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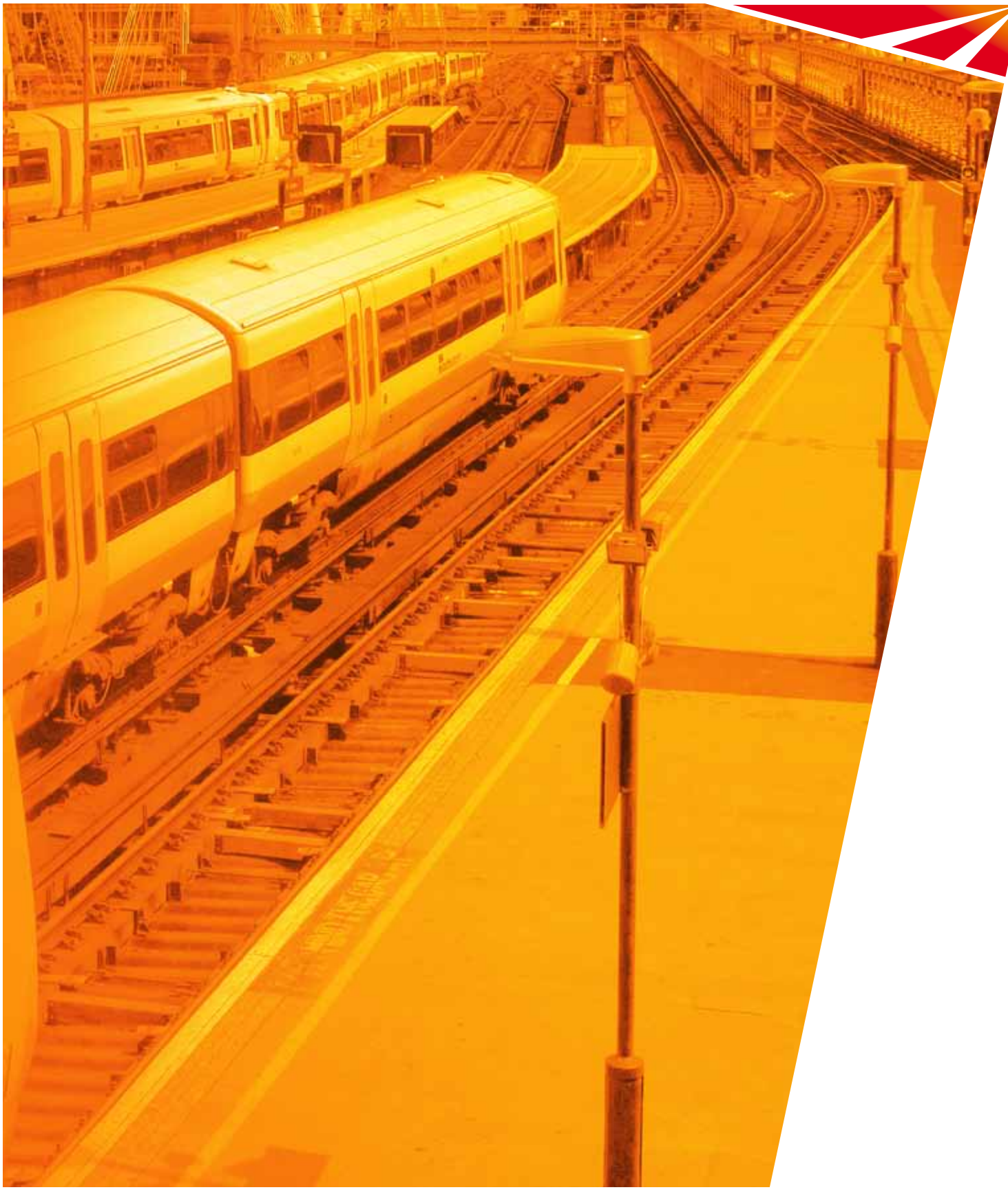
London and South East
Route Utilisation Strategy

NetworkRail



Contents

Foreword

Passenger numbers continue to rise on nearly all routes into London, with strong increases returning following the recession. Additional capacity will be required, delivered in a manner ever more focused on delivering better value for money

This Route Utilisation Strategy (RUS) provides a high-level overview and a consistent approach to capacity planning for the next 20 years for all rail routes into London. It is in this part of the country where public transport usage is at its highest, the rail network in and around the capital is therefore fundamentally linked to the quality of life of large numbers of people and to the success of the economy of the country as a whole. The RUS strategy is based upon adding capacity to meet growing demand, where this can be justified and achieved.

London's transport system will soon include Thameslink and the central London Crossrail route, but we now need to look further ahead

On many routes the focus is on implementing previously published strategy, with construction works now well underway at several locations in and around the capital. Ongoing committed schemes include Thameslink, Crossrail and a significant programme of platform lengthening, together with the ordering of more than 1,800 new carriages for use in and around the Capital. Beyond this the priority is on commencing work on other elements of existing strategy, including development of a new high speed rail network which will free up commuter capacity into London from key growth areas such as Milton Keynes and Northamptonshire.

However, previously published strategy needs updating on certain routes, with additional interventions now needing consideration to reflect the latest forecasts of future passenger numbers. The RUS therefore provides new or updated recommendations for the Great Western, West Anglia, Great Eastern and South West main lines, and for the busy orbital rail network around the Capital.

Consistent with Sir Roy McNulty's Value for Money study our analysis for new line-of-route capacity interventions in this RUS has sought to avoid major capital expenditure unless absolutely necessary, and in all cases apart from the South West Main Line, this appears to be achievable through relatively modest works. However, the main line route into London Waterloo will be a longer term challenge, with possible solutions outlined in this RUS for the longer term. In the meantime the review anticipated from the Department of Transport regarding ticket pricing structures may be one way of distributing loadings more evenly between individual trains across the day on this route and elsewhere.

Foreword

London's transport system will soon include Thameslink and the central London Crossrail route, but we now need to look further ahead

Historically rail journeys have generally ended with a terminus station at the edges of Central London, rather than continuing across it. However, this will change with an upgraded Thameslink line and Crossrail providing a new cross-London network. The RUS outlines the latest assumptions regarding possible Thameslink service patterns and describes industry thinking for potential future extensions to Crossrail, including recommendations for an extension to Reading and an extension to the West Coast Main Line. It provides an early view on a potential Crossrail line 2 for the longer term, providing extra capacity across London on a southwest – northeast axis and potentially connecting into National Rail lines beyond.

A preferred freight routeing strategy from the growing intermodal ports is provided. Implementing this will require further investment, but this would enable many freight trains between the key ports in South East England and distribution centres in the Midlands and North to avoid travelling through the Capital during normal operations.

This RUS was published as a Draft for Consultation in December 2010, with significant further development now included in this final strategy. Network Rail has led production, but extensive input has been received from passenger and freight operators, the Department for Transport, Transport for London, Passenger Focus, London TravelWatch and many others. I thank them all for their contribution.

The strategy includes a section on the Solent/South Hampshire area, so as to provide complete national coverage from Network Rail's RUS programme. I would like to particularly thank those who have expressed an interest in this element.

Paul Plummer
Group Strategy Director

Executive Summary

Introduction

The Network Licence requires that Network Rail publish and maintain Route Utilisation Strategies (RUSs), which establish the most efficient ways to use and, where appropriate, to increase network capacity in order to deal with forecast changes in demand. The London and South East RUS represents the latest such thinking for routes into and around the capital, together with other parts of South East England.

Network Rail published this RUS on its website as a Draft for Consultation in December 2010. This was followed by a 90 day consultation period, during which stakeholder briefings were held and written responses sought from interested parties to the RUS. The many submissions received during this period have now been published on Network Rail's website.

The RUS has involved close working between Network Rail and its industry stakeholders, but the analysis it is based upon and specific content is the responsibility of Network Rail. Since publication of the Draft for Consultation, Network Rail has undertaken further analysis and this, together with feedback received during the consultation and other developments such as the McNulty 'Value for Money' study, has influenced this final strategy.

The recommendations contained in this RUS are designed as a starting point to inform future infrastructure or train service planning, and where necessary, further analysis. Whilst the strategy is an advisory document, and its recommendations are non-binding on future decision makers, Network Rail believes the RUS represents a robust future plan for railway development on this part of the network.

Scope and planning context

This London and South East RUS builds upon a number of the earlier established RUSs previously produced by Network Rail, which covered most of the area within its remit. This RUS extends the strategy as follows:

- it looks at all corridors into London at the same time and in a consistent way to 2031, so results are now directly comparable between routes and, in many cases, have a longer timescale
- it considers current economic conditions which, despite a strong recovery in passenger growth in the last 18-24 months, result in differing demand forecasts from earlier RUSs on certain routes and affect affordability in the medium term
- it recognises that many infrastructure projects recommended by previous RUSs – for example the Crossrail and Thameslink Programmes, extra capacity at critical locations such as Reading, Gatwick and Hitchin, a major programme of platform lengthening and freight gauge and capacity enhancements – are now under construction or committed. However, it restates most of the previous recommendations which are not yet committed, since these are still valid
- it includes the proposed development of a High Speed Rail network from London to the West Midlands and beyond as a fundamental part of its strategy. This will provide a major increase in north – south capacity between key cities, whilst freeing up space on the West Coast Main Line (WCML) for improved commuter services to areas such as Milton Keynes, and for a continued shift of freight from road to rail
- it considers, at a strategic level, the impacts of rail expansion on the capacity of other elements of the transport system. This particularly has involved working closely with Transport for London (TfL) to develop synergies with schemes which have potential to alleviate crowding problems on the London Underground system
- it fills in some previous gaps in geographic RUS coverage, principally affecting the South Hampshire and Solent area.

RUS baseline – committed schemes

The baseline for the RUS includes committed infrastructure schemes (as defined in Network Rail's Control Period 4 (CP4) Delivery Plan, together with subsequent announcements by Government) and committed service changes (as defined in franchise agreements between the Department for Transport (DfT) and the train operating companies). Construction of many of these schemes has now commenced.

Key investments in this category include the Crossrail, and Thameslink Programmes, Reading remodelling, electrification of the Great Western Main Line (GWML), the Intercity Express Programme, the Evergreen 3 project on the Chiltern Line, a major programme of train and platform lengthening in many parts of the capital, conversion of the former Waterloo International terminal for use by domestic services and several freight schemes (for example initial elements of the Felixstowe to Nuneaton freight upgrade). For all these projects the RUS analysis has used the latest position with respect to future timetables to inform analysis of the effect on travel patterns and associated train loadings.

It is recognised that there is some uncertainty with respect to some elements of committed schemes, principally relating to precise details of the deployment of new and cascaded rolling stock following Thameslink, Crossrail and electrification schemes. The RUS has made assumptions in this area which will be kept under review as the position becomes clearer.

Other existing strategy

In considering its strategy the RUS draws heavily on the interventions considered by earlier established RUSs, with those recommendations still at present remaining uncommitted normally being carried forward into this RUS.

Elements of existing capacity strategy carried forward include additional rolling stock to enable further train lengthening on many routes and, in a few cases, additional peak trains. Infrastructure schemes in this category include further platform extensions, enhancements aimed at resolving key operational constraints and further electrification of the network.

Construction of High Speed 2 (HS2) is also considered in this category, as the only realistically viable means of alleviating north – south capacity constraints. Comments are provided in this RUS regarding its potential interaction with the transport system in London.

Forecasts of passenger growth

The RUS is based upon the following weekday peak growth forecasts to 2031 for each route corridor into and around the Capital. It concentrates primarily on the busiest hour of weekday morning peak arrivals into London since, at a strategic level, if the infrastructure can accommodate morning peak demand then loadings at other times should also be manageable. The forecasts are based upon ongoing schemes and incremental interventions from previous RUSs, and existing fares policy. They are sensitive to any future changes in these issues, since additional capacity through major schemes (for example HS2) or further interventions, including those in this RUS, would stimulate additional demand in their own right, and changes to fares policy could affect demand.

Busiest morning peak hour growth forecasts (committed schemes only)

Route into	Service group	Passengers on route in busiest morning peak hour			
		2010 total	2031 total	Extra passengers	Growth
London Paddington	Crossrail GW route	n/a	12,800	8,700	211 %
	Relief line trains (excl Crossrail)	4,100			
	Main line + other fast trains	9,000	13,600	4,600	51 %
	Heathrow Express	800	1,300	500	55 %
London Marylebone	All services	6,100	7,800	1,700	28 %
London Euston	Long Distance	3,700	6,500	2,800	76 %
	Suburban	8,100	12,100	4,000	50 %
London St Pancras	High Speed 1 (domestic)	2,500	5,300	2,800	111 %
	Thameslink MML	9,900	14,700	4,800	49 %
	MML Long Distance	2,300	3,800	1,500	68 %
	Thameslink ECML	n/a	13,000	5,100	66 %
London King's Cross	Great Northern	7,900			
	ECML Long Distance	2,000	3,000	1,000	52 %
Moorgate	All services	7,900	8,000	100	1 %
London Liverpool Street	West Anglia	14,300	18,000	3,700	26 %
	Great Eastern Main Line	16,500	24,600	8,100	49 %
	GE Inners	12,900	21,000	8,100	63 %
	Crossrail GE route	n/a			
	Crossrail Abbey Wood route	n/a	11,900	11,900	n/a
London Fenchurch Street	All services	15,300	17,000	1,700	11 %
London Bridge	Charing Cross	26,200	50,900	3,800	8 %
	Cannon Street	20,900			
	Thameslink Kent	n/a			
	Thameslink Sussex	n/a in peak	24,400	11,100	83 %
	Terminating (fast trains via East Croydon)	13,300			
	Terminating (inners)	9,200	11,500	2,300	25 %
London Blackfriars	All services via Elephant & Castle	10,400	11,900	1,500	15 %
London Victoria	Kent routes	10,300	8,700	-1,600	-16 %
	Fast trains via East Croydon	14,200	19,500	5,300	37 %
	Inner Suburban (via Balham)	9,700	10,300	600	6 %
London Waterloo	Windsor Lines (all services)	13,600	17,100	3,500	26 %
	Inner Suburban (via Wimbledon)	22,700	25,500	2,800	13 %
	South West Main Line	14,800	18,300	3,500	24 %
Radial routes totals		**288,600**	**392,500**	**103,900**	**36%**
Main Orbital routes	West London Line	2,700	5,500	2,800	109 %
	East London Line	4,200	9,800	5,600	132 %
	North London Line	2,700	3,000	300	11 %

Note: Major uncommitted schemes (e.g. HS2) and interventions from this RUS would further increase demand.

2031 Commuter peaks to London; gaps and options beyond existing strategy

The RUS process is built around the identification of 'gaps' (between future supply and demand) and then the identification and assessment of options which bridge these gaps.

On many routes the RUS considers that the combination of funded schemes and non-committed previous strategy will be sufficient to accommodate the increasing demand. However on certain lines this RUS has carried out an update to previous work, seeking to recommend additional options which would accommodate the latest demand forecasts in the most effective manner and consistent with Sir Roy McNulty's findings. Significant further work has taken place since the Draft for Consultation and is presented in this RUS.

This RUS has carried out an update to previous work, seeking to recommend additional options which would accommodate the latest demand forecasts

The RUS now identifies schemes which have potential to provide the necessary level of capacity, at a strategic level, on all routes into and around London. In most cases this appears to be achievable by lengthening or running more trains on existing route corridors, with infrastructure enhancements as necessary, for example on the Great Eastern Main Line (GEML). Elsewhere, as outlined in the Draft for Consultation, the capacity gap on the GWML via Reading appears resolvable, but this is only realistically possible by making changes to currently planned Crossrail and existing Heathrow Express operations, for which an economic appraisal has not at present been undertaken.

On a small number of key corridors more expensive options such as major infrastructure upgrades or new routes appear to be needed if predicted peak demand is to be fully accommodated. This principally relates to the WCML, the capacity constraints on which (for both commuter and longer distance services) can only realistically be addressed through the construction of High Speed 2 (HS2). However, the South West Main Line (SWML) also represents a major long term challenge, with an extra track from Surbiton inwards providing a potential eventual solution. The alternative, would be to utilise pricing policy and smartcard ticketing technology to manage demand at the busiest times, or to plan for standing over longer distances than is currently considered desirable.

The capacity strategy to 2031 for the main routes in and around the capital is summarised below.

Great Western Main Line capacity

The forecast capacity gap in 2031 in the busiest peak hour is some 5,800 people, even allowing for implementation of the Intercity Express Programme (IEP), which only provides sufficient peak capacity for growth up to 2019. The anticipated shortfall is on a combination of outer suburban and long distance services from Reading and the outer Thames Valley, with no capacity gap forecast on the inner stopping services (given the planned introduction of Crossrail services to Maidenhead in 2018). In coming to this conclusion the impact of committed schemes including Reading remodelling, the impact of electrification, IEP and the influx of other new vehicles has been included in the analysis.

In identifying a gap of this magnitude the RUS notes, crucially, that the existing IEP strategy for the GWML does not include any additional high-peak trains into London Paddington, though it does provide extra peak capacity through longer trains with more seating. The lack of extra peak services is due to existing capacity constraints associated with London Paddington station and its approaches, and due to the main lines having no spare capacity at present between Ladbroke Grove and Airport Junction (where the line to Heathrow Airport diverges from the main line). The expectation following the implementation of IEP is therefore that the current 15 main line timetable slots in the busiest hour will be replaced by nine IEP trains on long distance services, five outer suburban eight-car Electric Multiple Units (EMUs) and one retained High Speed Train running from the West of England.

