul style="list-style-type: none"> • Supports existing areas and areas of intensification • Improves public transport system reliability across London • Brings the network up to an efficient and reliable level of performance for freight and passenger movements 	On-going. Identified as a priority in TfL Business Plan
Congestion charging	<ul style="list-style-type: none"> • Improves journey times and reliability in central London through reduced road congestion • Improves the vitality and environment of Central London for businesses, tourists and workers 	To be introduced 17 February 2003
Demand management and travel behaviour	<ul style="list-style-type: none"> • Improves accessibility to town centres and Opportunity Areas and improves 	Individualised marketing pilot studies

projects, including improved information on travel alternatives	<p>the environment of local areas</p> <ul style="list-style-type: none"> • Reduces peak hour car use and improves the reliability of the transport network 	underway. School and workplace travel plans being developed.
Bus improvements (40% capacity increase to 2011, 50% increase to 2016)	<ul style="list-style-type: none"> • Improves accessibility to town centres and Opportunity Areas • Provides a substantial increase in overall public transport capacity 	11% increase in capacity since 2001. Continued expansion occurring.
South London Metro (phased improvements in services, stations and fares)	<ul style="list-style-type: none"> • Increases accessibility to areas of deprivation in South London • Increases accessibility and capacity to opportunity Areas (London Bridge and Waterloo) and areas of intensification (Woolwich Arsenal and Victoria) • Increases journey time reliability for orbital public transport movements between town centres in South London 	Identified as scheme for further development in SRA Strategic Plan 2002. Pilot schemes to be introduced in Autumn 2002.
Orbiraill (enhances the existing orbital rail network around inner London)	<ul style="list-style-type: none"> • Improves access to town centres and potential development areas • Relieves public transport pressures in central London 	SRA Strategic Plan 2002 identifies East London Line extension as step towards eventual implementation of Orbiraill.
Thameslink 2000 *	<ul style="list-style-type: none"> • Increases capacity to Central London Opportunity Areas (particularly Kings Cross, London Bridge) • Improves north-south links 	Northern extensions planned for opening in 2008, southern extensions planned for opening in 2012.
Walking and cycling	<ul style="list-style-type: none"> • Supports travel for those without direct 	On-going.

improvements	<p>access to cars</p> <ul style="list-style-type: none"> Increases the attractiveness of town centres and their accessibility to surrounding hinterland Increases accessibility to transport hubs, for shorter trips and trips between modes <p>Reduces pressure on other modes for short distance trips</p>	TfL Business Plan 2002 includes significant increase in walking and cycling programme.
Road network improvements	<ul style="list-style-type: none"> Facilitates more efficient use of road infrastructure to improve network reliability Improves highway accessibility to Opportunity Areas in East London (A13 junction upgrades via DBFO, North Circular Road improvements, improvement schemes at Wandsworth, Purley and Catford, A23 Inner Relief Road, A2 widening) Improved management information (using information technology) and enforcement will allow improved management of the road system. 	A13 schemes under construction, A23 scheme to begin Spring 03, North Circular schemes complete by 2006. London Traffic Control Centre opened. Street Works Task Force set up.
Channel Tunnel Rail Link *	<ul style="list-style-type: none"> Increases accessibility to Stratford and Kings Cross Opportunity Areas Improves London's international links and frees up capacity on the domestic national rail network into London 	Construction underway: section 1 to open 2003; section 2 to open 2007.
Crossrail line 1 *	<ul style="list-style-type: none"> Increase in capacity to Central London Opportunity Areas (particularly Paddington, Bishopsgate) and the Isle of Dogs Increases accessibility to Opportunity Areas in the Thames Gateway <p>Improves east – west links</p>	Business case being developed by SRA and GLA/TfL. Planned for opening in 2011.
Crossrail line 2	<ul style="list-style-type: none"> Increases capacity to Central London Opportunity Areas (esp. Victoria, Kings Cross) Increases accessibility to Areas of Deprivation in north-east London 	Studies underway to review route options. Planned for opening in