The RUS therefore seeks to provide additional capacity in the peak from Reading and the outer Thames Valley in response to the gap. The options in the Draft for Consultation attracted significant interest from stakeholders and the updated analysis of this RUS is now presented in the table below:

Peak capacity options for Thames Valley commuters		
Option A1	Extend services beyond the committed Crossrail terminus of Maidenhead to Reading.	This option is recommended for implementation in 2018. This is primarily due to capital cost savings in infrastructure which would otherwise be required, mainly at Maidenhead. It would also provide passenger benefits and improve train performance on the route. Further assessment is required but in the short term a peak 10tph Crossrail stopping service west of Paddington is potentially sufficient, rising to 12tph in the longer term (by extending trains otherwise planned to terminate in the sidings at Westbourne Park). However, this alone would do little to resolve the outer Thames Valley capacity gap, since journey times from Reading via the relief lines would be significantly longer than on main line services.
Option A2	Increase peak main line service via Reading from 15tph to 16tph following IEP.	This option does not require additional infrastructure and the RUS assumes that it would be implemented at some stage following IEP before other interventions are required. This would result in 6 peak outer suburban 8-car EMUs, in addition to the 10 long distance services. However this option would not be sufficient to resolve the 2031 gap in isolation.
Option A3	Lengthening of Thames Valley outer suburban EMUs to 12-car.	This option would involve lengthening from 8-car to 12-car of EMUs operating peak outer suburban services on the Oxford & Newbury routes to London Paddington. The RUS assumes that this option will need to be progressively implemented following IEP, with at least 4 of the 6 outer suburban EMUs resulting from **Option A2** progressively lengthened to 12-car. However this option would not be sufficient to resolve the 2031 gap in isolation.
Option A4	Major infrastructure upgrade between London Paddington and Airport Junction to enable peak additional trains.	This option requires two additional tracks between Ladbroke Grove and Airport Junction and two additional long platforms at London Paddington. Such an approach would be extremely complex and expensive, requiring the use of land outside the current railway boundary in a heavily built-up area. This option has not therefore been considered in detail by the RUS since **Option A5** below provides a similar level of capacity and passenger benefits without requiring additional infrastructure.
Option A5	New GWML peak service structure based on: • 20tph main line (9 IEP, 1 HST, 6 outer suburban EMUs from Oxford/Newbury as planned, plus 4 new outer suburban shuttles between Reading or beyond and London Paddington) • 16tph relief lines (including 10tph to Heathrow Airport).	This option is the only realistically viable means of fully responding to the peak capacity gap. It is therefore likely to be required within the RUS timescale, providing four extra fast trains per peak hour from Reading or beyond to London in the current Heathrow Express paths. The emerging service for Heathrow Airport, developed in response to feedback received during the consultation, is for 10 Crossrail trains per hour. The journey, based on a skip-stop pattern in the peaks, would be longer than on the existing Heathrow Express, but the trains would be significantly more frequent and would operate through central London, rather than just to London Paddington. This package of service changes has potential to provide major improvements to the GWML. Further development is required, especially in connection with avoiding any reduction to the rail modal share, and passenger experience, to and from Heathrow Airport.

The immediate emphasis is on implementation of Crossrail and IEP, with the latter requiring infrastructure work at London Paddington to provide enough platforms of sufficient length for the new trains. Extending relief line trains beyond Maidenhead to Reading is also recommended as a priority for 2018, to avoid incurring large capital costs associated with new infrastructure for turnback facilities in the Maidenhead area, and also involving an alternative scheme at Slough. This would save capital costs in the order of £31 million, as long as a decision is made within the next few months.

Beyond this the priority for the GWML will be provision of additional capacity from the Reading area to London at peak times. Implementation of **Option A2** and **Option A3** will be a priority beyond 2019, enabling the maximum possible capacity to be provided within the existing structure of services. However these are relatively small scale and if no further interventions were implemented then large numbers of standing passengers from Reading would become a significant problem in the latter years of the RUS timescale. In considering this issue **Option A4** would be extremely expensive and disruptive and is not considered further given that **Option A5** appears likely to be a more cost effective alternative.

Implementation of **Option A5**, which requires more detailed consideration, would broadly address the forecast capacity gap from the Reading area, enabling four extra fast main line trains in the busiest peak hours into London Paddington in response to Thames Valley commuter growth. There remains a variety of sub-options with regard to the origin point (potentially including Basingstoke as described under **Option F6**) and stopping patterns for such services, but the overall concept would be a 20 trains per hour peak main line service from Reading inwards (four trains per hour of which would call at a combination of Slough, Twyford and Maidenhead, with the remainder running fast).

With respect to Heathrow Airport services the emerging position is that providing a 10 trains per hour Crossrail route service from central London would provide an overall improvement in connectivity relative to commited schemes only, and is likely to become necessary by the mid 2020s to facilitate the additional peak Thames Valley services described above. At peak times the airport services would need to operate on the relief lines with increased journey times from London Paddington station itself (compared to the current Heathrow Express), but the additional Crossrail services would more than double the planned frequency and avoid passengers needing to choose between Heathrow Express and Crossrail on arrival at Paddington station. This would therefore involve 16 trains per hour at peak times from the Great Western route into the new central London tunnel, compared to 10 trains per hour under current plans. This would fully utilise all relief line capacity at peak times, so freight operations would need to be outside the high peak hours.

Linked to the above the RUS emphasises the desirability of extending Heathrow services westwards to improve connectivity, as described later. Beyond Terminal 5 a potential split towards the end of the RUS period could be four trains per hour to Reading (via Slough) and four trains per hour to Staines. Each of these requires the construction of new sections of railway and further work on the business case is recommended.

In the longer term the RUS notes ongoing development regarding how best to both construct and serve the proposed HS2 station on the GWML at Old Oak Common. This includes consideration of whether GWML long distance trains should call, the possibility of a Crossrail extension via Watford Junction, and local connections to routes in the area. Network Rail is closely working with the HS2 Ltd. project team to resolve the relevant issues in this area. There is also proposed to be a high speed rail station at Heathrow Airport at a later date, as part of the extension of the High Speed Rail network to Manchester and Leeds.

Marylebone routes capacity

As outlined in the West Midlands and Chilterns RUS the committed Evergreen 3 project will provide route-wide service improvements; increasing frequencies, reducing journey times and providing a new London Marylebone to Oxford service.

As a result of demand growth, part of which will come from the planned service improvements, there is likely to be a need for further interventions such as train lengthening or timetable changes beyond completion of the Evergreen 3 project. These would not require infrastructure enhancements so the RUS process has not identified a need to make more specific recommendations at the present time.

West Coast Main Line capacity

In the absence of the proposed High Speed Rail network, this RUS would forecast a significant capacity gap in 2031 on the WCML. The key issue affecting the London commuter market would be a significant shortfall in capacity in the morning peak on outer suburban services into London Euston. Optimisation of service patterns and capacity within the existing constraints on the route will be necessary over the coming years, but this approach alone will be insufficient to keep up with growing demand.

Consistent with proposed Government policy this RUS therefore assumes that construction of a new High Speed Rail network will go ahead, not only resolving the peak capacity gap (with which this RUS is mainly concerned) but also relieving capacity constraints on long distance services, improving journey times and creating capacity for additional services on the existing network.

Option K1, as described later, would provide new journey opportunities between the WCML and both Central London and Heathrow Airport and, in addition, may help to address London Underground system capacity at London Euston. Further development is recommended.

Midland Main Line capacity

On this route the Thameslink Programme will provide a large amount of extra capacity, enabling most peak outer suburban services to be lengthened from eight-car to 12-car formations. Beyond this the principal future crowding concern to London is forecast to relate to commuters on longer distance trains, with a forecast gap in 2031 of some 1,400 seats in the busiest peak hour.

Consistent with the recommendations of the Network RUS: Electrification Strategy and the East Midlands RUS the recommended approach to reduce this gap and provide significant other benefits will be to replace the existing High Speed Train fleet used on the Midland Main Line (MML) with higher capacity IEP trains or similar, following on from High Speed Train replacement on the GWML and East Coast Main Line (ECML).

In the longer term there would be significant transfer of north – south demand from the MML to the North East leg of the proposed High Speed Rail network, assuming the construction of new stations to serve the East Midlands and Sheffield conurbations. This would therefore fully resolve the capacity gap on the MML.

East Coast Main Line capacity

Long distance timetables have recently been substantially improved through the East Coast May 2011 timetable and, in the longer term, further opportunities will arise as a result of the major infrastructure enhancements planned at several locations along the route. The strategy for service improvements outlined in the East Coast Main Line 2016 Capacity Review is now established and optimises use of the ECML in the medium term.

However, existing strategy alone results in a forecast capacity gap of 1,500 seats in the busiest morning peak hour by 2031 on outer suburban services. Whilst this could be reduced marginally with tactical level interventions it is most readily addressable by High Speed Rail, which would shift long distance demand from the ECML to the new route. Passengers travelling to London from Leeds, Newcastle and Scotland would see additional capacity and significant journey time reductions via the new line, which would in turn, free up capacity at the southern end of the ECML for outer suburban commuters, as well as for freight.

The rolling stock strategy for the ECML is based on the planned implementation of IEP as a replacement for existing High Speed Trains and also the Class 365 EMUs currently used on fast Cambridge services. However, the existing Class 91/Mark IV sets will continue to be used on the majority of East Coast long distance high speed services for several years. In the medium term, replacement of these trains would enable a significant increase in seating capacity within the existing 11 vehicles overall length, or possibly more if longer trains were introduced at

the same time. The RUS therefore notes that future replacement of this train fleet will provide the principal opportunity for extra capacity on the key long distance flows in advance of High Speed Rail.

Closer to London the Thameslink Programme will alleviate suburban capacity constraints and improve connectivity on Great Northern routes by enabling many services to continue through the Thameslink tunnels rather than needing to terminate at London King's Cross. However, very limited additional peak trains relative to today are likely to be able to run through the critical Welwyn viaduct area, so outer suburban additional capacity from the Cambridge and Peterborough routes will be mostly restricted to that gained by running as many trains as possible at 12-car length, as recommended by the East Coast Main Line RUS.

Inner suburban services are anticipated to benefit from frequency increments following a combination of the Thameslink Programme and committed infrastructure enhancements in the Finsbury Park to Alexandra Palace area. During the consultation stakeholders have emphasised the need for the frequency increases on the Hertford Loop in particular, and a four trains per hour off-peak service is anticipated by the RUS on this route. On Moorgate routes in general the possible replacement of the Class 313 fleet has potential to provide some additional capacity, with an overall service increase to Moorgate towards the late 2020s implemented through new signalling technologies. In the shorter term direct Thameslink trains from the Potters Bar corridor to Farringdon/City Thameslink can be expected to alleviate crowding on the Moorgate branch.

West Anglia capacity

Several elements of the previous strategy for this route have now been reconsidered, given Government spending constraints in the short term and the Lea Valley four-tracking scheme (recommended by the 2007 Greater Anglia RUS) having being heavily influenced by previous plans for the major expansion of Stansted Airport. This four-tracking concept remains a stakeholder aspiration for this route, but the full scheme does not have a value for money business case at present. The RUS has therefore investigated whether smaller scale schemes could deliver as many of the original aims as possible, but at lower cost and in a shorter term timescale than would otherwise be practical.

As with the Greater Anglia RUS, the capacity strategy for the West Anglia main line is heavily reliant on progressively implementing 12-car operations on all services running fast via the Lea Valley. As a result the small number of stations on the Cambridge line not having platforms lengthened in CP4 will need to be served by longer trains at some stage, possibly with Selective Door Operation. Beyond this running as many peak trains to London Liverpool Street as practical using existing infrastructure is a priority, and a new option has now been identified which would divert Hertford East line services fast via Seven Sisters, enabling two additional services per hour on the West Anglia corridor overall and improvements to many journey times.

With respect to inner suburban services, in purely peak capacity terms (and based on existing travel patterns), the priority at present is the Southbury Loop, with eight-car platforms in the London area being much harder to extend than those on the main line and a peak capacity gap of 1,400 passengers forecast. The previously proposed new half hourly peak service from Cheshunt to Seven Sisters (for the London Underground Victoria Line) is not compatible with the Hertford East diversions via Seven Sisters, but additional stops could in future be inserted on the latter service in the inner suburban area if demand dictates. Beyond this, higher density rolling stock may be appropriate for certain inner suburban workings, or diverting some demand to the Lea Valley corridor as outlined below.

On the assumption that all the above interventions are implemented, future peak capacity is forecast to be broadly sufficient for demand to 2031. However capacity is only one of many issues on this route and several stakeholders have emphasised other significant factors, notably limited train frequencies at the lower Lea Valley stations (many of which are in potential regeneration areas), journey times on main line trains and an increasing demand for links to Stratford/Docklands. The RUS analysis has therefore focused on identifying an economically viable strategy to address these issues.

The recommendation in the RUS is for implementation of a four trains per hour Lea Valley to Stratford service. This is potentially deliverable in Network Rail's Control Period 5 (CP5), based upon a limited infrastructure scheme to facilitate turnbacks at Brimsdown. However, with that infrastructure alone some outputs (such as calling patterns) may not be ideal, so further development is required. If more extensive works are needed the business case would still be strong, but affordability constraints will be more of a factor.

A further option beyond the above has been considered for a three/four tracking scheme south of Brimsdown. If required this would provide further benefits including a better timetable and possibly more additional trains, but at significantly lower cost than full four-tracking of the route. It is possible that elements of this might, at some stage, be required to deliver a robust four trains per hour Stratford service. As with any option for extra tracks on this corridor the destination point for any resulting additional trains would need to be Stratford, as the RUS does not consider it operationally viable to further increase peak service levels on the constrained route via Hackney Downs to London Liverpool Street. The RUS also notes the need for power supply upgrade works for service increments on this corridor.

The option of an additional new half hourly service from Chingford to Stratford has also been considered, via a new curve at Hall Farm near Clapton. Whilst this also has significant merits the resulting total six trains per hour service to Stratford (when combined with the above) would reach the upper limit of capacity available to West Anglia routes in the Stratford area, due to interactions with the capacity strategy for the GEML as outlined below. Improving services from the Lea Valley is considered to be a higher priority than the Chingford line, given that the former provides benefits to more people over a wider area. The RUS is therefore unable to support a Chingford to Stratford service at this time, since a six trains per hour Lea Valley to Stratford service might eventually be justified by demand, though this conclusion should also be kept under review.

The RUS considers that, following the completion of Crossrail, many of the West Anglia to Stratford off-peak trains could potentially be extended to London Liverpool Street, utilising the infrastructure changes recommended for resolving the GEML capacity gap as outlined later. However, this would not be practical during the weekday morning and evening peaks, since the capacity would be required for the GEML route.

The table below updates the options assessed for this route:

Options for the West Anglia route		
From Greater Anglia RUS	Lengthening of all peak main line trains to 12-car.	Recommended progressively as required by peak capacity.
Option C1	Divert Hertford East trains via Seven Sisters and run additional trains to Liverpool Street.	Anticipated in a timetable change in the near future, with Hertford East services rerouted from the Lea Valley via Tottenham Hale to the Southbury Loop via Seven Sisters route. This will allow 2tph additional at peak times on West Anglia routes overall and facilitate better journey times on certain main line journeys.
Option C2a	4tph Lea Valley to Stratford service.	Requires limited additional infrastructure based upon a new turnback facility at Brimsdown. However at this stage this has not been shown to be operationally robust and further infrastructure may therefore be required. Recommended for detailed development for potential implementation in CP5.
Option C2b	4tph Lea Valley to Stratford service, with 4tph at all stations.	Requires a mixture of three and four-tracking between Lea Bridge and Brimsdown and turnback infrastructure at Brimsdown. In the absence of **Option C2a** this would be recommended, but it is significantly higher capital cost so it should be kept under review.
Option C3	6tph Lea Valley to Stratford service.	Deliverable with an additional length of four-tracking in the lower Lea Valley, beyond that required for **Option C2b**. Not recommended as this level of service to Stratford does not appear to be required by demand and the train service prevents **Option C5** below. However, this conclusion should be kept under review.
Option C4	8tph Lea Valley to Stratford service.	Requires the full four-tracking major upgrade scheme in the Lea Valley. This involves major works at Tottenham Hale and at locations north of Brimsdown, including the need to close several level crossings. Not recommended due to insufficient evidence of benefits and 8tph to Stratford being inconsistent with **Option D2**.
Option C5	2tph Chingford route to Stratford service.	Not recommended at present, as it is unclear whether demand from the Lea Valley could eventually warrant a 6tph service to Stratford under **Option C3**, which would provide a higher level of benefits to a wider area but utilise all available capacity at Stratford. This conclusion should be kept under review.
Option C6	Extend West Anglia to Stratford trains through to London Liverpool Street.	Operationally viable off-peak only, requires implementation of **Option D2**.

Finally the RUS notes that the West Anglia corridor may be an eventual destination for trains using a potential variant of the safeguarded Crossrail line 2 (or 'Chelsea-Hackney' line), as described later. Connection of the West Anglia route to such a tunnel through Central London would remove the London terminal capacity constraint, potentially enabling far more trians to run. The case for four-tracking of the Lea Valley should be kept under review in this context.

Great Eastern Main Line capacity

The Draft for Consultation forecast a major capacity challenge on the GEML, with no viable options identified at that stage for further increasing peak capacity once all peak trains via both Chelmsford and Wickford run at 12-car length (and with EMUs replacing the current ageing locomotive-hauled trains used for some services). It was emphasised that Crossrail will address capacity in East London, but not for main line services. The RUS demand modelling therefore forecast a capacity shortfall of space for 3,000 people without further schemes, implying high levels of standing on the route in the future. A number of stakeholders from Essex in particular noted during the consultation that this situation did not appear to be satisfactory, and the rail industry shared such concerns.

Following detailed further analysis the RUS has now identified an infrastructure enhancement scheme for the remodelling of the Bow Junction area, enabling the two 'Temple Mills' lines between Stratford and Bow to be fully usable for passenger trains rather than being generally restricted to freight and empty coaching stock as at present. This would effectively create six, fully usable tracks all the way between Stratford and Liverpool Street, two of which would be in the Crossrail tunnels. Such a scheme would allow use by main line services of the inner suburban capacity which will be released on the 'Electric Lines' following the diversion of services onto Crossrail.

Utilising this additional infrastructure, a morning peak timetable has been developed which would eventually involve 28 trains in the busiest peak hour on the up main line from Shenfield to Stratford, where trains would generally call alternately in platforms 9 or 10. Each of these platforms would then have an independent route to London Liverpool Street, enabling enough trains to be run overall to meet the forecast capacity gap. Further infrastructure enhancements would also be required elsewhere on the route at the starting points for the additional trains, principally in the Chelmsford area.

Some of the additional empty GEML trains running out from London Liverpool Street to clear platforms in the morning peak would need to run via the West Anglia route at Stratford in order to avoid exceeding the capacity of the single available contra-peak direction platform (10A) at Stratford. Additional berthing capacity would be required, and this would need to be in the Orient Way area for the same reason, ideally on the west side of the railway to reduce interaction with West Anglia to Stratford traffic.

It is also noted that at peak times this option would utilise the same capacity between Bow Junction and London Liverpool Street as **Option C6** above. Given that the forecast capacity gap on the GEML is significantly larger than that on the West Anglia routes, the RUS does not therefore support West Anglia to Stratford services running through to London Liverpool Street except potentially during the off-peak. Furthermore it is emphasised that six trains per hour (**Option C3**) appears to represent the absolute upper limit of available capacity at Stratford from the West Anglia route, whilst still enabling **Option D2** to be implemented, given that both involve extra trains in the Orient Way area.