		2016.
East London Line extensions	<ul style="list-style-type: none"> • Improves accessibility to a high proportion of Areas of Deprivation • Provides alternative access to Opportunity Areas in Thames Gateway, avoiding Central London 	Legal approval obtained; awaiting Government financial approval. Planned for opening in 2006.
National Rail/TOC improvements	<ul style="list-style-type: none"> • Increases overall public transport capacity which will particularly benefit Central London Opportunity Areas • Introduction of Metro services, including higher frequencies 	Planning assumptions about capacity growth made following dialogue with SRA.
London Underground improvements to existing network (in the PPP)	<ul style="list-style-type: none"> • Increases overall public transport capacity through line and station upgrades which will particularly benefit Central London Opportunity Areas • Station improvements will benefit Opportunity Areas, particularly in Central, West and North London 	Improvement spread over the period.
DLR extensions: City Airport/King George V Dock, Woolwich Arsenal, Barking Reach, Stratford International. 3-car upgrade of Bank-Lewisham route.	<ul style="list-style-type: none"> • Increases accessibility and capacity to Opportunity Areas and areas of intensification north and south of the Thames, e.g. Royal Docks, Stratford, Barking Reach and Woolwich Arsenal. • Links housing, employment centres and key transport nodes in the Thames Gateway and makes a key contribution to regeneration 	Legal approval obtained for City Airport/King George V Dock. Public inquiry into Woolwich extension end January 03
Light transit schemes: East London, Greenwich Waterfront, West London, Cross River, Tramlink extensions	<ul style="list-style-type: none"> • Increases accessibility and capacity to a number of town centres and Opportunity Areas north and south of the Thames • Serves a number of Areas of Deprivation • Support regeneration in key corridors • Increases the attractiveness of town 	Four transit schemes approved by TfL Board for planned implementation by 2011. Detailed

	centres and their accessibility to surrounding hinterland	planning occurring on West London Transit and project team established. Study into Croydon Tramlink extensions nearing completion.
Interchanges, stations & terminals	<ul style="list-style-type: none"> • Improves efficiency of use of public transport capacity in London • Improves the efficiency of distribution of workers from terminals and stations • Enhances development and intensification at major interchanges and town centres 	On-going programme of interchange improvements being implemented.
River crossings – Thames Gateway Bridge & Silvertown link	<ul style="list-style-type: none"> • Increases accessibility to Opportunity Areas in southern Thames Gateway (Woolwich Arsenal, Thamesmead, Belvedere) and Greenwich • Improves transport accessibility between the north and south of the river 	TGB project about to start consultation on design and environmental assessment.

* Scheme identified by Government in Regional Planning Guidance for the South East (RPG 9) as significant for regional development.

3.1.3 Details of the transport programme are subject to on-going development, and scheme details will continue to evolve. Also, it is not possible to be certain about delivery and timing because significant elements of the programme are the responsibility of other organisations (e.g. the Strategic Rail Authority). **The analyses reported here should be seen as broadly indicative of the expected outcomes of the proposed investments.**

4 Analysis of Programme Outcomes

4.1.1 This section of the report examines the impact of the proposed transport improvements and their relationship with the requirements of the DLP. This is examined with respect to the following measures:

- The additional capacity which will be delivered by the transport programme
- The impact on crowding levels

- Improvements in accessibility

4.2 BASIS OF ANALYSIS

4.2.1 This analysis is largely based on strategic transport modelling. The focus was on comparing current conditions with the main horizon year in the DLP, namely 2016. The key conditions and factors represented in the model include:

- Growth in the number of jobs in London, and the number of people living in London and the surrounding region in line with DLP projections
- The existing and future transport system, comprising information provided by TfL, London Underground and the Strategic Rail Authority

4.2.2 The modelling is strategic, in relation to the overall network, and should be used to draw general conclusions. Further work will be needed at a later stage on the local impacts of particular schemes.

4.2.3 As part of the analyses TfL has examined a range of sensitivity tests and scenarios, including delays or withdrawal of elements of the transport programme. The scenarios examined for 2016 are:

- Planned schemes all implemented - including all major schemes in London Plan.
- Sensitivity test of effect of delaying Crossrail 1 and 2 beyond 2016
- Low delivery scenario - assumes a number of major schemes do not happen by 2016. It excludes schemes such as Thameslink 2000, East London Line Extensions, Crossrail 1 and 2, Docklands Light Railway extensions to Barking Reach and Stratford International, most improvements to the existing National Rail system.

Capacity increases - Bus

4.2.4 The proposed public transport improvements will provide a substantial increase in capacity. The bus network provides a significant proportion of overall public transport capacity across London. The proposed increase of 50% in total capacity on the bus system by 2016 will provide significant benefits across Greater London. The capacity on the bus system is already being expanded. Capacity has increased by 11% since 2001, and it is expected that this will continue to 2016. A large proportion of public transport capacity growth over the next 5 years before major rail projects are operational will be met by buses.

Capacity increases – Rail

4.2.5 Rail network improvements and new schemes, as set out in **Table 4**, will provide significant additional capacity, service quality and reliability improvements.

4.2.6 Transport capacity can be quantified in terms of provision in a defined area, such as Greater London, using a measure of spaces provided by distance such as place kilometres. This measure takes account of the amount of capacity on each train, the service frequency and the distance operated by the services. The standard measure of rail capacity used by TfL and LUL is Planning Guideline Capacity, which is based on the number of seats plus an allowance for standing in reasonable conditions. This reflects a 'tolerable' level of crowding on the system. On this basis the additional capacity delivered by the various schemes and network enhancements is summarised in **Tables 5 and 6**, based on the Planning Guideline Capacity arising from each type of rail improvement. Since the majority of this work was carried out, London Underground have identified further potential service volume improvements which could increase capacity delivered over the peak period, as reported to the Select Committee for Transport on 22 January 2003. It is also possible that additional capacity could be delivered as a result of reliability improvements. Further work will be carried out to assess the impacts.

Table 5: Total Rail Capacity, millions of place kilometres within London at Planning Guideline Capacity in morning peak period (0700-1000 hours)

	2001	2016
Underground (1)	19.9	23.1
DLR/Croydon Tramlink	0.6	1.3
Transit schemes	-	0.8
Crossrail line 1(2)	-	9.1
Crossrail line 2 (2)	-	3.4
Thameslink	1.6	5.7
East London Line	0.1	0.6
CTRL	-	1.5
Rest of National Rail (3)	28.6	27.5
Total	50.7	73.1
Total change from 2001 (absolute)		22.4
Total change from 2001 (%)		44%

- (1) Underground total excludes East London Line extensions. Further work has been carried out by London Underground which could result in further capacity improvements over the peak period.
- (2) Crossrail capacity is subject to scheme and rolling stock definition, and includes some existing services incorporated into the scheme.
- (3) Rest of National Rail declines to 2016 because major projects incorporate some existing services.

Table 6: Contribution of projects to rail capacity increases

	Increase between 2001 and 2016 (millions of place km*)	Proportion of the increase in rail capacity from 2001
Underground (1)	3.2	14%
DLR/Tram	0.8	4%
Transit schemes	0.8	4%
Crossrail line 1 (3)	9.1	41%
Crossrail line 2 (3)	3.4	15%
Thameslink	4.2	19%
East London Line	0.5	2%
CTRL	1.5	7%
Rest of National Rail (4)	-1.0	-5%
Total capacity increase from 2001	22.4	100%

- (1) Underground total excludes East London Line extensions. Further work has been carried out by London Underground which could result in further capacity improvements over the peak period.
- (2) National Rail total includes major projects such as Crossrail, extended East London Line, and TOC refranchising
- (3) Crossrail capacity is subject to scheme and rolling stock definition, and includes some existing services incorporated into the scheme.

- (4) Rest of National Rail declines to 2016 because major projects incorporate some existing services.
- 4.2.7 There are significant increases proposed on the National Rail network arising from the major new schemes Crossrail 1 and 2, Thameslink and CTRL. Increases in capacity are also planned from TOC refranchising.
- 4.2.8 Capacity improvements on the Underground arising from PPP will result in additional capacity throughout most of the network, with increases of more than 30% additional capacity on the Jubilee, Hammersmith & City, Metropolitan, and Northern (City branch) lines. The planned schemes will also result in an increase in capacity on the Docklands Light Railway of 180%.
- 4.2.9 There are plans for two new tram schemes (West London Tram and Cross River Tram), two busway schemes (East London Transit and Greenwich Waterfront Transit) and two extensions to Croydon Tramlink. The transit schemes will result in significant additional capacity in areas subject to substantial growth in jobs and population.
- 4.2.10 The foregoing analysis shows the overall rail capacity increase across the London network. A complimentary measure of rail capacity is the capacity provided across a boundary or a cordon around a defined area. This is calculated by adding together the capacity on each of the individual rail lines crossing the cordon. Three cordons have been defined to illustrate the change in rail capacity arising from the planned transport improvements: central London, inner London and Greater London. The central cordon is approximately equivalent to the route of the Circle line; the outer cordon is equivalent to the Greater London boundary; the inner boundary is located approximately midway between the central and outer cordons. The rail capacity crossing the cordons in the inbound direction (towards central London) is shown in **Table 7**.