The table below summarises the options now presented:

Options for the Great Eastern Main Line

From Greater Anglia RUS	Lengthening of all peak main line trains to 12-car.	Recommended progressively as required by peak demand.
	Replace 'intercity' vehicles with new rolling stock.	Recommended to provide additional capacity as rolling stock replacement becomes due.
Option D1	Run 28tph at peak times with existing infrastructure.	Not recommended as increasing services beyond 24tph is not considered operationally robust.
Option D2	Run 28tph at peak times with enhanced infrastructure.	28tph recommended by 2031 for peak capacity reasons, with 26tph as an interim step in the early 2020s. Implementation requires remodelling of Bow Junction, additional turnback infrastructure in the Chelmsford area and at Wickford and additional capacity to stable rolling stock in the Orient Way area (on the Stratford – Tottenham Hale route).

Fenchurch Street route capacity

Capacity enhancements on the route corridor to London Fenchurch Street are planned, with increasing 12-car operations. The RUS considers that this approach will provide sufficient additional peak capacity to match demand on this line. By the end of the RUS timescale it is anticipated that all peak services on this route will need to be operating with 12-car formations.

Kent route capacity

As previously recommended by the South London and Kent RUSs, additional capacity in the South East London suburbs will be required through a programme of train and platform lengthening. The carriages to facilitate this are not committed at present, but many of them are anticipated to be provided by the major rolling stock cascade that can be expected upon completion of the Thameslink Programme. The platform lengthening programme has now commenced, with the main work initially being on the various routes to Dartford, followed by the more complex remodelling work at Gravesend, with further work anticipated at locations such as Rochester and potentially London Charing Cross in CP5.

Whilst full 12-car suburban operations would provide significant extra capacity where most needed, there remain significant operational issues to resolve, including the 11-car length of platforms 4 – 6 at London Charing Cross, operational constraints in that area and around New Cross/Lewisham, platform lengths at Woolwich Dockyard and power supply constraints. The RUS advises that further work is needed to resolve these issues.

A limited peak capacity gap will also exist on High Speed 1 (HS1) services between East Kent and London St Pancras International. The Kent RUS recommended an option for lengthening and extension further back into Kent of the current Ebbsfleet peak shuttle service and this remains the recommended approach. This would build on the recent implementation of peak services between Maidstone West and London St Pancras International via Strood. The RUS also emphasises the importance of the fare pricing structure in Kent, to encourage North Kent coast passengers in particular to transfer to capacity which is available on HS1.

The potential extension of the London Underground Bakerloo line onto the Hayes branch, as described later, also remains a potential long term means of providing increased capacity into London Charing Cross from other routes.

Sussex route capacity

Significant additional capacity is now being provided on Network Rail's Sussex route – the Brighton Main Line (BML) and branches, plus the South London suburban area – through an extensive train lengthening programme and the implementation of the Thameslink Programme. This is in response to recent growth and current crowding problems on these lines.

The committed extra capacity includes train lengthening on Brighton to Bedford services (which will be lengthened from eight-car to 12-car and peak trains rerouted to run via London Bridge), the Redhill Line (more 12-car operations), the East Grinstead Line (where platform lengthening works to lengthen from eight-car to 12-car have now commenced), the Sydenham Line (where lengthening is planned from eight-car to 10-car) and all routes via Balham to London Victoria (lengthening from eight-car to 10-car). In addition to this a small number of additional trains are planned to run upon completion of the Thameslink Programme, though this can only be to a very limited degree as the major constraint through the East Croydon area will remain.

The Sussex RUS recommended further train lengthening which is not currently committed. This included running 10-car trains on the Uckfield Line and running additional longer trains on the Purley corridor (now anticipated to be combined 10-car Caterham/Tattenham Corner trains to London Victoria, with 12-car later). Inserting Clapham Junction calls in certain peak Gatwick Express services was also recommended to provide improved connectivity from Brighton to this area and spread loadings more evenly between peak trains. This RUS re-emphasises the need for these changes, shown below.

Sussex route – further recommendations (in addition to current plans)		
From Sussex RUS	Uckfield line train lengthening to 10-car.	Recommended.
	Caterham/Tattenham Corner lines to Victoria 12-car (services to join at Purley).	Recommended (with 10-car as an interim stage).
	Call certain peak Brighton/Gatwick Express services at Clapham Junction.	Recommended.

Assuming that the above strategy is implemented this RUS still forecasts a peak capacity gap on the BML in 2031 of some 3,000 passengers in the busiest peak hour, principally to London Victoria. There is an existing capacity gap on this route today, with peak standing regularly occurring as far as Haywards Heath. The RUS strategy is therefore heavily reliant on the new 12-car Thameslink rolling stock, which will be configured internally to maximise on-train capacity. Whilst overcrowding on the BML is not forecast to be fully resolved by this approach, the most heavily loaded trains will be alleviated.

The RUS has been unable to identify workable options to resolve the remaining capacity gap in a cost effective way. Ongoing reviews will be required by operators to optimise service patterns, fare structures and rolling stock allocation, to minimise the numbers of standing passengers and the duration of such standing on a train-by-train basis. Significant levels of spare capacity will exist during 'shoulder peak' times, partly due to the fixed-formation nature of vehicles using Thameslink routes, and effectively utilising the opportunity this provides is likely to be a key consideration in the future.

In the inner suburban area further train lengthening from 10-car to 12-car, as recommended by the South London RUS, could be required at some stage to alleviate high levels of standing on the Sydenham route and possibly routes via Balham. Demand forecasts on these routes are subject to uncertainty, so these conclusions should be kept under review.

South West Main Line capacity

The most significant scheme at present on the South West Main Line (SWML) is 10-car inner suburban operations, a recommendation of the South West Main Line RUS and now fully committed. As a result the modelling for this RUS does not indicate a peak capacity gap on inner suburban services in 2031, with the additional carriages providing sufficient on-train space. During the consultation period a number of stakeholders expressed views that passenger numbers in the suburban area will grow faster than suggested by the modelling. Whilst this is not the forecast in this RUS it is recognised that further lengthening to 12-car under **Option F1** would be needed in such a scenario and it is recommended that no work is undertaken which precludes this.

However the current train lengthening project only directly benefits suburban passengers, given that main line trains are generally already full length and no additional timetable slots can be found on the route for extra trains, regardless of capacity at London Waterloo. With respect to longer distance services the RUS therefore notes that a significant peak capacity gap may arise, with a forecast shortfall in capacity for some 7,000 passengers in the busiest peak hour; this figure includes capacity required on today's already overcrowded trains, along with the 3,500 resulting from future growth. The gap could potentially be reduced slightly with additional lengthening, for example on the Salisbury line and on semi-fast services from Guildford via Cobham (given that some of the latter run fast from Surbiton at peak times), and these are considered

robust tactical level interventions but this would then only marginally reduce the gap to 6,100 passengers.

The RUS has now considered seven options in significantly more detail than was presented in the Draft for Consultation. **Option F2** involves double-deck trains and work has identified that this is potentially achievable at high cost for a small number of services, but such an approach would result in significant operational complexities and is not capable of providing sufficient additional capacity. **Option F3** involves running significantly longer domestic trains than those in operation anywhere else on the UK network into the former International Platforms at Waterloo. However again this also involves major operational restrictions in where such trains would originate, it requires complex grade separation works in the Clapham Junction area for the SWML to pass over or under the Windsor lines approaches to London Waterloo, and is also not capable of providing sufficient additional capacity to fully resolve the gap.

As neither double-deck trains nor trains longer than 12-car appear to represent a robust way forward the remaining options are therefore additional services on either the existing or a new route. **Option F4** would therefore involve increased peak service frequency through an additional four trains per hour from a location such as Basingstoke, potentially requiring additional infrastructure such as a new flyover at Woking and enhancements between Clapham Junction and London Waterloo. However, stakeholders have significant concerns regarding whether the resulting 28 trains in the busiest peak hour over the Surbiton – Waterloo section is operationally viable, so further work would be needed to determine if such a level of service could be robustly delivered by future signalling technology. Even if it were achievable this approach would still only provide just over 50 per cent of the capacity needed to resolve the gap, so crowding would remain broadly at current levels.

As a result of the above the RUS has investigated a new **Option F5**, which would involve providing a fifth track from Hampton Court Junction (south of Surbiton) inwards. This appears to be broadly achievable within the existing railway boundary, but detailed engineering design work will be required to confirm viability. The RUS recommends further consideration of such a project towards the latter years of its timescale. In the meantime the land on this corridor and at London Waterloo should be protected from any development which precludes this occurring. However, the high cost of this intervention suggests that this route should be a priority for investigating the extent to which demand management interventions can be used to mitigate overcrowding before turning to major infrastructure schemes, for example through smartcard technology to encourage season ticket holders to work from home once a week.

As a further consideration a variant on **Option A5** has been developed, based on some of the additional services to London Paddington starting at Basingstoke. This **Option F6** may be a sensible way forward, though it requires infill electrification.

From the above it can be seen that a full conventional capacity solution to the SWML gap would require expensive and significantly disruptive infrastructure upgrades over a wide area. An alternative way to increase capacity on the route would be to increase the number of tracks from the Surbiton area to central London from four to six, but this is only realistically achievable by means of tunnelling over a long distance. Such a tunnel would need to fit into a cross-industry strategy for future underground lines in the capital in general. The RUS has therefore worked closely with Transport for London to identify a variant of the currently safeguarded Crossrail line 2 route, and this forms **Option F7** in this RUS.

The SWML conclusions are summarised in the table which follows:

Options for the South West Main Line		
From SWML RUS	Run all main line trains at maximum length.	This involves lengthening all peak fast trains into London Waterloo to the maximum number of carriages readily achievable without major infrastructure changes. This means either: • 12-car length (routes with 20m vehicles) or • 10-car length (routes with 23m). This approach particularly applies to semi-fast services from Guildford via Cobham and peak services on the Salisbury route. The RUS considers this will need to be implemented as a priority, though it will only partially resolve the gap.
Option F1	Implement 12-car inner suburban operations.	Modelling has not indicated that this option will be required, but this conclusion should be kept under review.

Option F2	Run double-deck trains on SWML outer services.	Detailed analysis has indicated that only a limited number of double-deck trains would be viable, even with major infrastructure works for gauge clearance on both the Southampton and Portsmouth routes to London Waterloo. The additional capacity provided would therefore be insufficient to resolve the gap. This option is therefore not recommended due to high cost and not providing sufficient additional capacity.
Option F3	Run 16-car trains on SWML outer services into London Waterloo International.	Detailed analysis has indicated that only a limited number of 16-car trains would be viable, even with major infrastructure works in the Clapham Junction area for a grade-separated junction from the main SWML tracks into the former London Waterloo International Platforms. The additional capacity provided would therefore be insufficient to resolve the gap. This option is therefore not recommended due to high cost and not providing sufficient additional capacity.
Option F4	Run 28tph SWML outer (4tph additional) with additional infrastructure at key pinchpoints.	This option would involve running additional trains in the high peak on the main lines into London Waterloo, potentially with infrastructure enhancements such as the grade separation of Woking Junction and changes between Clapham Junction and London Waterloo. However, even with these enhancements the option has not been shown to be operationally viable on the number of lines currently available from Surbiton inwards, so it is highly dependant on future signalling technologies. In addition, this level of service would only provide just over 50 per cent of the capacity needed to resolve the gap, so further interventions would still be required to fully resolve the gap.
Option F5	Run 32tph or more SWML outer with additional infrastructure at key pinchpoints and provision of five tracks between Hampton Court Junction and Clapham Junction.	This option further develops the major infrastructure enhancements from **Option F4**. In order to fully resolve track capacity from Surbiton inwards it also includes an additional main line track from around that point to Clapham Junction, which is potentially viable within the existing railway corridor. The remodelling of the London Waterloo approaches would then convert a current Windsor Line track for use by main line services. This option is therefore recommended for further development, with the land on the route corridor and at London Waterloo station protected from alternative uses which would render it impractical.
Option F6	Run services from Basingstoke into London Paddington via Reading.	This would be a variant of **Option A5** as described earlier, with some of the Thames Valley peak services to London Paddington commencing from Basingstoke, to which additional electrification would be provided. This option provides new journey opportunities and appears to have significant merit in the context of a 20tph peak GWML main line service, but would not resolve the SWML capacity gap in isolation.
Option F7	Free up SWML main line capacity by running inner services into a variant Crossrail line 2 route.	This would require the Crossrail line 2 route to eventually be constructed in tunnel out to at least the Wimbledon area (with branches towards Kingston and Epsom). As a result existing SWML stopping services would utilise the new tunnel, running via Central London rather than to London Waterloo. This would free up capacity on the existing surface level railway for additional fast trains. Further consideration is recommended as part of the planning process for Crossrail line 2.

Windsor Lines capacity

The starting point for this RUS includes reopening of the currently unused former International Platforms at London Waterloo, to enable the planned service increase on routes via Putney (the 'Windsor Lines') from the current 15 to a future 16 trains in the busiest peak hour. This is the only train service frequency increment currently committed.

A far larger volume of additional capacity is currently planned through the operation of 10-car services, which will provide 25 per cent extra vehicles on many trains. However, the committed CP4 platform lengthening programme only extends as far out as Virginia Water, so the South West Main Line RUS recommendation for full 10-car operations, involving further platform lengthening to Reading is carried forward into this RUS. As with other routes, additional rolling stock would be required to enable all trains on this corridor to be lengthened.

Once the above are implemented a limited peak capacity gap is forecast on the Windsor Lines by 2031.

The RUS has therefore considered two variants for running 18 trains in the peak on the Windsor lines as a whole, both of which would address the gap. The options have sought to minimise the impact on level crossing downtimes, by routeing the additional trains where practical via the Hounslow line, rather than the congested route via Richmond. The need for two options was influenced by the potential construction of a new route between Staines and Heathrow Terminal 5, with implementation as part of the BAA Heathrow Airtrack scheme, since this would have resulted in significant changes to the future train service structure. However, the Transport and Works Act (TWA) Application for this scheme has been withdrawn, with an alternative proposal now provided under **Option J3** later for accessing the Windsor Lines from Heathrow.

Whilst the additional peak trains under **Option G1** are operationally viable without additional infrastructure there is a degree of interaction with the TfL Piccadilly Line upgrade scheme in the Hounslow area, which, if implemented as planned, could delay the growth in demand on the Windsor lines as some passengers would switch modes.

Windsor Lines options		
From SWML RUS	Run all trains at maximum length.	This requires platforms extensions to 10-car on the Virginia Water to Reading route and is recommended for implementation in CP5.
Option G1	Run 18tph at peak times, without an increase in the off-peak.	A timetable has been developed which enables two additional train paths in the busiest peak hour, both of which are routed via Hounslow. This option is operationally viable without additional infrastructure so is recommended for further consideration through the franchise process.
Option G2	Run 18tph at peak times on the Windsor Lines, including two trains an hour to Staines or Heathrow throughout the day.	A timetable has been developed which would also enable two additional train paths, but running throughout the day. In the peak the additional paths would be via Hounslow as above, but the increment would be via Richmond in the off-peak. Track remodelling on the approaches to the former London Waterloo International terminal would potentially have been required to maintain robust performance associated with the increased level of all-day service. In addition infrastructure enhancements would have been required at Queenstown Road to run this increased level of service in the contra-peak direction. Given that the BAA Heathrow Airtrack scheme is not being progressed no further development is anticipated in the near future.
Option G3	Implement 12-car Windsor Line operations.	Modelling has not indicated that this option will be required, but this conclusion should be kept under review.

Elephant & Castle corridor to Blackfriars/ Thameslink capacity

Committed capacity increments on this route include the major impact of the Thameslink Programme. The completion of Key Output 2 of the Thameslink Programme will enable additional trains to operate into the new London Blackfriars bay platforms and capacity will be freed up over Herne Hill Junction by rerouteing Brighton Main Line trains via London Bridge which will enable additional local services.

Consistent with the recommendations of the South London RUS, operational analysis indicates that services routed via Herne Hill will need to operate into the new London Blackfriars bay platforms, whilst services routed via Catford will need to operate through the Thameslink core. Given the track and station layout currently under construction at London Blackfriars, reversing this arrangement is not considered operationally viable.

Following the impact of the above the modelling forecasts a capacity gap of some 900 passengers in the busiest peak hour in 2031, primarily inner suburban services on the Herne Hill corridor.

The RUS has considered train lengthening on this route but this is considered highly complex due to track layouts at locations such as Herne Hill and Tulse Hill, where major works would be required. It is therefore anticipated that the use of higher density rolling stock is likely to be required at some stage for these services.

Orbital routes capacity

The RUS has identified a significant capacity gap on orbital routes, which are increasingly used by passengers on journeys not requiring travel into Central London. For example on the West London Line (WLL) by 2031 the forecasts suggest a capacity gap of some 3,000 passengers in the busiest peak hour on this route, a figure which does not include the potential major impact of the proposed HS2 station at Old Oak Common.

Two of the recommendations for orbital routes relate to the WLL. As presented in the Draft for Consultation a particular problem at present is the 73-minute gap in the morning peak on otherwise hourly direct services from the WCML to the WLL. Stakeholders have indicated significant support for this to be increased to half-hourly, at least at peak times (**Option I1**). This requires a timetable recast on the WLL to match WCML paths, though this is likely to be needed anyway due to the general recast south of London following completion of the Thameslink Programme. The RUS therefore recommends detailed consideration, once sufficient dual voltage rolling stock which is needed to implement this option is cascaded from elsewhere following the introduction of new-build Thameslink trains. In advance of this during CP5, the RUS also recommends platform lengthening to allow eight-car Southern services to call at stations on the WLL (**Option I2**), which would provide a significant increment in capacity over the critical Clapham Junction/Croydon to Shepherds Bush link. The RUS also notes that development plans for the Earl's Court area can be expected to exacerbate existing crowding problems on the WLL in the absence of additional capacity.

Beyond the above other capacity solutions for orbital routes involve London Overground services. NLL trains are already configured at a high standing density, but are considered for lengthening by **Option I3**, with lengthening under **Options I4** and **I5** also addressing London Overground capacity on the ELL and Gospel Oak – Barking line respectively. Stakeholders have suggested additional trains on orbital routes as an alternative but the RUS considers this unlikely to be consistent with the important role these have with respect to freight.

The RUS also notes that the NLL and WLL routes run very close to the proposed HS2 station at Old Oak Common, so providing increased capacity and journey opportunities to this area on these routes will be an important factor.