Table 7: Inbound rail capacity at cordons, morning peak period (0700-1000), places at Planning Guideline Capacity (seats on National Rail only shown at outer cordon)

	2001	2016	Change	
			Absolute	%
Central cordon	1,182,000	1,690,000	509,000	43%
Inner cordon	988,000	1,397,000	409,000	41%
Outer cordon (Seats on National Rail)	439,000 (366,000)	623,000 (525,000)	184,000 (159,000)	42% (43%)

Note: Assumes implementation of planned schemes in 2016

4.2.11 Generally the figures in **Table 7** indicate significant increases on rail services across all cordons as a result of increased capacity on Underground, Docklands Light Rail and National Rail. The figures indicate that the additional capacity will be provided where it is most needed. The figures include additional capacity from new schemes such as Crossrail and Thameslink 2000. The figures show that, in the inbound direction in the morning peak period, there will be an increase of 509,000 (43%) places across the central London cordon and 184,000 additional spaces (a 42% increase) across the outer London cordon in the morning peak period, by 2016 if all planned schemes are implemented. This supports the extra 237,000 jobs in central London. This growth in capacity includes an additional 159,000 seats on National Rail (including major schemes) entering London at the outer London boundary in the morning peak period.

4.3 CROWDING ON THE RAIL SYSTEM

4.3.1 Crowding results from an imbalance between the number of people using the system and the transport capacity provided. Many parts of London's transport system are crowded to some extent, especially at times when people are travelling to and from work.

4.3.2 TfL measures crowding by comparing the number of people using a link (a link is a section of the network connecting two stations) and the capacity of the link in terms of its Planning Guideline Capacity. The relationship between crowding and capacity can be represented as a crowding ratio, where links with a ratio above 1.0 have more passengers than the Planning Guideline Capacity and are considered to be crowded to varying degrees. Based on practical experience, LUL take the view that a crowding ratio of around 1.50 is the point at which the sheer number of people using the system results in delays at stations and it becomes difficult to maintain service frequencies. However crowding is not a completely fixed or absolute concept, and relates to passengers'

willingness to tolerate uncomfortable conditions. In some cases, for example, this may be for relatively short periods of time.

Current Crowding Levels (2001)

4.3.3 TfL's strategic transport model has been used to represent the number of links which are crowded on the Underground and National Rail systems in 2001 and in 2016 in the morning peak. The analysis focuses on crowding in the **morning peak hour**, which is when crowding is at its worst. This normally occurs in the period when most people are travelling to or from work. The level of crowding on the Underground in 2001 is based on counts and surveys of the number of people using the system. The number of people using the National Rail system in London is based on a modelled estimate.

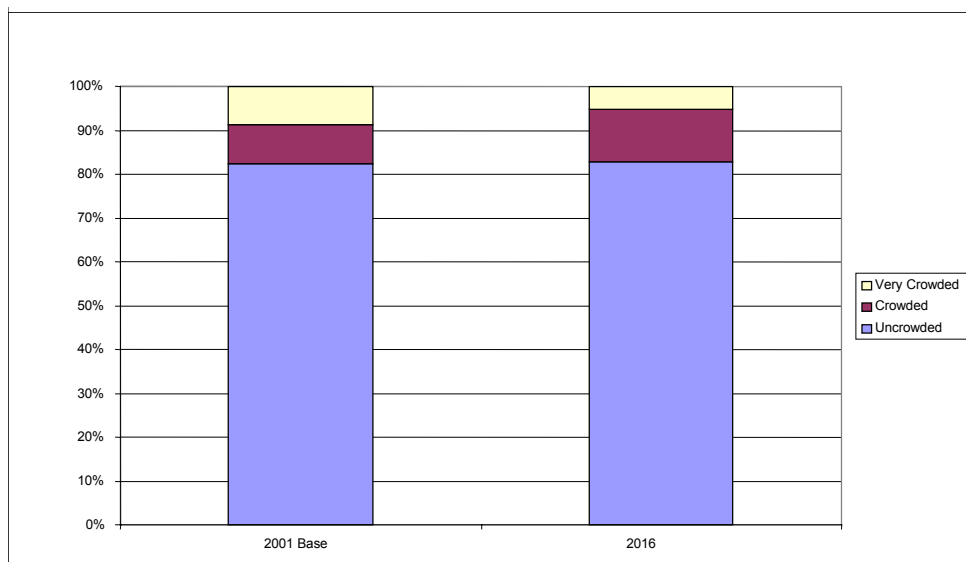
4.3.4 Looking at crowding on the whole rail system (that is taking the Underground and National Rail systems together) 21% of links are currently crowded (above a crowding ratio of 1.0) in the morning peak hour, affecting more than half of passengers travelling at this time. In terms of the worst crowding, 12% of links and a third of passengers are experiencing very crowded conditions (at least 25% above Planning Guideline Capacity). The results are considered in more detail in the following sections.

Crowding on the Underground

4.3.5 Figure 1 shows the scale of crowding on the Underground system by summarising how many links are uncrowded, crowded or very crowded, based on results from TfL's strategic transport model. The categories used in Figure 1 are based on the level of crowding relative to the Planning Guideline Capacity, where links with a crowding ratio below 1.0 are "uncrowded", links with a crowding ratio between 1.0 and 1.25 are "crowded" and links with a crowding ratio above 1.25 are "very crowded".

4.3.6 Figure 1 shows that many sections of the Underground system are currently crowded. Increasing numbers of passengers in recent years has led to an increase in the intensity of crowding. Overcrowding is particularly a problem at peak times and is particularly acute on sections of the District, Northern, Piccadilly, Victoria and Central lines. Also sections of the Docklands Light Railway are crowded. 18% of all Underground links are crowded, including 9% crowded at more than 25% above Planning Guideline Capacity. These crowded links are within, and on the approach to, the central area where passenger demand is concentrated: 43% of passengers are using these crowded links. Only about 1% of links are crowded at the very limit of the operable capacity of the Underground system.

Figure 1: Crowding on London Underground, proportion of links in crowding categories, morning peak hour



Source: TfL Transport Model

Note: In the Figure “uncrowded” relates to crowding ratio less than 1.0; “crowded” relates to crowding ratio between 1.0-1.25; “very crowded” relates to crowding ratio over 1.25.

Crowding on National Rail

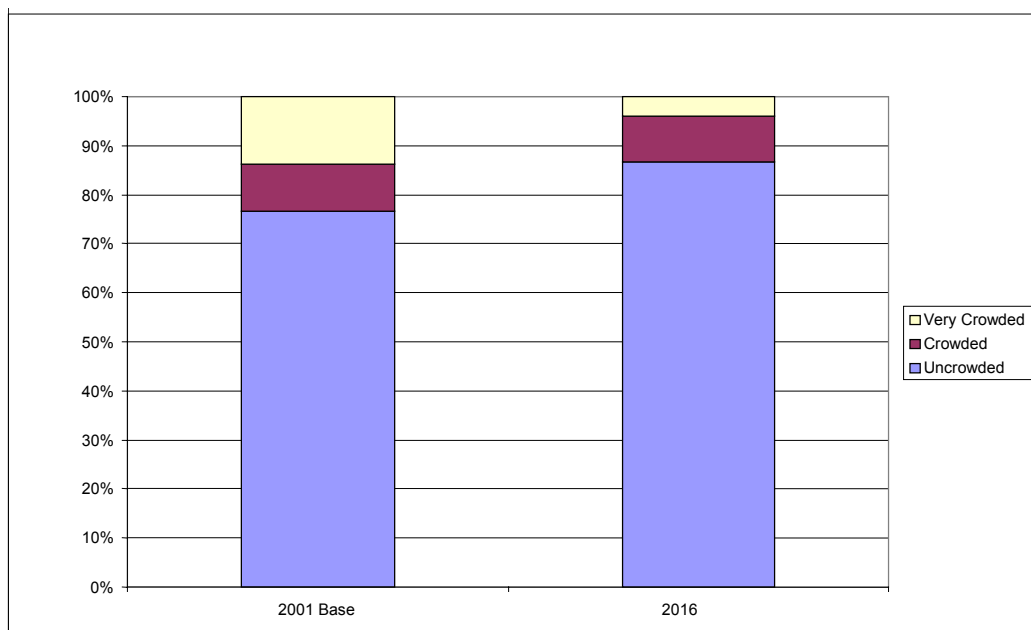
4.3.7 Figure 2 shows the proportion of National Rail links which are crowded or uncrowded in 2001. This is based on the same Planning Guideline Capacity approach as applied to the Underground. 23% of all links are crowded, affecting over 60% of passengers using services which serve London (based on modelled estimates of demand). Services are

particularly crowded on sections of lines approaching the following terminals:

- Paddington
- London Bridge
- Waterloo
- Victoria
- Cannon Street
- Fenchurch Street
- Liverpool Street

4.3.8 Severe crowding affects services through the South-East London, especially on the approach to London Bridge, and through Greenwich, Blackheath and Lewisham.