On the South London Line service changes as part of the London Overground extension to Clapham Junction are planned, and the RUS considers that the post-Thameslink Programme timetable is likely to provide the opportunity for a four trains per hour all day service to/from London Victoria at Denmark Hill and Peckham Rye without impacting on journey times for longer distance passengers.

Options for orbital routes		
Option I1	Increase West London Line – Watford Junction (or beyond) peak service to 2tph.	Requires timetable recast on WLL. Recommended for detailed consideration once sufficient dual voltage rolling stock becomes available.
Option I2	Lengthen Southern WLL services to eight-car.	Recommended.
Option I3	Lengthen London Overground NLL/WLL services to six-car.	Recommended for further development.
Option I4	Lengthen London Overground ELL services to five-car.	Recommended for further development.
Option I5	Lengthen London Overground Gospel Oak–Barking services to three-car or four-car.	Recommended for further development, potentially linked to electrification.

Potential new lines

The RUS notes several strategic connectivity gaps (ie potential major flows where journey opportunities by rail do not currently exist) in the London area. It has only sought to consider gaps in this category related to major drivers of demand and recognises that other smaller-scale gaps and options exist at a more local level.

Improving access to Heathrow Airport

The RUS considers that the difficulty in accessing Heathrow Airport by rail (except from Central London) is a strategic gap. The options shown in the table below for new lines are described:

More detailed development of potential new rail routes to serve Heathrow airport is recommended, initially focussing on a detailed study regarding a new western access to allow through-running services. Such a link would provide connections at Reading to the West Country, South Wales and the West Midlands. This further analysis would need to be undertaken jointly between DfT, the rail industry, BAA and local stakeholders.

In addition implementation of **Option A5** described earlier would involve a ten rather than four trains per hour service from the Central London Crossrail tunnels running to Heathrow Airport. This significantly increased frequency would be a major improvement for Crossrail users from Central London, though some of the features of the existing Heathrow Express operation would be lost.

Option K1 below would provide new journey opportunities between Heathrow Airport and stations at the south end of the WCML, with one change of train.

Potential Crossrail extensions – maximising the benefits of the central London tunnels

The Draft for Consultation emphasised the desirability of optimising the usage of Crossrail tunnels, focusing on avoiding the need for services to terminate from the east in sidings at Westbourne Park (later at the proposed High Speed Rail station at Old Oak Common). This approach received a high degree of support from stakeholders and is considered to have potential to provide a high level of benefit at relatively low capital cost for major schemes of this nature.

The emerging scenario is of a 24 trains per hour peak Crossrail service (16 off-peak), all running to/from locations west of Paddington. This would create a relatively simple service pattern, based on the following peak service level:

- 10tph semi-fast to (or via) Heathrow Airport
- 6tph semi-fast on the GWML
- 8tph via a new route to the WCML slow lines.

The WCML extension option appears to have a good business case and the RUS therefore now recommends detailed development. The benefits would compliment HS2 and the two schemes have synergies, including in the Old Oak Common area through which the necessary Crossrail alignment would run.

Options for new rail routes to Heathrow Airport

Option J1	BAA Heathrow Airtrack.	Transport and Works Act (TWA) is now not proceeding in the near future. An alternative means of providing access to Heathrow Airport from the Windsor lines is provided by Option J3.
Option J2	Heathrow Airport Western connection (North).	Would enable up to 4tph Crossrail semi-fast services to be extended to Reading via Slough over a new line. Recommended for detailed consideration.
Option J3	Heathrow Airport Western connection (South).	Would enable up to 4tph Crossrail semi-fast services to be extended to Staines over a new line. Recommended for detailed consideration, as an incremental step towards Option J1.
Option J4	New High Speed Rail station complex serving Heathrow Airport directly.	The Government's proposed High Speed Rail strategy includes a new station at Heathrow Airport, to be provided when the High Speed Rail network is extended beyond the West Midlands to Manchester and Leeds.

Crossrail extension options		
Option A1	Extend relief line services to Reading.	Recommended as described earlier, for implementation as part of the 2018 scheme.
Option A5	Additional Crossrail trains to Heathrow Airport.	As described earlier a potential future train service which appears likely to be required could involve 10 Crossrail tph, all running skip-stop from Paddington at peak times. Under this option Crossrail would serve all Heathrow terminals, rather than just terminals 1-4 as planned.
Option K1	Crossrail extension onto WCML slow lines.	Recommended for detailed investigation, for several reasons: • to provide direct trains from this corridor to the West End, City of London and locations such as Canary Wharf, avoiding the need to change onto the London Underground system at London Euston • to free up capacity on the London Underground system, both at Euston station and on the Northern and Victoria lines • to improve access to Heathrow Airport, by providing the WCML corridor with access to Heathrow Airport with a single change at Old Oak Common • to improve access to orbital routes from the WCML, with potential for a single change at Old Oak Common • to enable full benefit to be made of the Central London Crossrail tunnels, with 24tph arriving from key corridors to the west and none needing to start at Old Oak Common/Westbourne Park. The case for this option is strengthened by HS2 proceeding. The option would reduce the number of trains and passengers needing to be accommodated at London Euston during HS2 construction works, and in the longer term.
Options J2/J3	Crossrail extensions west of Heathrow.	Recommended for detailed consideration as described above.
Kent RUS option	Crossrail extension to Gravesend.	Safeguarded scheme to improve connectivity to Dartford area, subject to business case.

The combination of **Options A1**, **A5** and **K1** would lead to all the peak 24 trains per hour trains from the west into the Crossrail core coming from further afield, rather than 14 Crossrail trains per peak hour starting their journey at London Paddington as currently planned.

High Speed 2

Proposed Government strategy for HS2 is consistent with the strategy outlined in this RUS. This will involve providing additional north – south capacity through the construction of a new line from an expanded London Euston to the West Midlands, running via a major new station at Old Oak Common. Later stages involve future extensions to Manchester and Leeds, together with a station at Heathrow Airport.

Whilst the strategic business case for HS2 is much wider than the peak London commuter flows that are the focus of this RUS, there are significant transport planning issues to consider in the London area. The RUS therefore recommends further development with respect to both the London Euston and Old Oak Common areas. This includes potential local links (eg between Old Oak Common and the NLL and WLL routes), capacity as a whole at London Euston and detailed consideration of which, if any, GWML fast line trains should call at Old Oak Common.

The RUS also recommends further consideration of the proposal for connecting HS1 to HS2, focusing on reducing the impact on other elements of this strategy. The current proposal involves significant interaction with London Overground and freight on the NLL in the Primrose Hill/Camden Road area. Additional infrastructure in this area is likely to be required to provide a robust solution.

Crossrail line 2 (Chelsea – Hackney Line)

The RUS supports the continued safeguarding of the alignment of a new cross-London rail tunnel. This would improve connectivity on a south west to north east axis and alleviate London Underground congestion, consistent with the Mayor's Transport Strategy.

The RUS notes that a number of potential modifications to the proposed route appear appropriate, given other developments:

- firstly, the alignment has potential to provide significant additional dispersal capacity for the passengers from the High Speed Rail network at London Euston. This would alleviate crowding in Euston Underground station and on the London Underground Victoria Line, so further consideration is recommended by this RUS
- beyond this the RUS also considers that Crossrail line 2 may have potential to fully resolve the SWML peak capacity gap. This is potentially significant for the longer term, given that the alternative approach described in **Option F5** has not been confirmed as economically viable at this stage
- the resolution of the SWML peak capacity gap appears to require an alignment via Clapham Junction, an area which is a significant driver of demand in its own right. This approach is considered by the RUS to have more potential as a means of jointly alleviating London Underground and National Rail capacity issues than the currently safeguarded alignment via the Southfields route to Wimbledon, so further development is recommended
- finally the RUS notes that the West Anglia corridor may provide an eventual destination for trains using such a cross-London tunnel. This route would provide a ready-made destination corridor for services through the tunnel, which would relieve the constraints of London terminal capacity. Possible long-term four tracking of the West Anglia route, as considered under **Option C4** should be considered in this context.

The RUS recommends further development of Crossrail line 2 for the longer term, to alleviate both London Underground and main line congestion on trains, provide new journey opportunities and reduce journey times.

East – West Rail

The RUS notes the potential for further development of the proposed East – West Rail link, promoted by a consortium of local authorities, which would run over the Oxford – Bletchley axis and potentially beyond. Any passenger connectivity gap addressed by this scheme is outside the scope of this RUS, but it is noted that reopening of this route would also provide a potential new freight routeing, in additional to those existing at present, which might assist with flows such as Southampton Docks to Daventry.

Other potential Transport for London schemes interacting with the National Rail network

As described above the RUS supports the concept of a southern extension to the London Underground Limited Bakerloo line, providing new journey opportunities and alleviating crowding on rail routes into London Charing Cross, by means of taking over the Hayes route.

Other recent work by TfL has considered extending the Docklands Light Railway system. The principal interaction with this RUS would be any extension westwards of Bank, giving interchange to north-south National Rail routes at City Thameslink.

The RUS notes ongoing development work on the Croxley Link scheme, being promoted in conjunction with Hertfordshire County Council, which would enable the extension of London Underground Metropolitan Line services to Watford Junction, so improving connectivity.

Finally, extending the Tramlink system to Crystal Palace would involve the closure of the National Rail line via Birkbeck, with affected rail services diverted to Norwood Junction.

Other routes

Various other new lines or reopenings are possible, mostly schemes of a local nature. Further work is planned by the appropriate scheme promoters in this respect.

Freight in South East England

The RUS has considered capacity issues associated with the interaction between passenger and freight in South East England in detail, focussing on a main routeing strategy for key future flows. The principal capacity issue is the need to accommodate growing intermodal import traffic from the container ports, in addition to passenger growth on much of the network as discussed earlier. Most of this new traffic is heading for distribution centres which are generally located in the Midlands or north of England, rather than in the London area.

Given that the London railway network is heavily congested the RUS has therefore considered how routes avoiding London could best be improved such that traffic not serving the Capital directly can have alternative routeing options, whilst not incurring uncompetitive cost or journey time increases which would adversely affect rail freight companies and the industry in general. The approach of avoiding London received mixed views in the consultation, with freight operators seeking new routes for the growth element of traffic only, whereas those representing passenger services sought as much existing freight to be routed away from the Capital as possible.

A key short term objective is to increase train lengths and move from five to six-day working of key flows. This would reduce the number of additional paths needed on weekdays per tonne moved overall. However, the RUS emphasises that the needs of six-day operation and longer trains are likely to lead to a need for infrastructure interventions in several areas, and that these are not currently funded.

Beyond this the RUS recommends the main freight routeings for key flows as outlined below, based on optimising network capacity overall. Capability upgrades focussing on these routes, together with appropriate diversionary options (some of which are via London), for maximum efficiency in terms of loading gauge, speed and trailing loads are now being developed through the ongoing Strategic Freight Network workstream.

Key freight growth area	*2010 average traffic*	*2031 traffic forecast*	*Proposed main routeing during normal operations*
Felixstowe/ Bathside Bay	28tpd	58tpd	Main route for current and future traffic recommended as being the cross-country route via Bury St Edmunds. To achieve this, the cross-country route will need to be progressively upgraded beyond current commitments, with services using this route needing to be just as efficient to operators as a London routeing.
Southampton	20tpd	51tpd	Main route for current and future traffic recommended as being via Oxford. Redoubling of sections of the Leamington Spa – Coventry line could assist with future growth, but would not in isolation resolve the need for freight traffic from the WCML to Southampton to make flat crossing moves at both Nuneaton (in the southbound direction) and Coventry. The RUS therefore notes that reopening of the East – West Rail corridor (promoted by a consortium of local authorities) is potentially a useful and faster new route for certain freight flows, enabling traffic for Southampton to leave the WCML at Bletchley. This is, however, subject to the major issue of paths on the WCML itself – but this is considered to be less of a concern post-HS2.

Key freight growth area	2010 average traffic	2031 traffic forecast	Proposed main routeing during normal operations
Essex Thameside (London Gateway etc)	8tpd	50tpd	Main route for as much traffic as possible recommended as being the Gospel Oak – Barking line and the WCML. This would minimise the passenger/freight interactions in the Forest Gate/Stratford area. Electrification of the Gospel Oak – Barking line and the associated Thameshaven Branch and Ripple Lane Sidings was recommended in the Network RUS: Electrification. Further consideration has been undertaken regarding the forecast need for approximately 9tpd each way between London Gateway and the ECML, with the RUS analysis now identifying the availability of 5 paths in the daytime off-peak via Forest Gate/Stratford for this traffic, subject to the Felixstowe/Bathside Bay traffic running via the Bury St Edmunds route as above. The remaining 4tpd would need to run late in the evening or overnight.
Channel Tunnel	6tpd	35tpd	Main route for current and future traffic envisaged as remaining via Maidstone East, Catford and the WLL to the WCML.
Kent Thameside (Isle of Grain, Medway etc)	9tpd	24tpd	Various routeings via the London area, dependent on destination.

Note: tpd = trains per day.

In addition to the above, new domestic intermodal freight traffic serving the capital is expected to arise, though this requires the development of new terminal sites convenient to the flows concerned. This has potential to remove significant numbers of lorries from the highway network.

During the consultation stakeholders raised specific concerns regarding future off-peak freight capacity on the Midland Main Line following completion of the Thameslink Programme, as described later. Resolving these will potentially require changes to be made to future passenger services.

South Hampshire and Solent

This RUS has provided the equivalent of a first generation RUS for this area, which was not covered in detail by the South West Main Line RUS. The key recommendations are:

- Brighton to Southampton Central service, to run as a loop service via Eastleigh and Southampton Airport Parkway, thence returning to Brighton via the Netley Line. This would effectively create a link between Southampton Airport and the West Coastway route in both directions
- targeting of journey time improvements wherever possible, either through infrastructure upgrades or timetable recasts
- small-scale infrastructure enhancements that might lead to further service changes, in particular redoubling of part of the Botley line and consideration of an additional platform 4 at Eastleigh. Other works may be needed linked to the growth in freight from Southampton Docks as described above.

The RUS has also investigated reopening of the Marchwood line to passenger traffic and potential conversion of the Netley Line to tram-train technology, but is unable to recommend either of these at this time.

Next steps

This strategy will now be considered by the Office of Rail Regulation (ORR). Subject to the ORR not issuing an objection this RUS will then become Established. The strategy will then influence the future investment plans of Network Rail and its industry partners.

1. Background

1.1 Introduction to Route Utilisation Strategies

1.1.1 Following the Rail Review in 2004 and the Railways Act 2005, the Office of Rail Regulation (ORR) modified Network Rail's Network Licence in June 2005 to require the establishment and maintenance of Route Utilisation Strategies (RUSs) across the network, with guidance also published by the ORR on what a RUS should contain. Both of these documents were then updated and re-issued on 1 April 2009.

1.1.2 A RUS is defined in Condition 1 of the Network Licence as, in respect of the network[1] or a part of the network, a strategy which will 'promote the route utilisation objective'. The route utilisation objective, which focuses on issues associated with the availability of network capacity, is defined as:

> **"the effective and efficient use and development of the capacity available on the network, consistent with the funding that is, or is likely to become, available during the period of the route utilisation strategy and with the licence holder's performance of the duty."**

Extract from ORR Guidelines on Route Utilisation Strategies, April 2009

1.1.3 The ORR Guidelines explain how Network Rail should consider the position of the railway funding authorities, their statements, key outputs and any options they should wish to be tested. Such strategies should address:

> **"• network capacity and railway service performance**
> **• train and station capacity including crowding issues**
> **• the trade-offs between different uses of the network (eg. between different types of passenger and freight services)**
> **• rolling stock issues including deployment, train capacity and capability, depot and stabling facilities**
> **• how maintenance and renewals work can be carried out while minimising disruption to the network**
> **• opportunities from using new technology**
> **• opportunities to improve safety."**

Extract from ORR Guidelines on Route Utilisation Strategies, April 2009

1.1.4 The guidelines also set out principles for RUS scope, time period, processes to be followed and assumptions to be made. Network Rail has developed a RUS manual which consists of a consultation guide and a technical guide. These explain the processes used to comply with the licence condition and guidelines. These and other documents relating to individual RUSs and the overall RUS programme are available at **www.networkrail.co.uk.**

1.1.5 The ORR Guidelines require options to be appraised and the RUS has been developed using economic analysis carried out by Network Rail to the Department for Transport's (DfT's) appraisal criteria, on which further information can be found at **www.dft.gov.uk/pgr/economics**. The appraisal criteria are based on maximising the value of the railway to society at large, not just to companies within the rail industry. Analysis of operational issues and infrastructure capability has been carried out by specialists within Network Rail.

1 The definition of network in condition 1 of Network Rail's network licence includes, where the licence holder has any estate or interest in or, right over a station or light maintenance depot, such station or light maintenance depot

1.2 Second generation RUSs

1.2.1 The Network Licence requires Network Rail to both establish and maintain RUSs. Since 2005 Network Rail has consulted on and published several Generation One RUSs of relevance to London and South East England, starting with the South West Main Line RUS Draft for Consultation in November 2005 and most recently the West Coast Main Line RUS in July 2011. Given the length of time which has passed since the start of the programme – and developments affecting the railway industry in this period – this Generation Two RUS aims to make sure the strategy remains consistent across the multiple route corridors into the capital and brings all the recommendations affecting this part of the country up to date.

1.2.2 This strategy builds on the established Generation One RUSs, which generally made detailed recommendations covering the period to 2019. However it also takes into account Government rail policy decisions made subsequent to the Generation One RUSs, for example changes as a result of the Comprehensive Spending Review (October 2010), ongoing work on the Crossrail, Thameslink and Intercity Express Programmes, and ongoing design work with respect to High Speed 2. Like other RUSs, it primarily focuses on peak capacity, since that is what determines strategic level planning of railway infrastructure, rolling stock and timetables. The RUS does not therefore seek to cover all other issues, given that other mechanisms exist for addressing these.

1.2.3 This RUS extends detailed analysis of peak passenger and freight demand to 2031, identifying gaps where currently committed supply will not meet forecast demand. To address these gaps it identifies interventions, some of which are carried forward from Generation One RUSs. New options are then identified for a number of route corridors and recommended where possible, backed up by timetable development, infrastructure design and economic analysis as appropriate.

1.2.4 The process is designed to be inclusive, with high levels of collaboration between rail industry parties, who govern and share ownership of the RUS through its industry Stakeholder Management Group (SMG). There have been a number of working groups on specific key issues, many of which were also attended by Passenger Focus on behalf of rail user groups. Briefings were carried out to wider stakeholders such as councilors and elected representatives during the RUS consultation period and further briefings will now take place.