Figure 2: Crowding on the National Rail network, proportion of links in crowding categories, morning peak hour



Source: TfL Transport Models

Note: In the Figure “uncrowded” relates to crowding ratio less than 1.0; “crowded” relates to crowding ratio between 1.0-1.25; “very crowded” relates to crowding ratio over 1.25.

4.3.9 Apart from representing the conditions that thousands of people experience every day, these figures can also provide a benchmark against which estimates of future conditions can be compared. These are considered below.

2016 with Planned Transport Improvements

4.3.10 Figures 1 and 2 include the crowding predicted to occur in 2016 on the Underground/Docklands Light Railway and National Rail, respectively, with the planned transport improvements implemented.

4.3.11 **Table 5** showed that total rail capacity (including Underground, the Docklands Light Railway, transit schemes and National Rail) increases by 44% in the morning peak period, more than keeping pace with an increase in demand of 39% (in **Table 2**). However there is a 25% reduction in the number of crowded links, indicating that additional capacity is being introduced where it is needed most. As a result the proportion of all links (taking Underground and National Rail together) which are crowded goes down from 21% to 15%, with the proportion of rail passengers affected decreasing from 53% to 39%.

4.3.12 On balance it can be concluded from the modelling that with the transport improvements there is overall sufficient growth in capacity to accommodate the growth in demand and to achieve some overall improvement to current travelling conditions. Since the majority of this work was carried out, London Underground have identified additional potential capacity improvements over the peak period which could provide further relief to crowding. Further work will be carried out to assess the impacts of the additional capacity.

Sensitivity Tests

Impact of Delaying Crossrail

4.3.13 Crossrail lines 1 and 2 provide a significant element of the additional capacity required to support the growth described in the London Plan. Crossrail line 1 on its own would deliver more than 40% of the additional rail capacity, and is considered by Government to be of national significance. A sensitivity test was carried out to explore the impact of delaying Crossrail lines 1 and 2 beyond 2016.

4.3.14 As a result of removing Crossrail lines 1 and 2, crowding on the Underground network is significantly worse than current conditions, with the proportion of links crowded rising from 18% to 28% (cf. 18% with planned schemes). Under this scenario the proportion of the network which is experiencing very crowded conditions (more than 25% above Planning Guideline Capacity) increases from 9% to 15%.

Low Delivery Scenario

- 4.3.15 A further pessimistic scenario was examined which assessed the impact if most of the planned transport improvements had not been achieved by 2016. The schemes which were removed included Crossrail lines 1 and 2, Thameslink 2000, East London Line extensions, DLR extensions to Barking Reach and Stratford International, East London phase 2, Greenwich phase 2 light transit schemes and Croydon Tramlink extensions. In addition most of the National Rail train operating company capacity improvements from refranchising were deleted – only capacity improvements on Chiltern services were retained. In assessing this scenario it was assumed that the full growth in demand, arising from the London Plan population and job growth, would occur.
- 4.3.16 Delaying most of the planned capacity improvements beyond 2016 has the effect of increasing the proportion of crowded links on Underground and National Rail in the morning peak period from 15% to 28%, with the proportion of crowded links on the Underground increasing from 17% to 31% of the total network. Significantly, in terms of the ability of the transport system to accommodate the forecast demand, the proportion of links which are more than 50% above the Planning Standard Capacity increases from 3% to 16% on the Underground. Furthermore the majority of lines within central London, and on the approaches to central London in the morning peak period become very crowded (more than 25% above Planning Guideline Capacity).

Station Capacity

- 4.3.17 The strategic transport models do not represent crowding at stations and interchanges, therefore this is not taken into account in the previous analysis of network crowding. There are already regular problems with crowding at some stations, such as at Victoria during peak hours. Without additional capacity these crowding problems will increase as demand rises. TfL is working with its partners to identify appropriate measures to increase station capacity. Schemes are being developed with partner organisations at stations such as Camden Town and Victoria.