1.2.5 RUSs occupy a particular place in the planning activity for the rail industry, providing non-binding recommendations which influence future activities such as refranchising, rolling stock deployment and infrastructure enhancement schemes. The recommendations are based on detailed modelling of passenger and freight demand and are shaped by Government policy in terms of affordability in the short term, but seek to influence policy where necessary over the longer term. For this Generation Two RUS, the identification of longer-term constraints which require strategic interventions is an important output in order to influence policy.

1.2.6 RUSs form an essential building block of the Industry Initial Plan, itself a precursor to the High Level Output Specification process which will define the outputs required from Network Rail's infrastructure in its next control period (Control Period 5 2014–2019) and from operators with respect to their train services. Many of the interventions in this RUS have been recommended for Control Period 5.

1.2.7 Network Rail will also take account of the recommendations from RUSs when carrying out its shorter-term activities. In particular, they will be used to inform decisions regarding the allocation of capacity through application of the normal Network Code processes. The ORR also takes account of established RUSs when exercising its functions, for example when considering requests for train paths.

1.3 About this document

1.3.1 This strategy is the third[2] Generation Two RUS published by Network Rail.

1.3.2 The initial chapters set the scene for the RUS analysis. **Chapter 2** covers the geographic scope and timeframe of the document as well as the planning context which it sits within. **Chapter 3** considers issues emerging from the consultation and how they have been considered by Network Rail. Current operations, train performance and peak passenger demand trends into and around the capital are reviewed in **Chapter 4**. **Chapter 5** details pre-existing strategy for weekday peak capacity, including both committed (funded) schemes and other recommendations still outstanding from previous RUSs.

1.3.3 The later chapters describe future forecasts of demand, peak capacity gaps and options which would bridge them. **Chapter 6** summarises the modelled peak passenger demand on key corridors into the capital to 2031. Based on these forecasts **Chapter 7** then quantifies strategic gaps between capacity and demand at a route corridor level, with timetable development, infrastructure design and economic analysis of options to resolve them, with several recommendations made as a result. **Chapter 8** covers new lines or extensions, as some such schemes are more appropriate than capacity upgrades to the existing network. This includes how to improve access to Heathrow Airport, possible extensions to Crossrail and issues associated with High Speed 2. **Chapter 9** develops a strategy for growing rail freight, focusing primarily on identifying route capacity for the specific growth area of intermodal traffic from the key ports. **Chapter 10** then summarises the recommended strategy for Control Period 5 and beyond, including consideration of wider impacts such as those on the London Underground system. Finally, **Chapter 11** provides a particular strategy for the South Hampshire and Solent area, given that this area was not covered by a Generation One RUS.

1.3.4 This RUS will be considered by the ORR, which has the right to require Network Rail to undertake further work on it should it wish to do so.

2 The first two being the Northern RUS and the Scotland RUS, which were published in May 2011 and June 2011 respectively

2. Scope and planning context

2.1 Introduction

2.1.1 This chapter details the geographic scope for the London and South East Route Utilisation Strategy (RUS) and its linkages to other studies, its purpose, governance arrangements, timeframe and the planning context in which it is set.

2.2 Geographic scope

2.2.1 The RUS covers passenger and freight demand in the Greater London area and abutting regions of South East England. Unlike previous RUSs it has no specific scope in terms of railway network geography, instead considering capacity issues on all routes into and around London, together with including a specific study of the Solent/South Hampshire area.

2.2.2 This RUS provides a high level overview of the following geographic (ie line of route) or other RUSs previously published:

- South West Main Line (March 2006)
- Cross London (August 2006)
- Freight (March 2007)
- Greater Anglia (December 2007)
- East Coast Main Line (February 2008)
- South London (March 2008)
- Kent (January 2010)
- Sussex (January 2010)
- East Midlands (February 2010)
- Great Western (March 2010)
- West Midlands and Chilterns (May 2011)
- West Coast Main Line (July 2011)
- Network RUS : Scenarios and Long Distance Forecasts – June 2009
- Network RUS : Electrification Strategy – October 2009;
- Network RUS : Stations – published as a Draft for Consultation in May 2011
- Network RUS : Passenger Rolling Stock – published as a Draft for Consultation in May 2011.

2.2.3 Each of the above RUSs contains a substantial volume of background information regarding issues such as infrastructure capability, characteristics of the railway network and train operations for their respective areas. This baseline information is not fully repeated in this document in order to preserve brevity but all the above earlier RUSs are available at **www.networkrail.co.uk**.

2.3 Purpose of the London and South East RUS

2.3.1 The RUS is designed to provide a strategic level overview of the development of the railway in much of South East England, covering a 20-year timescale in detail, together with an indication of potential issues beyond this time. The railway network in this part of the country is largely utilised for commuting to London and given recent and ongoing growth in passenger numbers the RUS considers the need for additional peak capacity over the next 10-15 years as its primary theme. Beyond this there are a number of new or route extension options for improving freight operations, for providing additional journey opportunities and for integration with Mayoral and Transport for London strategy, so the RUS considers these concepts.

The RUS is designed to provide a strategic level overview of the development of the railway in much of South East England, covering a 20-year timescale in detail, together with an indication of potential issues beyond this time.

2.3.2 The London and South East RUS builds upon the existing established RUSs, which cover most of the area within its remit. However, it also looks beyond this previous strategy, for example in the following areas:

- the London and South East RUS looks at all corridors into London in a consistent way, so results are now directly comparable between routes
- following publication of the Transport White Paper in 2007, all subsequent RUSs were expected to look towards a 30-year planning horizon. Some of the previous RUSs (and those being worked on at the time of the White Paper) looked at a shorter-term horizon, typically to around 2019. For consistency, these earlier RUSs are having their planning horizons extended by this RUS, with detailed analysis on all routes now covering to 2031
- economic conditions have changed markedly since the time of earlier RUSs, impacting on both forecast demand and affordability
- unlike in some of the earlier RUSs, schemes such as the Thameslink, Crossrail and Intercity Express Programmes, platform lengthening in many parts of the capital and various other projects are now committed schemes. This has led to further understanding of the effects of these (on both infrastructure and train services), which is now incorporated into this RUS
- similarly in the freight sector, funding has been made available for a number of projects, principally involving capacity enhancement schemes and gauge clearance to allow the operation of 9'6" containers on conventional wagons. More is also now known about freight trends and anticipated freight terminal developments
- several of the previous RUSs indicated that London terminal capacity would become a limiting factor for accommodating growth in the future. Given that a potential solution to this could be further future development of the Crossrail network, the Thameslink network or the construction of further cross-London rail corridors (such as a Crossrail line 2 also known as the Chelsea – Hackney line) it is considered appropriate for such issues to be addressed through a London-wide analysis rather than on a line-by-line basis
- the first of Network Rail's RUSs, the South West Main Line RUS, was developed as a prototype and was produced within comparatively short timescales in order to inform the South Western refranchising process in 2006. As a result, certain parts of the network (for example the South Hampshire and Solent area) were not considered fully, so the opportunity is taken in this RUS to remedy this
- Government policy has changed with respect to airport growth in particular at Heathrow Airport and Stansted Airport
- Government policy now includes the development of a High Speed 2 network from London to the West Midlands and beyond. This has significant implications for the whole of the West Coast Main Line and other routes to the north, for the Old Oak Common area and for associated issues such as the impact of links to High Speed 1.

2.3.3 It is important to emphasise that the London and South East RUS has not re-examined the established RUS strategies relating to Network Rail's Control Period 4 (covering the period to 2014), and has only re-examined strategies for subsequent control periods where there has been a material or significant change in circumstances since the strategy was established. In general the recommendations from previous RUSs have therefore been carried forward into this updated strategy, with the starting point being the assumption that these are implemented before new options are sought.

2.4 Stakeholders and RUS governance arrangements

2.4.1 The RUS has been managed through a rail industry Stakeholder Management Group (SMG), the governing authority for the strategy. The SMG met at the start of the process to agree the scope, then convened again at various key stages in the process to steer the emerging strategy as necessary. The most recent meetings covered changes required as a result of the consultation process and to agree the conclusions in this RUS.

2.4.2 The SMG included representatives from Network Rail, the Department for Transport (DfT), Transport for London (TfL) and the Association of Train Operating Companies. It included the following passenger Train Operating Companies; Chiltern Railways, CrossCountry, East Midlands Trains, First Capital Connect, First Great Western, Grand Central, Heathrow Express/British Airports Authority, London Midland, National Express East Anglia, Southeastern, Southern Railway, South West Trains and Virgin Trains. The rail freight industry was represented by DB Schenker, Freightliner Group and the Rail Freight Group. London TravelWatch and Passenger Focus attended the SMG to represent the interests of rail passengers.

2.4.3 Reporting to the SMG, a number of working groups were established during the development of the RUS. These covered the South West Main Line, Windsor Lines, Great Eastern Main Line, West Anglia route, Great Western Main Line, freight in South East England, potential new lines in the London area and Solent/South Hampshire. Each had a specific remit to develop an understanding of future demand requirements and appraise options to address RUS gaps. The working groups were made up of relevant representatives from the SMG.

2.4.4 As can be expected the SMG and working groups expressed a wide range of views on key issues, but the final responsibility for production of the RUS lies with Network Rail. In areas where full agreement from all industry stakeholders was impractical Network Rail has sought to develop options which represent a compromise between different views, consistent with the Route Utilisation Objective as discussed in **Chapter 1**. The Office of Rail Regulation attends the SMG and working groups in an observing capacity and is able to assist in this regard.

2.5 Time horizon

2.5.1 The strategy covers the 20-year period from its publication in 2011 to 2031. However, in practice if growth rates are different to those the RUS anticipates then the recommendations it contains would remain appropriate, but phasing of their implementation may need to be reconsidered either in the shorter or longer term.

2.5.2 In general the outputs and recommendations of previously established RUSs are being used to inform development of the High Level Output Specification (HLOS) for Network Rail's Control Period 5, covering 2014 – 2019, so this RUS has in most cases carried these forward into this strategy, though new analysis has been undertaken where necessary.

2.5.3 The new options in this RUS are therefore primarily envisaged as influencing transport and other planning policy over a time period beyond 2019, with new recommendations in many cases being for Control Period 6 and beyond. However there are some recommendations in this RUS which would potentially be appropriate to implement in advance of this.

2.6 Government strategy – Department for Transport

2.6.1 The DfT published the 'Delivering a Sustainable Railway' White Paper in July 2007. This confirmed that the policy of the Government in place at that time for the railways was to facilitate significant growth, with a commitment to a continuing investment programme.

2.6.2 The White Paper described a long-term ambition for a railway that:

- can handle double today's level of freight and passenger traffic
- is even safer, more reliable and more efficient than now
- can cater for a more diverse, affluent and demanding population
- has reduced its own carbon footprint and improved its broader environmental performance.

2.6.3 The White Paper described how demand nationally had grown by 40 per cent within the ten years to 2007 and was predicted to grow by at least 30 per cent over the decade to 2017. When this level of growth was combined with already high levels of crowding at the time of its publication, there was a significant capacity challenge for the railway. This led to the creation of a number of HLOS metrics, covering the specific requirements for Control Period 4. On many routes current franchise commitments now require delivery of extra capacity to meet the HLOS.

2.6.4 Since the present Government came to power in May 2010, there has been no fundamental change to the policy of a growing railway. Recent Government announcements have included full approval to the Crossrail and Thameslink schemes, together with new rolling stock, plus full approval to the Intercity Express Programme and electrification of the Great Western Main Line to Bristol, Cardiff, Newbury and Oxford. Development of plans for a High Speed Rail network is ongoing and currently subject to consultation.

2.6.5 However, in light of current and future public spending constraints, the rail industry is now under particular scrutiny with respect to the need to reduce its costs. The most recent development in this regard is the publication in May 2011 of the 'Realising the Potential of GB Rail – Report of the Rail Value for Money Study', following detailed work headed by Sir Roy McNulty.

2.6.6 A key recommendation from the value for money study is the setting of a target of a 30 per cent saving in rail industry unit costs (ie the total cost per passenger kilometre) by 2019. Recommendations to achieve this focus on removing the following ten principal barriers to efficiency in the rail industry:

- fragmentation of rail industry structures and interfaces
- the way in which major players in the industry have operated
- roles of Government and industry
- nature and effectiveness of incentives
- franchising
- fares structures
- legal and contractual frameworks
- supply chain management
- insufficient emphasis on whole-system approaches
- relationships and culture within the industry.

2.6.7 With respect to RUSs, McNulty recommended a move away from 'Predict and provide' to 'Predict, manage and provide'. Consistent with this, this RUS only recommends capital solutions where there is a robust economic case and where all other options (such as better utilising existing capacity) have been exhausted.

2.7 Transport for London

2.7.1 In addition to central government strategy, the transport, economic and spatial planning development of the Greater London area is covered by the Mayor's London Plan, which has significant interface with this RUS and covers the entire Greater London Authority area. The most recent update was published as a draft in October 2009 and subsequently has been subject to consultation and examination in public. It is expected to be formally adopted in late 2011.

2.7.2 The plan comprises three documents: The London Plan is the overall strategic development plan for the capital and sets out an integrated economic, social, environmental and transport policy framework for London over the years to 2031; The Economic Development Strategy sets out ambitions for the economic future of London and the Mayor's Transport Strategy (MTS) sets out a vision for transport in London over the next 20 years.

2.7.3 Of most relevance to this RUS the MTS was published in May 2010, and sets the following strategic goals:

- economic development and employment growth (managing public transport crowding and highway congestion, preparing for further population and employment growth, strengthening the role of Outer London in London's economy)
- quality of life (addressing poor air quality and climate change and ensuring that journeys are as comfortable as possible)
- safety and security (maintaining and improving safety and security of streets and the transport network)
- transport opportunities for all (improving the accessibility of the transport system)
- climate change (cutting CO2 emissions and preparing for change).

2.7.4 In response to these challenges the MTS sets out a comprehensive range of proposals to improve London's transport network, with 14 specific proposals for the National Rail network in the Greater London area. These would be delivered by a range of stakeholders including TfL itself, passenger and freight train operating companies and Network Rail.

2.7.5 In addition to the above the MTS also describes in detail ongoing improvements to the London Underground network, buses, river, Tramlink, the Docklands Light Railway, streets, walking and cycling.

2.7.6 With respect to potential further expansion of the London Underground system and other TfL networks the MTS specifically notes potential future extensions of the Northern Line towards Nine Elms/ Battersea, of the Bakerloo Line south of Elephant & Castle, of the Metropolitan Line to Watford Junction, of the DLR (to Dagenham Dock, south of Lewisham, west of Bank and north of Stratford International) and to the Tramlink system.

2.7.7 The proposals in the MTS have informed this strategy. The RUS has sought for the options it has considered to be consistent with the proposals in **Figure 2.1** where possible.

Figure 2.1 – Mayor's Transport Strategy proposals with respect to the National Rail network (May 2010)

Proposal 1
The Mayor, through TfL, and working with the DfT, Network Rail, the operators of international rail services and other transport stakeholders, will encourage the provision of direct international rail services to a wider range of European destinations, with some of those new services serving Stratford International station.
Proposal 2
The Mayor, through TfL, and working with the DfT, Network Rail, train operating companies, freight operating companies, London boroughs and other transport stakeholders, will support the development of more rail freight terminals in or near London, including connections to HS1 for international freight, in line with the London Plan policy to identify new sites for strategic rail freight interchanges.
Proposal 3
The Mayor, through TfL and working with the DfT, Network Rail, train operating companies, freight operating companies, London boroughs and other transport stakeholders, will support the development of National Rail routes that relieve London of freight without an origin or destination in the capital.
Proposal 4
The Mayor and TfL support the development of a national high speed rail network and will work with the DfT, Network Rail, High Speed Two and other transport stakeholders to ensure that the main London terminal for any new high speed line is centrally located, well connected to the existing public transport network, and widely accessible to maximise access to jobs and London's population. It is currently considered that London Euston best meets these criteria. Further evaluation will be made of this and other potential termini, in particular, in relation to links to Heathrow Airport.
Proposal 5
The Mayor, through TfL, and working with the DfT, Network Rail, train operating companies, freight operating companies, boroughs and other transport stakeholders, will seek to ensure that Crossrail is delivered by 2017[1], and that it is fully integrated with the rest of London's public transport system; that the impacts of construction on residents and businesses are minimised as far as possible; and that the future benefits Crossrail brings are monitored to ensure the rail link achieves its objectives.

1 Now 2018

Proposal 6
The Mayor, through TfL, and working with the DfT, Network Rail, train operating companies and other stakeholders, will consider future extensions of Crossrail that reduce congestion and improve connectivity on London commuter routes.
Proposal 7
The Mayor, through TfL, will seek to ensure that Network Rail and the train operating companies deliver the committed improvements to the rail network and services in London as set out by the DfT's High Level Output Specification for the period 2009 to 2014.
Proposal 8
The Mayor, through TfL, and working with the DfT, Network Rail, train operating companies, London boroughs and other transport stakeholders, will seek further rail capacity across London's rail network, beyond those schemes already committed. The highest priorities in the medium term are to further increase capacity on London Overground; on southwest routes; on West Anglia routes, including access to Stratford; on Great Northern services; and at congested stations. In the longer term, further capacity solutions may be required on a number of rail corridors, such as the Brighton Main Line.
Proposal 9
The Mayor will support new rail capacity in the broad southwest to northeast corridor, for example, new lines or services using the Chelsea – Hackney line safeguarded alignment. TfL will undertake a review of the route to ensure it is providing the maximum benefits, including helping the onward dispersal of passengers from Central London termini and value for money.
Proposal 10
The Mayor, through TfL, will seek to ensure that the DfT, Network Rail and the train operating companies achieve the HLOS 'public performance measure' for reliability, as well as an overall reduction in significant lateness and cancellations for London and southeast services.
Proposal 11
The Mayor, through TfL, and working with the DfT, Network Rail, train operating companies and London boroughs, will seek to deliver capacity enhancements at some of London's most congested stations. The highest priorities include: Central London termini station congestion relief and onward distribution enhancements (the potential of all onward modes will be considered) Clapham Junction station capacity enhancement (new improved links between platforms, additional entrances and more ticketing facilities) Improved capacity at National Rail stations with severe congestion, including Finsbury Park, Bromley South, Wimbledon, Vauxhall and Barking Improved capacity at National Rail stations with moderate congestion, including Willesden Junction, Balham, West Croydon, Putney, Norwood Junction and Surbiton.
Proposal 12
The Mayor, through TfL, and working with Network Rail, the train operating companies and other transport stakeholders, will encourage the achievement of a seven day railway by better planning and management of necessary engineering and maintenance work on the railway.
Proposal 13
The Mayor, through TfL, and working with Network Rail, the train operating companies and other transport stakeholders, will encourage the provision of rail services in London that meet common service standards, including improved ambience, amenities and wayfinding at all stations, and staff availability at each station. It is intended these improvements will be rolled out as franchises are renewed. However, they would be better achieved if the Mayor had more control over suburban rail services in the London area.
Proposal 14
The Mayor, through TfL, working with the DfT and Network Rail, will deliver the committed investment in the Overground network, investigate the feasibility of providing further capacity to assist orbital movement, and will review potential benefits of extensions to the network of services.

2.8 South Hampshire and Solent area

2.8.1 The planning context of this area is provided in **Chapter 11**, which considers this part of the network in detail.

3. Consultation Process

3.1 The Draft for Consultation

3.1.1 This Chapter summarises the consultation process for the London and South East Route Utilisation Strategy (RUS) and the steps which have been taken in response.

3.1.2 This RUS was published as a Draft for Consultation in December 2010. This was placed on Network Rail's website and a press release was issued announcing its publication. Hard copies of the document were distributed to stakeholders known to have a particular interest and to a number of wider representatives.

3.1.3 All interested parties were invited to submit written comments on the Draft for Consultation, with a 12-week period allowed for this. All written submissions received during this period have now been placed on the Network Rail website and have influenced this chapter, so that the range of views formally expressed is visible to all.

3.1.4 During the consultation period detailed briefings were conducted by Network Rail staff to Stakeholder Management Group members, to a range of local authorities and selected elected representatives.

3.1.5 Feedback from Rail User Groups was particularly sought and this element of the consultation was carried out in conjunction with Passenger Focus, who provided significant assistance in seeking views across a wide spectrum of rail users, as well as submitting a consultation response in their own right.

3.1.6 The key themes emerging from the consultation, whether by written submissions or arising during questioning at briefings, have been considered in detail by those carrying out the analysis which has now informed this RUS. The development of options has sought to respond to concerns raised where it has been practical to do so and where appropriate evidence exists.

3.1.7 All those who responded to the consultation are thanked for their contribution to the process. Unfortunately it has not be practical to enter into detailed correspondence on specific issues with individuals or other non-funders, but all views received have been welcomed and many of them have helped to influence this final strategy.

3.2 Consultation responses

3.2.1 Stakeholders who responded to the main element of the consultation fell into six broad categories. Formal responses were received from:

1. **The rail industry, including RUS Stakeholder Management Group members**
   - Arriva UK Trains
   - Associated Society of Locomotive Engineers and Firemen
   - Association of Train Operating Companies
   - DB Schenker Rail (UK)
   - Department for Transport
   - First Great Western
   - Freightliner Group
   - Heathrow Express
   - Office of Rail Regulation
   - Passenger Focus
   - Rail Freight Group
   - Stagecoach South Western Trains
   - Transport for London
2. **Local Authorities, including the majority of London Boroughs**
   - Bedford Borough Council
   - Borough of Broxbourne
   - Buckinghamshire County Council
   - Cambridgeshire County Council
   - City of London
   - Crawley Borough Council
   - East Herts Council
   - East Sussex County Council
   - Eastleigh Borough Council
   - Essex County Council
   - Fareham Borough Council
   - Hackney Council
   - Hampshire County Council
   - Hart District Council
   - Hastings Borough Council
   - Havant Borough Council
   - Hertfordshire County Council
   - Hungerford Town Council
   - Kent County Council
   - London Borough of Barking & Dagenham
   - London Borough of Barnet
   - London Borough of Bexley
   - London Borough of Brent
   - London Borough of Camden
   - London Borough of Croydon
   - London Borough of Ealing
   - London Borough of Enfield
   - London Borough of Hammersmith & Fulham
   - London Borough of Haringey
   - London Borough of Harrow
   - London Borough of Havering
   - London Borough of Hillingdon
   - London Borough of Lewisham
   - London Borough of Newham
   - London Borough of Redbridge
   - London Borough of Southwark
   - London Borough of Sutton
   - London Borough of Tower Hamlets
   - London Borough of Waltham Forest
   - London Borough of Wandsworth
   - London Councils
   - Milton Keynes Council
   - New Forest District Council (NFDC)
   - Norfolk County Council
   - Peterborough City Council
   - Portsmouth City Council
   - Reading Borough Council
   - Royal Borough of Kensington and Chelsea
   - Royal Borough of Kingston upon Thames
   - Royal Borough of Windsor and Maidenhead
   - Sevenoaks District Council
   - Southampton City Council
   - Tandridge District Council
   - Test Valley Borough Council
   - Transport for South Hampshire
   - Uckfield Railway Line Parishes Committee
   - Waltham Forest Council
   - West Sussex County Council
   - Winchester City Council

3. **Elected representatives and Political Parties, including nine Members of Parliament**
   - Bellingham Ward Councillors
   - Councillor Clyde Loakes
   - Councillor Denise Hyland
   - Councillor Sue Vincent
   - Jane Ellison MP
   - Jim Dowd MP
   - Joan Ruddock MP
   - John Denham MP
   - Justine Greening MP
   - Kate Hoey MP
   - London Assembly's cross-party Transport Committee
   - London Assembly Liberal Democrats
   - Sir Alan Haselhurst MP
   - Sir John Stanley MP
   - Theresa May MP
   - Valerie Shawcross AM
4. **Passenger Focus, London Travelwatch and a number of Rail User Groups**
   - Bexhill Rail Action Group
   - Chingford Line Users Association
   - Clapham Transport Users Group
   - Crofton Park Transport Users Group
   - East Surrey Transport Committee
   - East Sussex Rail Alliance
   - Edenbridge and District Rail Travellers Association
   - Fen Line Users Association
   - Great Eastern Mainline Group
   - London TravelWatch
   - Marlow–Maidenhead Passenger Association
   - Marshlink Action Group
   - Oxon and Buckinghamshire Rail Action Committee
   - railfuture
   - Sevenoaks Rail Travellers Association
   - South Hampshire Rail Users Group
   - Southwark Rail Users Group
   - Sutton Rail Users Forum
   - West Anglia Routes Group
   - West London Line Group
   - West Sussex Rail Users Association
   - Windsor Lines Passengers Association
5. **Organisations, many of which focussed on aviation issues around Heathrow**
   - ARUP UK
   - Associated British Ports
   - Association of British Travel Agents
   - Association of Transport Co-ordinating Officers
   - BML2 Project Group
   - British Airways
   - Derwent London
   - DP World London Gateway
   - DP World Southampton
   - Forest Hill Society
   - Gatwick Airport
   - Gatwick Airport Consultative Committee
   - Greengauge 21
   - Heathrow Airport Limited
   - Heathrow Area Transport Forum
   - Heathrow Hub
   - IATA
   - International Air Rail Organisation
   - London (Heathrow) Airline Consultative Committee
   - London Chamber of Commerce and Industry
   - London Heathrow Airline Operators Committee
   - London Luton Airport
   - North London Strategic Alliance
   - Sea Space – Hastings & Bexhill Renaissance
   - South London Transport Strategy Board (South London Partnership)
   - Southampton International Airport
   - Sydenham Society
   - Thames Gateway South Essex Partnership
   - The Camberwell Society
   - Transport Research Group University of Southampton
   - Transworth Rail - Gazeley
   - West London Alliance
   - Winchester Action on Climate Change
6. **31 individuals**

3.2.2 In addition a number of stakeholders were primarily concerned with the South Hampshire and Solent element of the consultation, which covered an area not considered by previous RUSs. Details of the responses received are considered in **Chapter 11**.

3.3 Key themes emerging from the consultation

3.3.1 This section summarises the key themes emerging from the consultation period and how development of the RUS has been influenced as a result.

3.3.2 Some of the issues raised were concerns relating to ongoing programmes of work, some of which are already under construction, rather than the requirement or otherwise of additional schemes for the future. **Chapter 5** now clarifies further details of existing schemes where such information exists, for example improved information on the service structure assumed by this RUS following the completion of work on the Thameslink Programme, though this remains a work in progress and will be subject to detailed consultation at a later stage. Other information about ongoing or already committed schemes is published on the Department for Transport's (DFT's) website, on Network Rail's website (through regular updates to its Control Period 4 Delivery Plan) or by train operators themselves.

3.3.3 Various other comments were made regarding previously established RUS recommendations, these comments are outlined here, where they have been made in significant numbers. As a general point it is noted that this London & South East RUS has sought to extend rather than to rework previously established strategy, unless circumstances have changed. However, this RUS now makes clearer those elements of previous published strategy which it is reliant on and provides additional information as appropriate.

3.3.4 A number of the responses submitted included issues of relevance to day-to-day railway operations, rather than of a long term strategic nature, or identified potential tactical level interventions for the slightly longer term but which are still more effectively considered through processes other than the RUS. These included various potential station upgrades, timetable shortcomings, rail franchising concerns, incremental enhancements to railway infrastructure etc. Such matters are in general capable of being addressed through processes such as ongoing discussions between Network Rail and its funders, through the franchise management process or by passenger and freight trains operators themselves. Whilst comments not directly aimed at strategic level issues have not influenced the RUS itself they are likely to be a useful information source when such issues are considered by the industry.

3.3.5 With respect to the longer term the RUS primarily focussed on peak capacity, which triggered the need for, and analysis of, additional interventions to cope with the future growth on many routes. In feedback received many respondents indicated that they were of the opinion that growth forecasts appeared to be too low, or that the RUS was somewhat lacking in ambition. This issue is considered further in **Chapter 6**, but the RUS emphasises the following key points:

- the RUS has sought to identify a robust plan for increasing peak capacity as far as practical on key route corridors. Whilst the business cases and other analysis presented herein assumes a certain timing for implementation (based on the growth anticipated by this RUS) these same interventions are likely to remain appropriate, but would be required sooner, in the event of growth being higher than expected. The case for the interventions described by this RUS is therefore strengthened in a higher demand scenario
- commuting growth forecasts by rail into Central London are heavily reliant on the overall future population of South East England and future likely employment levels in the centre of the Capital. Together with analysis of past demand trends over recent decades these factors are considered as providing an indication that the overall level of growth in this RUS at peak times into Central London is reasonably robust. Future demand is uncertain but the aim of the RUS has been to identify future strategic level interventions and those recommended herein are considered appropriate within a realistic range of demand forecasts.

3.3.6 Some felt that the RUS focussed too much on the issue of line-of-route peak capacity. However, the RUS is a strategic level overview of much of South East England covering a 20-year timescale in detail, so it is not the appropriate mechanism for considering all issues. Experience has shown that it is likely to be capacity that determines the need, at a strategic level, for infrastructure upgrades or service pattern changes. Further analysis has also taken place with respect to key options for new routes, all of which have been considered on the basis of significant potential demand.

3.3.7 The RUS notes that certain respondents were seeking specific infrastructure upgrade schemes in areas of interest to them, but without a clearly identified train service output change as a result. These have been useful contributions but the RUS analysis has sought to define all options in terms of a specific train service output, rather than simply enhancing infrastructure for its own sake.

3.3.8 The following covers key issues emerging from the consultation with regard to the strategy in the Draft for Consultation, presented in general by line of route.

Great Western route

3.3.9 The extension of relief line services beyond Maidenhead to Reading was supported by most respondents, with the general opinion being that the planned electrification of the Great Western Main Line (GWML) is a strong reason to re-evaluate the original selection of Maidenhead as a terminus of Crossrail route services. This extension is now recommended in **Chapter 7**.

3.3.10 Beyond this the peak capacity strategy presented for the GWML received significant interest. There was widespread agreement with the RUS finding that there will be a capacity gap from the Reading/outer Thames Valley area (even after the Intercity Express Programme), so the RUS remains of the view that a solution needs to be found. The proposed Thames Valley shuttle service in the Draft for Consultation was also widely supported. However there was a significant level of concern from aviation stakeholders that implementing this would require changes to the existing Heathrow Express method of operation, which would be incorporated into Crossrail as a result. On the other hand, these proposed changes were widely supported at a conceptual level by those stakeholders with a wider remit than just airline passengers, subject to various issues being resolved. It was recognised by many stakeholders that the Paddington station area is only a secondary demand driver by Central London standards, and that many successful airport train services operate as part of a wider network, rather than just on a point-to-point basis.

3.3.11 In responding to aviation industry concerns the RUS now recommends the further development of this proposal, including a major increase in the planned Crossrail route to Heathrow Airport service, which would be increased from four to ten trains per hour throughout the day. For the majority of the day at least four of these trains would maintain existing journey times between Paddington station and Heathrow Airport and passengers travelling between Heathrow and the West End, City of London and Canary Wharf would benefit from the increased frequency of service. In response to specific journey time concerns from the Paddington area the proposed peak timetable structure is designed around a Crossrail skip-stop semi-fast service to Heathrow Airport, with some services running non-stop at all other times. Further information is provided in **Chapter 7.**

3.3.12 The changes made in response to the consultation have sought to provide the maximum frequency of trains between Central London Crossrail stations and Heathrow Airport, together with the fastest possible door-to-door journey time for users of this service. The RUS emphasises that the most realistic alternative scenario, that of implementing currently committed schemes only, would involve a high degree of standing in future on large numbers of main line services via Reading, greatly reducing the quality of the journey experience for large numbers of users of the GWML.

3.3.13 Some sought a view on whether more radical options than those presented in the Draft for Consultation might enable alternative train services to be provided. In response the RUS therefore now describes a possible six-tracking approach for London Paddington – Airport Junction, but notes that this would be extremely costly and disruptive and does not appear to provide significant additional benefits, so cannot be recommended. It would also require additional platforms at London Paddington which would be highly problematic.

3.3.14 The concept of a western rail access to Heathrow Airport was widely supported by a range of stakeholders during the consultation, to avoid the need for passengers from the GWML having to change at Reading, Hayes & Harlington or London Paddington. Further development is recommended in **Chapter 8**.

Chilterns route

3.3.15 The Chiltern route received few comments in the consultation with ongoing route upgrade works widely supported. These have the potential to provide sufficient capacity as well as offer significant other improvements to this corridor.

3.3.16 London TravelWatch reiterated long standing concerns regarding service levels at suburban stations in Outer London and also noted the potential desirability of an improved interchange station at West Hampstead.

3.3.17 Some stakeholders made mention of a potential new railway between this route and Heathrow Airport, to resolve an additional airport connectivity gap.

3.3.18 Further detail of the strategy for this route can be found in the recently published West Midlands and Chilterns RUS.

West Coast Main Line

3.3.19 Passenger capacity on the West Coast Main Line (WCML) received few comments in the consultation with it generally being accepted that the route is running at very close to the maximum level of train service achievable until a new High Speed Rail network is implemented. Consultation regarding the High Speed Rail network is currently being led by the DFT.

3.3.20 Freight stakeholders generally supported the concept of the WCML being the preferred route for freight growth, but had serious reservations about the availability of pathways until such a time as High Speed 2 is open. The concept of using the east west rail corridor for freight from Southampton to access the WCML at Bletchley was not supported by the freight industry due to concerns that extra mileage might be involved. The RUS therefore notes that this new route (promoted by a consortium of local authorities) would generally be an option to create flexibility in addition to existing routeings, rather than replacing them.

3.3.21 The proposed concept of a Crossrail extension to the WCML received a very high level of support in response to the consultation with many correspondents noting that this scheme has significant synergy with the High Speed Rail strategy, especially in regard to its potential for alleviating congestion at London Euston. Further detail is provided in **Chapter 8**.

3.3.22 Many stakeholders expressed concern regarding the findings in the RUS regarding peak frequencies between the WCML and West London Line, potentially linked to an infrastructure upgrade scheme at Watford Junction. Further analysis has now taken place, with recommendations for improvements provided in **Chapter 7**.

3.3.23 Further detail can be found in the West Coast Main Line RUS, published in July 2011.

Midland Main Line

3.3.24 Passenger capacity on the Midland Main Line (MML) also received relatively few comments during the consultation with stakeholders recognising that the Thameslink Programme will provide significant benefits to rail users on this route.

3.3.25 Freight industry stakeholders emphasised the need to ensure that significant capacity exists for freight growth (especially in connection with increasing southbound trailing load limits) following the completion of the Thameslink Programme. Freight stakeholders also had a number of concerns regarding the drafting of the document which this final RUS has sought to address.

East Coast Main Line

3.3.26 As with other routes between London and the north, passenger capacity on the East Coast Main Line (ECML) also received relatively few comments during the consultation. There was broad support for the strategy of; incremental infrastructure upgrades on the London approaches in the short term (principally the Hitchin Cambridge line flyover and extra tracks for passenger trains between Finsbury Park and Alexandra Palace); followed by the connection of the ECML to the Thameslink tunnels in the medium term and alleviation of north south capacity constraints through High Speed Rail in the longer term.

3.3.27 Stakeholders welcomed the view expressed in the RUS that the Hertford Loop would indirectly benefit from the Thameslink Programme, owing to capacity being made available at Moorgate due to trains currently serving the Welwyn Garden City route being diverted through the Thameslink tunnels.

West Anglia routes

3.3.28 There was extensive stakeholder lobbying for an infrastructure upgrade scheme for the Lea Valley route. Many expressed views that only the full four-tracking scheme should proceed, with other options providing insufficient benefits.

3.3.29 All parties agreed that once 12-car operations are in place on all services via Harlow Town peak capacity is unlikely to be the most pressing priority. Improving journey times, performance, service levels in the developing lower Lea Valley, journey opportunities to Stratford and potentially some station upgrade schemes were regarded as the appropriate aspirations for any route upgrade.

3.3.30 Extensive infrastructure design work, timetable development and economic analysis of a wide range of options has now taken place, with the current scheme status and recommendations now provided in **Chapter 7**.

3.3.31 Some stakeholders sought for a Chingford – Stratford service option to be included in the RUS analysis, via a new chord at Hall Farm near Clapton station. The RUS now outlines the interaction between this option and the others in its analysis.

Great Eastern Main Line

3.3.32 The lack of viable options in the Draft for Consultation to address the significant forecast capacity gap on Great Eastern Main Line (GEML) outer services triggered extensive concern from stakeholders. There was contact from many representatives in Essex and beyond, who indicated that having an unresolved peak capacity gap on such a key route was unacceptable.

3.3.33 In response to this issue significant further development has now taken place. An upgrade scheme for key locations on the route has been identified which would enable additional trains to run, with the key to this being track remodelling at Bow Junction to enable the use by extra main line trains of some of the platforms released at London Liverpool Street upon the completion of Crossrail. Significant initial design work and timetable analysis has now taken place, with recommendations for improvements provided in **Chapter 7**.