Highway Congestion

- 4.3.18 London's road network carries significant volumes of traffic, particularly within and on the approaches to central London and the town centres. A 10% growth in London's population and a 14% increase in jobs will put additional pressures on the highway system. Highway accessibility is regarded as an important issue by business.

4.3.19 The proposed programme of transport improvements will help to encourage greater use of the public transport system and relieve some of the growth in highway traffic. Despite this, traffic volumes outside central London are expected to continue to grow. Congestion Charging in central London, coupled with public transport improvements, will have the effect of reducing the volume of traffic in central London.

4.3.20 The change in average vehicle speeds between 2001 and 2021 on all roads within the M25 was estimated based on results from the LTS strategic transport model. The modelling indicates that there will be pressures on the highway network, particularly in outer London where there will be a growth in traffic volumes leading to a decline in average traffic speeds. However previous periods of strong growth in jobs and population, for example in the 1990s, did not lead to strong growth in traffic, therefore it is considered that the model may be over-estimating highway growth. The trend in vehicle speeds in inner and central London is much flatter than outer London, partly due to the expected effect of central London congestion charging. It should be noted that the modelling does not fully reflect the benefits of management and enforcement measures to improve the use of the existing network.

4.4 ACCESSIBILITY

4.4.1 TfL's transport model has been used to represent accessibility using two measures:

- Average public transport travel times from one zone to all other zones
- the population living within 45 minutes travel distance of a zone for both public transport and highway journeys.

4.4.2 These were applied to the current transport network and the 2016 network as a basis for examining the impact of the proposed transport programme.

Public Transport Accessibility

4.4.3 The total population within 45 minutes travel time from each zone in London was quantified for 2001 and 2016. All areas of London will benefit from reductions in average journey times for trips by public transport between 2001 and 2016. For example large reductions in average travel time will occur in areas affected by Crossrail line 1 in the southern Thames Gateway and west London. The overall reductions in public transport journey time are due to a combination of London-wide improvements including expansion of the bus network, reduced journey times on National Rail and Underground services, and new transport infrastructure.

- 4.4.4 Areas with the highest total population within 45 minutes travel distance by public transport in 2016 are concentrated in and around Central London and the metropolitan centres. For example Croydon has outstanding accessibility with a population in excess of 2.5 million within 45 minutes journey time – a figure comparable to Central London. In addition, Wood Green, Harrow, Ealing and Ilford are all highly accessible metropolitan centres with a population in excess of 1.5 million within 45 minutes journey time.
- 4.4.5 A number of zones in parts of Islington, Hackney, Camden, Southwark, Tower Hamlets, Newham and Greenwich will see increases of over 0.5 million in the population within 45 minutes travel distance by public transport. These areas have high population growth within their enlarged catchment areas and will gain the most benefit from improved accessibility due to schemes such as the East London Line northern extension and Crossrail lines 1 and 2.
- 4.4.6 A majority of zones within the boroughs of Westminster, Kensington & Chelsea, Hammersmith & Fulham, Camden, Islington, City of London, Hackney, Tower Hamlets and the northern zones of Southwark, Lambeth and Wandsworth will have a population in excess of 2 million within 45 minutes travel distance by public transport in 2016.

Highway Accessibility

- 4.4.7 Compared to public transport accessibility, there will be comparatively little change in highway accessibility between 2001 and 2016 across most parts of London. The most significant increases in population (up to 600,000) within 45 minutes travel time will occur in the southern Thames Gateway reflecting the increased accessibility provided by new river crossings. There will also be small increases in parts of Central London (up to 300,000) due to improved speeds resulting from congestion charging. In parts of outer London there will be small decreases in the total population within 45 minutes journey time reflecting increased highway congestion in these areas.

Access to Opportunity Areas and Areas of Intensification

- 4.4.8 The Opportunity and Intensification areas identified in the DLP were reviewed with a view to assessing whether sufficient transport accessibility and capacity will be provided to support their development. The sites were reviewed with reference to current transport accessibility and capacity.