3.3.34 Some of the demand forecasts on the GEML were reviewed at length by SMG members, since it was initially felt that growth may have possibly been overestimated. Whilst there still remains a degree of uncertainty with respect to future passenger numbers forecast by the modelling in this area, this would only affect the timing of the interventions, not the need for them. The recommendation in the RUS is that the Bow Junction scheme is implemented before 2019, with associated works implemented and train services progressively increased over the following decade.

3.3.35 There was also some concern raised by freight stakeholders that the capacity strategy was built around most of the freight from the Felixstowe/ Bathside Bay area eventually being routed via Bury St Edmunds, not just the growth element. **Chapter 9** therefore emphasises that a significant upgrade to the Bury St Edmunds route would be needed to achieve this in a manner that does not impact on freight journey times or other operating costs.

3.3.36 Crossing movements across the GEML for future London Gateway to ECML flows were a further concern of freight stakeholders, since no viable solution to this issue was provided in the Draft for Consultation. Further timetable analysis has now taken place to resolve this issue, with the findings detailed in **Chapter 9**.

London Tilbury & Southend area

3.3.37 Passenger routes out of London Fenchurch Street received few comments in the consultation, with full 12-car operations generally considered as having sufficient potential to provide the necessary capacity in the long term.

3.3.38 The concept of using the Gospel Oak – Barking line for most freight from the nearby London Gateway port development was supported by stakeholders, as described later.

Kent routes

3.3.39 No significant new issues were presented in the Draft for Consultation, beyond those previously covered by the Kent RUS. However, many stakeholders reiterated their previous concerns with that established strategy.

3.3.40 The main areas commented on by stakeholders related to the post-Thameslink Programme timetable structure. This includes the anticipated replacement of some existing London Cannon Street services with trains to the Thameslink route, which triggers issues as 12-car services are currently unable to operate south of Tunbridge Wells due to insufficient power supply in the area (for which the Kent RUS was unable to recommend an upgrade, principally due to the high capital costs considered, at time of publication, to be involved). The power supply capability on this route is now under detailed review.

3.3.41 Other issues included concerns regarding the current level of service on the Maidstone East line, the lack of a direct service from most of Kent to Gatwick Airport and the desire for improved journey times throughout this part of the network.

3.3.42 Stakeholders on the Catford Loop emphasised the importance of through journeys from this route to the Thameslink network, mindful of the campaign relating to the Wimbledon Loop on the same issue.

3.3.43 A four trains per hour service to London Victoria at Peckham Rye and Denmark Hill was considered desirable, but not at the expense of increasing the journey times for longer distance passengers. **Chapter 5** provides more details of the assumed future timetable structure which seeks to achieve this.

Brighton Main Line and Sussex

3.3.44 The Draft for Consultation did not recommend any new interventions (beyond previous strategy) for the routes via East Croydon. Many stakeholders felt that this was unacceptable and that additional interventions are required.

3.3.45 The RUS emphasises that the Brighton Main Line (BML) and branches will benefit greatly from committed schemes and other previous recommendations which form part of the 'do-minimum' scenario used in the analysis. Committed schemes include 10-car suburban operations on routes via Sydenham and via Balham, 12-car operation of BML Thameslink services (and running these via London Bridge at peak times), 12-car operation of all peak services on the East Grinstead line and the Redhill line, additional trains once the planned remodelling works at London Bridge are complete, enhanced infrastructure at Gatwick Airport and upgrades to several congested stations including major works at East Croydon. These improvements are all in addition to the recent successful extension of peak Gatwick Express services to Brighton, which has provided significant extra capacity.

3.3.46 Previous recommendations not yet committed but carried forward into the strategy include 10-car (later 12-car) operation of Caterham and Tattenham Corner branch services (coupling at Purley), lengthening of Uckfield line services, an additional platform at Redhill and potential works at Reigate, minor infrastructure works in the Croydon area and stopping certain morning peak Gatwick Express services (which have started back from Brighton) at Clapham Junction to improve connectivity. This last intervention was not supported by aviation industry stakeholders, who considered it would be detrimental to the journey quality of passengers landing at Gatwick Airport in the early morning. However, research has indicated that it does have significant support from other users of the route.

3.3.47 The demand forecasting indicates that the above schemes will significantly alleviate existing BML crowding, even though they will not fully resolve the gap. Given the many interacting operational constraints on the route the only further infrastructure options, then viable as a means of running additional trains, would involve a very high level of cost and complexity in the form of a new tunnelled alignment from outer London, so whilst such a scheme may eventually be required in the very long term, it has not been considered in detail by the RUS.

3.3.48 Given the above, the RUS considers that the strategy outlined herein for the BML is robust and will provide passengers on this route with a significant capacity improvement relative to today. Other interventions sought by stakeholders, for example a new BML2 alignment via Uckfield, Oxted and Catford Bridge, requiring a new tunnel under the South Downs and from somewhere south of Lewisham to an unspecified London terminal, have been reviewed by the RUS but are not considered to resolve the issues they seek to address and would create major problems of their own.

3.3.49 Stakeholders interested in the Uckfield Line noted the potential benefits of electrification and/or reinstating additional double track sections as well as potential reopening of the line to Lewes. It is emphasised that the recommendations carried forward from the Sussex RUS for the lengthening of peak trains on this route do not preclude this.

3.3.50 Stakeholders on routes via Tulse Hill emphasised the importance of through journeys from this route to the Thameslink network. However the RUS restates previous analysis which indicates that the location of the bay platforms on the west side of Blackfriars River Bridge precludes such further improvements.

South West Main Line

3.3.51 The lack of any option in the Draft for Consultation to fully address the forecast capacity gap on South West Main Line (SWML) longer distance services triggered extensive concern from stakeholders. There was interest in the options presented for 16-car or double deck trains, but the complexity of such schemes was widely recognised. The disused former International Platforms at London Waterloo were referred to by many stakeholders, but the RUS emphasises that these are at present planned to be brought into use for the Windsor Lines as below, that a flyover would be required for them to be used by any other service group and that the SWML route is capacity constrained inwards from at least Surbiton, not just at the London terminal station. Identifying a robust solution for this route corridor has therefore been a high priority for recent work.

3.3.52 Many parties, including South West Trains, observed that extending suburban operations beyond the planned 10-car to 12-car is likely to be needed. This is not necessary for the RUS demand forecasts (although, as described in **3.3.5** above, many stakeholders felt that these were too low) but this strategy emphasises the importance of passive provision in the ongoing 10-car scheme in case circumstances change.

3.3.53 In response to main line capacity concerns significant further development has now taken place. An interim scheme could potentially enable additional trains through major enhancements, including works at Woking and on the London Waterloo approaches, with the aim of running up to 28 trains in the busiest peak hour inwards of Surbiton on the Up Main Line. However, this level of service would be insufficient to fully resolve the gap, it would represent a significant risk to robust performance (so is unproven operationally, based on the existing signalling system) and it would not enable long standing aspirations for some peak time main line calls at Clapham Junction to be met.

3.3.54 In order to potentially address all of the above in the longer term the RUS has identified a major upgrade for the Surbiton – London Waterloo corridor, with an additional track as far inwards as Clapham Junction. Outline design work has taken place, with the current status provided in **Chapter 7**. An alternative approach would be to incorporate the route into the Crossrail line 2 alignment as outlined in **Chapter 8**.

Windsor Lines

3.3.55 As above, stakeholders were keen to see progress on the conversion of the disused former International Platforms at London Waterloo for domestic use. Options for running additional peak trains on this corridor were generally supported, as was the desirability of 12-car operations, rather than just the 10-car currently planned.

3.3.56 Increasing off-peak services received a more mixed response. The RUS recognises that there are significant concerns regarding level crossing downtimes on this route and the BAA Heathrow Airtrack scheme is now not proceeding in the short term, partly in response to this issue.

3.3.57 However stakeholders were generally supportive of the concept of a connection between Heathrow Airport and the south west, so **Chapter 8** now presents alternative options in this regard.

3.3.58 Significant discussions amongst industry stakeholders took place regarding the infrastructure necessary on this route, focussing on Queenstown Road and at London Waterloo.

Orbital routes

3.3.59 Comments regarding freight formed an important element of the feedback on the Draft for Consultation. There was support from Transport for London (TfL) and the London Boroughs for options that would route freight away from London onto alternative routes, notably the Bury St Edmunds route for freight from the East Coast Ports and the Gospel Oak to Barking line in preference to the North London Line where possible. However as noted earlier, freight operators emphasised that new route options not involving London would need to be just as cost-effective to them as a London routeing.

3.3.60 Freight operators also emphasised the importance of diversionary routes, for example upgrading of the route via Kew Junction to W10 gauge as a freight diversionary route was sought.

3.3.61 With respect to passenger capacity there was extensive support for the recommendation in the Draft for Consultation for 8-car Southern operations on the West London Line following very rapid growth in recent years on this route.

3.3.62 As described earlier many stakeholders expressed concern regarding the findings in the RUS regarding peak frequencies between the WCML and West London Line. Further analysis has therefore taken place, with recommendations for improvements provided in **Chapter 7**.

3.3.63 The consultation process identified many linkages between the strategy for orbital routes and High Speed 2. It was widely noted that the proposed station at Old Oak Common should connect to, at least, the North and West London Lines and that operational interactions between trains running over a High Speed 1 – High Speed 2 connection, London Overground trains and freight traffic in the Camden Road station area were best avoided.

3.3.64 Following extensive discussions with industry stakeholders the RUS now includes new options for lengthening of London Overground services to six-car on the North London Line, five-car on the East London Line and four-car on the Gospel Oak to Barking line. Recommendations are provided in **Chapter 7**. Many stakeholders supported electrification of the latter, consistent with the recommendation of the Network RUS : Electrification Strategy which is carried forward into this RUS.

3.3.65 User groups have a significant level of interest in these routes. Multiple options for future development of the West London Line were provided and, as with all other written consultation responses, this submission is now available on Network Rail's website.

3.3.66 Stakeholders on the South London Line reiterated previous concerns regarding the planned withdrawal of the existing London Victoria – Denmark Hill – London Bridge service following the completion of the London Overground extension via Denmark Hill to Clapham Junction. The RUS can confirm that there is not sufficient capacity available to operate both services. The change could in any event, be required due to the forth coming Thameslink construction works at London Bridge. The RUS considers that, taken as a whole, the proposed service changes will result in a better overall service on this route. Further details of the proposed medium-term strategy for Denmark Hill and Peckham Rye are provided in **Chapter 5**.

New lines

3.3.67 The Draft for Consultation included a 'Network Connectivity' chapter. Several stakeholders suggested a more specific focus to this work so this has been replaced in this final RUS with a 'New Lines' **Chapter 8**, focusing only on the most strategically significant schemes (with a National Rail network element) in the London area. The key issues emerging from the consultation are outlined below.

3.3.68 With respect to Crossrail, the committed scheme involves, 24 peak trains per hour across central London, only 10 of these running west of Paddington. This was widely considered by respondents not to be a satisfactory solution for the longer term, representing under-utilisation of an expensive new resource. The RUS has been heavily influenced by such views and now outlines proposals for all trains to eventually run to destinations in the outer suburbs or beyond.

3.3.69 Also as described earlier, the proposed concept of a Crossrail extension to the WCML received a very high level of support in response to

the consultation, with many correspondents noting that this scheme has significant synergy with the High Speed Rail strategy, especially in regard to its potential for alleviating both the main line and underground stations at Euston. Further detail is provided in **Chapter 8**.

3.3.70 There was a lower degree of specific comment with respect to the Crossrail line 2 (formerly known as the Chelsea–Hackney Line), probably because of the longer term nature of this scheme and it only being of limited relevance to a Network Rail consultation. Stakeholders recognise however, that this is a potential future major scheme for the capital and it has widespread support, so the RUS now outlines the latest industry thinking in this regard. Provision of a station on this route at Euston to link into High Speed 2 plans was widely supported.

3.3.71 As described above, the impact of High Speed 2 on the London area attracted significant interest, focussing on the constructability of and access to London Euston station and similarly with respect to Old Oak Common.

3.3.72 Heathrow Airport connectivity attracted many comments as described earlier. This final RUS therefore focuses on greatly improving Crossrail services to the airport and recommends further development of new western rail connections towards Slough and Staines.

3.3.73 The potential Bakerloo line extension, Croxley Link and East-West Rail all received positive comments. Mention was also made of potential Tramlink and Docklands Light Rail extensions and comment is also now made regarding these.

South Hampshire and Solent

3.3.74 This part of the network had not been addressed in any previous RUS so was included in the Draft for Consultation to provide completeness of network coverage.

3.3.75 Stakeholders expressed disappointment that the RUS had been unable to recommend major infrastructure in this area. Further information has been provided by the promoters of certain specific schemes, but this broadly remains the position. However, in response to the views submitted the RUS seeks to provide an output improvement, where possible, so recent work has focussed on identifying smaller scale interventions. Further detail is provided in **Chapter 11**.

3.3.76 The long term need for four freight paths per hour to/from Southampton has been a point of discussion in identifying the strategy for this area, as has the strategy for diversionary routes for freight when the route via Winchester is closed for any reason. Further detail is provided in **Chapter 9**.

3.4 Development of RUS Strategy in response to Consultation Feedback

3.4.1 The above section seeks to provide an overview of the key themes from the consultation responses to this RUS, together with an indication of how those developing the RUS have adapted the analysis in response to the feedback received wherever possible.

3.4.2 The contribution of all those who responded to, or participated in any way in the consultation, is gratefully acknowledged.

4. Overview of train operations, recent demand and performance

4.1 Introduction

4.1.1 This chapter considers the railway network as it stands today in terms of train operations, recent passenger demand trends and train performance. Subsequent chapters then build on how key elements of this will develop in the future, with committed schemes covered in **Chapter 5** and high level forecasts of future peak demand provided in **Chapter 6**.

4.2 Overview of passenger services covered by this Route Utilisation Strategy

4.2.1 The rail routes converging on Central London, upon which this Route Utilisation Strategy (RUS) primarily focuses, are among the busiest and most complex anywhere. Passenger train services in operation upon them may be broadly categorised between Long Distance High Speed (LDHS), other main line, outer suburban, inner suburban, with different operating, rolling stock and passenger characteristics for each of these. Away from Central London there are some routes which are more rural in nature, for example much of the South Hampshire area which is covered by the special study in **Chapter 11**.

4.2.2 The following train operators run services into London at the busiest times so are of particular relevance to this RUS:

- most services out of London Paddington are operated by First Great Western, who operate a complex mix of LDHS, interurban, suburban and regional services between London Paddington, the Thames Valley, the West of England and South Wales
- other services out of London Paddington are operated by BAA, who operate the non-stop Heathrow Express to Heathrow Airport and, in partnership with First Great Western, the Heathrow Connect service to the airport via intermediate stations
- Chiltern Railways operates the Chiltern franchise between London Marylebone and Birmingham Snow Hill, with routes to Stratford-upon-Avon and Aylesbury. These latter services share tracks with the London Underground Metropolitan Line on the approaches to London
- London Midland holds the West Midlands franchise, which includes outer suburban and interurban services on the West Coast Main Line (WCML) from London Euston

- Virgin Trains operates the LDHS trains on the WCML. These run between London Euston and destinations in the West Midlands, North Wales, North West England and Scotland and between Birmingham and Scotland
- London Overground operates several orbital routes across London, obviating the need to interchange at the busy terminal stations. These are the North London Line between Stratford and Richmond, the Gospel Oak to Barking line, the East London Line between Highbury & Islington and West Croydon/Crystal Palace/ New Cross and the West London Line between Clapham Junction and Willesden Junction. London Overground also operates the all-stations suburban service between Watford Junction and London Euston, sharing tracks with the London Underground Bakerloo Line
- East Midlands Trains operates LDHS services on the Midland Main Line between London St Pancras International and Derby, Nottingham and Sheffield, together with many regional services in the East Midlands.
- East Coast currently operates the majority of LDHS services on the East Coast Main Line, with frequent trains running between London King's Cross, West Yorkshire, the north east of England and Scotland
- National Express East Anglia currently operates the Greater Anglia franchise, comprising services to and from London Liverpool Street. This operation includes the West Anglia main line to Stansted Airport and Cambridge, West Anglia inner and outer suburban services, Great Eastern inner suburban stopping services on the Shenfield route and a mix of outer suburban, long distance and regional services centred on the Great Eastern Main Line.
- the Essex Thameside franchise is also run by National Express, under the c2c branding. It comprises services between South Essex and London Fenchurch Street on the London, Tilbury and Southend lines
- First Capital Connect (FCC) holds the Thameslink and Great Northern franchise, which comprises a complex mix of inner and outer suburban routes. The Great Northern routes run between Cambridgeshire, Norfolk and Hertfordshire and London's King's Cross and Moorgate. The Thameslink routes run between Bedford and Luton in the North, via London Blackfriars, to South London via the Wimbledon Loop, Brighton and various destinations in Kent, jointly operated with Southeastern.
- Southeastern holds the Integrated Kent franchise, comprising the intricate suburban network in South East London, the main line routes to Kent and parts of East Sussex, local services and the domestic services operating on High Speed 1. Services run to London St Pancras International, London Charing Cross, London Cannon Street and London Victoria, together with the joint operation with FCC via London Blackfriars as outlined above.
- Southern operates the South Central franchise, which comprises the dense network of inner suburban routes in South London, main line routes to East and West Sussex, the Gatwick Express and coastway routes. London journeys begin or end at London Bridge or London Victoria. Southern also operates an orbital route between East/South Croydon and Milton Keynes via the West London Line
- South West Trains holds the South Western franchise, operating a comprehensive service into and out of London Waterloo. This covers the South West Main Line from London to Weymouth, routes to Portsmouth and Exeter, regional services, and the extensive network of suburban routes in South West London and beyond, including trains on the Windsor lines towards Reading
- Eurostar operates services from Europe to London St Pancras International via High Speed 1.

4.2.3 In addition to those above, some less frequent services to London terminals are run by other operators. These include open access operators (Grand Central and Hull Trains) on the East Coast Main Line to London King's Cross, the ScotRail Caledonian sleeper to London Euston (which arrives into London in the early part of the morning peak, so is relevant to peak platform capacity utilisation) and regular charter train operators on many routes, including the Venice Simplon Orient Express service which utilises a platform at London Victoria station in the morning peak.

4.2.4 CrossCountry does not operate into London, but has train operations of particular relevance to this RUS between Bournemouth/Reading and the West Midlands (and beyond) via Oxford.