4.4.9 With respect to accessibility to opportunity areas and areas of intensification:

- Nearly all sites in Central London are highly accessible by public transport and will benefit from an increase in excess of 0.5 million in the total population within 45 minutes public transport journey time by 2016
- Several sites in East London will also benefit from an increase in excess of 0.5 million in the total population within 45 minutes public transport journey time by 2016 including Isle of Dogs, Royal Docks and Woolwich Arsenal
- Many of the Areas of Deprivation coincide with areas likely to benefit from the largest increases in population within 45 minutes journey time by public transport
- Crossrail lines 1 and 2 will improve public transport access to Areas of Deprivation.
- The improvements in accessibility provided by the East London Line northern extension will benefit Areas of Deprivation in Hackney and Islington
- The proposed new river crossings will provide accessibility improvements north and south of the Thames

4.4.10 With respect to transport capacity, each Opportunity and Intensification area was reviewed using detailed information from TfL's transport model on current and future passenger demand and capacity on rail links serving rail stations adjacent to each site. Each site was then categorised as either having no or relatively minor transport capacity issues, or significant transport capacity issues requiring further consideration of development phasing. The results of the transport capacity review are shown in **Table 8**. In addition to rail capacity issues, there will also be pressures on bus station capacity as a result of the growth in demand particularly at major terminals such as Victoria.

Table 8: TfL Assessment of Predicted Transport Capacity Issues on Rail Links serving London Stations Adjacent to Opportunity Sites 2001-2016
(Shading indicates capacity issues)

Area of Opportunity/ Intensification	Station	New jobs	Potentially Significant Rail Link Capacity Issues	
			London Underground	National Rail
Waterloo	Waterloo	15000		
London Bridge	London Bridge	24000		
Elephant & Castle	Elephant & Castle	4200+		
Vauxhall/ Battersea	Vauxhall	7600+		
Kings Cross	Kings Cross	11400		
Paddington	Paddington	23200	Subject to Crossrail 1	
Farringdon	Farringdon	2000	Subject to Thameslink	
Holborn	Holborn, Covent Garden, Leicester Sq.	2000	Subject to Crossrail 1 & 2	
Euston	Euston, Euston Sq	4000	Subject to Crossrail 1	
Tottenham Ct Rd	Tottenham Ct Rd	2000	Subject to Crossrail 1 & 2	
Victoria	Victoria	2000	Subject to Crossrail 2	
Arsenal/ Holloway Rd	Arsenal/ Holloway Rd	1500		
Whitechapel/ Aldgate	Whitechapel/ Aldgate	14,000		
Isle of Dogs	Canary Wharf	100,000	Subject to Crossrail	
Stratford	Stratford	30,000		Subject to Crossrail 1 & 2
Lower Lea Valley	West Ham, Canning Town	8500		
Royal Docks	Custom House	11,000	Subject to Crossrail 1	
Barking Reach	Dagenham Dock	4,200	Subject to Crossrail	
Greenwich Peninsula	North Greenwich	15,000 - 20,000	Possible complexities from Canary Wharf	
Thamesmead	Abbey Wood	1500	Subject to Crossrail 1	
Wembley	Wembley Central/ Wembley Park	5000	Subject to Crossrail 1	
White City	White City/ Shepherds Bush	11,000		

Park Royal	Park Royal	10,000		
Willesden Junction	Willesden Junction	3600	Subject to Crossrail 1	
Tottenham Hale	Tottenham Hale	5000+		
Mill Hill East	Mill Hill East	500		
Cricklewood/ Brent Cross	Cricklewood	5000- 14,500	Possible extra station if jobs at 14500	
Hendon RAF	Colindale	500		
Wood Green	Wood Green	1500		
South Wimbledon/ Colliers Wood	South Wimbledon/ Colliers Wood	2000		

Notes: The table is based on an assessment of the capacity of transport links adjacent to the station only. The assessment did not include a review of station capacity, nor did it consider capacity constraints beyond the immediate vicinity of the stations considered.

5 CONCLUSIONS

- An extensive programme of transport improvements is planned which, if implemented, will increase rail capacity by 40% and will increase bus capacity by 50% by 2016.
- Not implementing the programme of transport improvements will result in severe worsening in crowding, effectively restricting the ability of the transport network to accommodate a proportion of the demand.
- Implementation of the planned transport improvements will provide sufficient capacity by 2016 to support the growth in jobs and relieve crowding on some sections of the rail network.
- The transport improvements mean that travel accessibility by public transport is improved across many areas of London, including key regeneration areas such as Thames Gateway.

Transport for London

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