4.2.5 **Table 4.1** indicates the current train service at each London terminal, split by line of route, together with the number of platforms and approach tracks available.

Table 4.1 – London terminals train operations

London Paddington arrivals 0800-0859	
Line	**TPH**
Up Main	19
Up Relief	10
Total:	**29**
No. of platforms:	14
Trains per platform per hour:	2.1
No. of approach tracks:	2
Trains per track per hour:	14.5
Trains per track per hour:	8.3

London Marylebone arrivals 0800-0859	
Line	**TPH**
Up	14
Total:	**14**
No. of platforms:	6
Trains per platform per hour:	2.3
No. of approach tracks:	1
Trains per track per hour:	14

London Euston arrivals 0800-0859	
Line	**TPH**
Fast lines	14
Slow lines	8
DC lines	3
Total:	**25**
No. of platforms:	18
Trains per platform per hour:	1.4
No. of approach tracks:	3
Trains per track per hour:	8.3

London St Pancras International (domestic) arrivals 0800-0859	
Line	**TPH**
MML fast lines	5
HS1 domestic	8
Total:	**13**
No. of platforms:	7
Trains per platform per hour:	1.9
No. of approach tracks:	2
Trains per track per hour:	6.5

London King's Cross arrivals 0800-0859	
Line	**TPH**
Fast lines	9
Slow lines	11
Total:	**20**
No. of platforms:	12
Trains per platform per hour:	1.7
No. of approach tracks:	2
Trains per track per hour:	10

Moorgate arrivals 0800-0859	
Line	**TPH**
Up	12
Total:	**12**
No. of platforms:	2
Trains per platform per hour:	6.0
No. of approach tracks:	1
Trains per track per hour:	12

Table 4.1 – London terminals train operations

London Liverpool Street arrivals 0800-0859	
Line	**TPH**
Up Electric	16
Up Main	22
Up Suburban	21
Total:	**59**
No. of platforms:	18
Trains per platform per hour:	3.3
No. of approach tracks:	3
Trains per track per hour:	19.7

London Fenchurch Street arrivals 0800-0859	
Line	**TPH**
Up line	19
Total:	**19**
No. of platforms:	4
Trains per platform per hour:	4.8
No. of approach tracks:	1
Trains per track per hour:	19

London Charing Cross arrivals 0800-0859	
Line	**TPH**
Up fast	14
Up slow	15
Total:	**29**
No. of platforms:	6
Trains per platform per hour:	4.8
No. of approach tracks:	1*
Trains per track per hour:	29
*At Borough Market viaduct	

London Cannon Street arrivals 0800-0859	
Line	**TPH**
Up Main	14
Reversible	11
Total:	**25**
No. of platforms:	7
Trains per platform per hour:	3.6
No. of approach tracks:	1*
Trains per track per hour:	25
*At Borough Market viaduct	

London Victoria arrivals 0800-0859	
Line	**TPH**
Up Brighton fast	17
Up Brighton slow	15
Up Chatham fast	8
Up Chatham slow	8
Total:	**48**
No. of platforms:	19
Trains per platform per hour:	2.5
No. of approach tracks:	4
Trains per track per hour:	12

London Waterloo arrivals 0800-0859	
Line	**TPH**
Up Main fast	24
Up Main slow	18
Rev Windsor	2
Up Windsor	13
Total:	**57**
No. of platforms:	19
Trains per platform per hour:	3
No. of approach tracks:	4
Trains per track per hour:	14.2

4.2.6 In general it can be seen from **Table 4.1** that stations based largely around LDHS operations can accommodate, at most, up to two arrivals in each platform at the busiest times, with a maximum of a train every three minutes over each individual track (for example on the Up Main approaching London Paddington) and in some cases much less than this because of the mix of speeds and stopping patterns of the trains concerned. Stations serving shorter distance services see more intensive utilisation, reflecting shorter turn-around times, more homogenous services and other operating characteristics, the busiest examples being the platforms at Moorgate (which each achieve a train every 10 minutes) and the two-track approaches to London Charing Cross at Borough Market viaduct (over which 29 trains each way are operated in the busiest hour).

4.2.7 Whilst LDHS services need longer turn-around times in order to provide for cleaning, tanking, restocking and other servicing, there are variations between London terminals which suggests that some may be operating more efficiently than others. In extremis, the RUS notes that if overly long turn-around times can be reduced, this may offer future opportunities to reduce the size of rolling stock fleets.

4.3 Morning peak passenger demand: overview

4.3.1 As described in **Chapter 1** this RUS has focussed on capacity during the weekday peak periods, with morning peak commuting into Central London in particular being, on most routes, the critical issue with respect to timetable planning and hence determining whether strategic level interventions are needed to supply more capacity.

4.3.2 On most corridors the RUS anticipates that, if sufficient capacity can be provided in the morning peak to satisfactorily accommodate all passengers wishing to travel, then capacity in the evening peak will generally be resolvable using the same interventions. Weekday off-peak, evening and weekend demand have therefore not been considered in detail by the RUS; if the network has sufficient capacity to cope with the morning period then these times should be capable of being managed at a more tactical level through timetable changes implemented by operators or, if an operating subsidy is required with respect to the quieter times of the day, through the franchising process.

Peak travel to London

4.3.3 London is by far the largest employment centre in the UK, with over 4.5 million people employed in the Greater London area, nearly half of whom (2.2 million) work in the area considered by this RUS as Central London[1]. Around a fifth of those working within Central London live outside the Capital and, together with large numbers of travellers within the Capital itself, these make up the London commuter market.

4.3.4 London is also by far the largest attractor of rail trips in the UK, with over 500 million rail journeys being made to or from Central London annually. In addition to this there are growing markets to secondary destinations such as Canary Wharf, Croydon and Hammersmith, plus large numbers of travellers throughout the day to the major airports of Heathrow, Gatwick, Luton and Stansted.

4.3.5 The London rail travel market is relatively mature when compared to other UK cities and regions, with changes in demand tending to occur gradually over a number of years, except in cases where new routes have been opened. At peak times commuter flows dominate, though passengers travelling on irregular business trips also use the railways in significant numbers, often from further afield. There is also substantial interaction between commuting and the leisure and tourism markets, although these tend to have a greater affect on the evening rather than the morning peak period.

4.3.6 Rail demand on radial routes builds up as these get closer to the city centre, though there are several key interchange stations in the inner suburbs; such as Tottenham Hale, Clapham Junction, Finsbury Park and Stratford, meaning that the maximum on-train load is not always at the London terminal. The RUS analysis uses the demand at the busiest point on the route, wherever this is located.

4.3.7 Of all morning peak journeys across all modes into Central London, 80 per cent are from a location within the Greater London area. Unlike most of the rest of the country the vast majority of peak trips into the capital are made using public transport, as shown in **Figure 4.1**, with the proportion increasing with distance travelled. Within Central London there is also a high modal share of public transport, though this is a lesser figure due to the short nature of journeys meaning that a high number of trips are made on foot or bicycle. Initiatives such as the Central London Congestion Charge and the Cycle Hire scheme have contributed significantly to these trends over recent years.

4.3.8 **Figure 4.2** shows the distribution of where commuters into Central London live. Whilst, as described above, 80 per cent of morning peak travellers into the centre of London (across all modes), are from within Greater London itself, on the railways a significantly higher proportion of trips originate from beyond the Capital's boundaries. This is because of the much greater distances being travelled on the railways when compared to journeys made on the bus, Docklands Light Railway and London Underground systems.

1 The City of London, plus the Boroughs of Camden, Islington, Kensington and Chelsea, Southwark, Tower Hamlets and Westminster

Figure 4.1 – Origin and mode type of morning peak trips to Central London

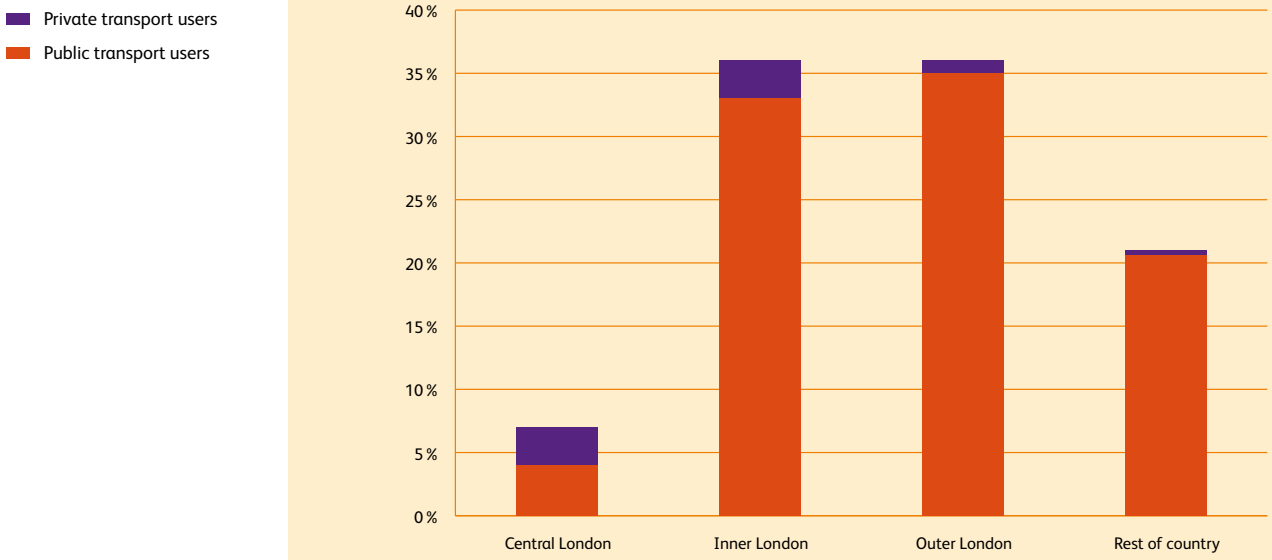
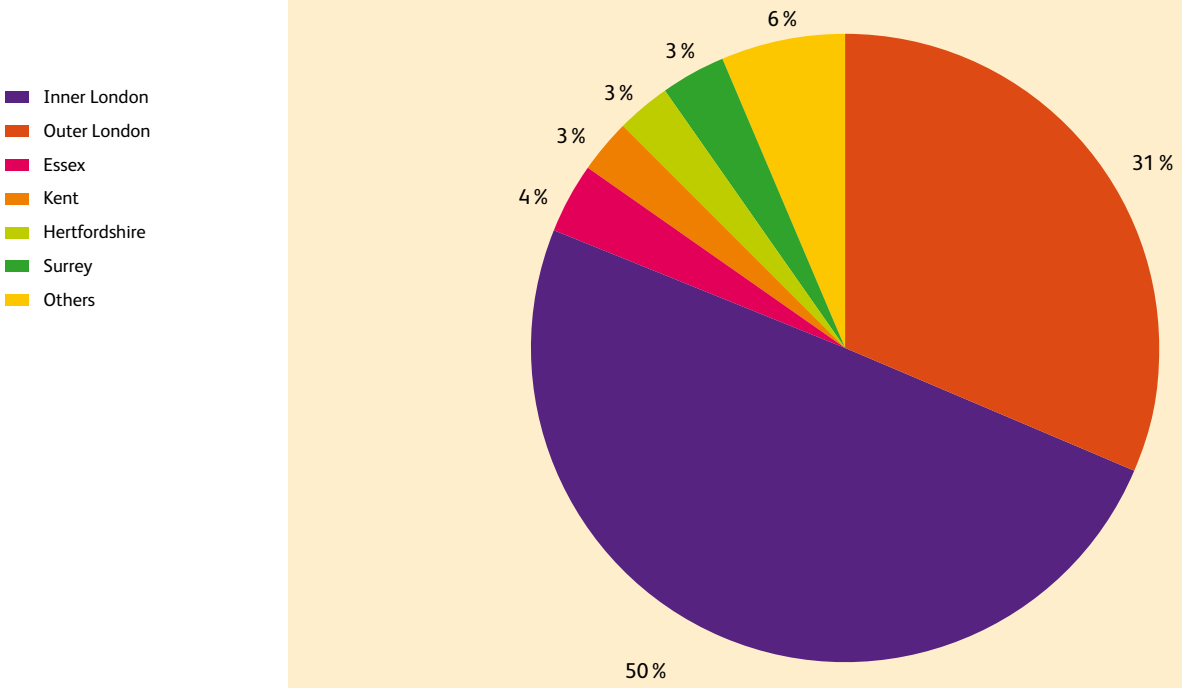
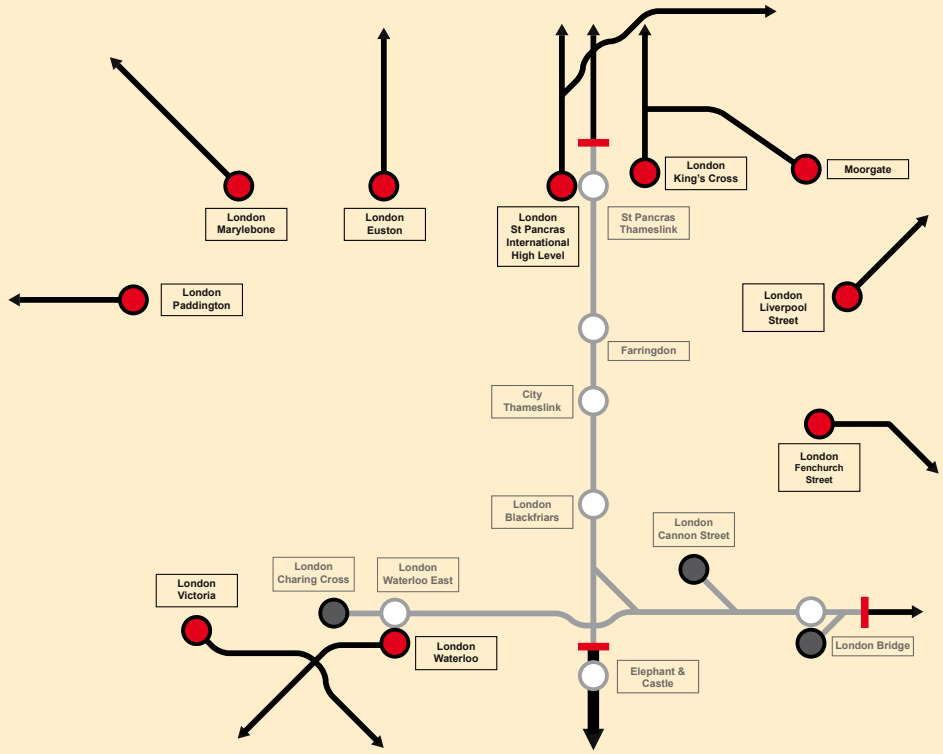


Figure 4.2 – Contribution to Central London workforce by area of residence



Terminating route
Cordons
Terminating services (within cordon)
Through services (within cordon)

Figure 4.3 – Central London capacity modelling baseline



Rail commuting into Central London: baseline data for demand modelling

4.3.9 The analysis in this RUS is based on the modelling of future demand as described in **Chapter 6**, with the baseline validated against observed train loading data from autumn 2010. Since the RUS is a high level strategy the future year modelling is undertaken at a line-of-route corridor level on key routes into the Capital, rather than on a train-by-train or station-by-station basis.

4.3.10 All the radial routes into London are considered in the Central London capacity model, as shown in **Figure 4.3**. All existing trains operating in the morning peak into London are included in the RUS baseline, with 'cordons' rather than individual terminals used in certain cases. Orbital routes have been considered using a broadly similar process.

4.3.11 The baseline passenger demand data in the RUS analysis comes from the Department for Transport's (DfT's) 'Green Book' counts, with the latest data from autumn 2010 quoted by this RUS. All morning peak services into London run by franchised train operating companies are covered by these counts, with data utilised on a train-by-train basis. Whilst historically the collection of train loading data has relied on manual passenger counts many modern trains now incorporate sophisticated on-train weighing equipment which results in greatly improved data accuracy.

4.3.12 The morning peak period is defined by the RUS as 07:00 – 09:59 arrivals in London inclusive. Trains have been allocated into 15 minute time bands within that period for modelling purposes, based on the time that the train arrives in Central London.

4.3.13 The maximum demand on each train is the number of passengers on it when the train is at its busiest. This includes both standard and first class passengers. This is known as the critical load which, as described earlier, is not always at the London terminal. The route demand is the sum of the critical loads for all the trains on the route.

4.3.14 In addition to recent demand information the RUS baseline also includes the capacity of all trains in the timetable. On-train capacity is defined as the total number of seats (standard and first class) if the train does not call within 20 minutes of Central London. If the train does make a station call then a standing allowance, as specified by the DfT in the Green Book, is included as making up a proportion of the on-train capacity. Industry planning guidance is for no passengers to have to stand for more than 20 minutes in normal circumstances.

Central London passenger services: total demand and capacity

4.3.15 In autumn 2010 a typical weekday three-hour morning peak period saw over 575,000 passengers travel into Central London by rail, roughly equating to a quarter of total Central London employment.

4.3.16 The busiest hour is generally 08:00 – 08:59, with half the total morning peak demand typically occurring in this one hour. The 'shoulder peaks' – the periods immediately before and after the busiest hour – are generally much less busy with around a quarter of the morning peak demand in the hours either side. The busiest hour is slightly earlier on routes where the London terminus is located further away from the City and West End than other routes, as many passengers complete their journey by other modes.

4.3.17 The total capacity supplied into Central London in the three-hour morning peak period is sufficient for nearly 775,000 passengers. This appears to more than cater for the overall number of passengers as described above, but some trains are inevitably more popular than others and, critically, the profile of capacity is spread more evenly across the duration of the peak than the passenger demand profile over the same period. Only 42 per cent of peak capacity is supplied in the busiest hour between 08:00 – 08:59 (compared to 50 per cent of demand), with spare capacity available in the shoulder peaks on many trains. The overall demand and capacity profile is shown in **Figure 4.4**.

4.3.18 **Figure 4.5** shows the numbers of passengers arriving on the different service group types; inner suburban services carry the most passengers into London, followed by outer suburban, long distance trains and airport service groups (Heathrow Express and Gatwick Express). The share of passengers carried by outer and long distance services is somewhat higher than the 20 per cent of commuters coming from outside Greater London, as shown in **Figure 4.2**. This is partly because many commuters from within Greater London have a choice of travelling on the London Underground; partly because some outer suburban services serve stations within Greater London and partly because long distance services (in particular) carry significant numbers of passengers travelling for reasons other than commuting.

Figure 4.4 – Overall London demand and capacity profile over the morning peak

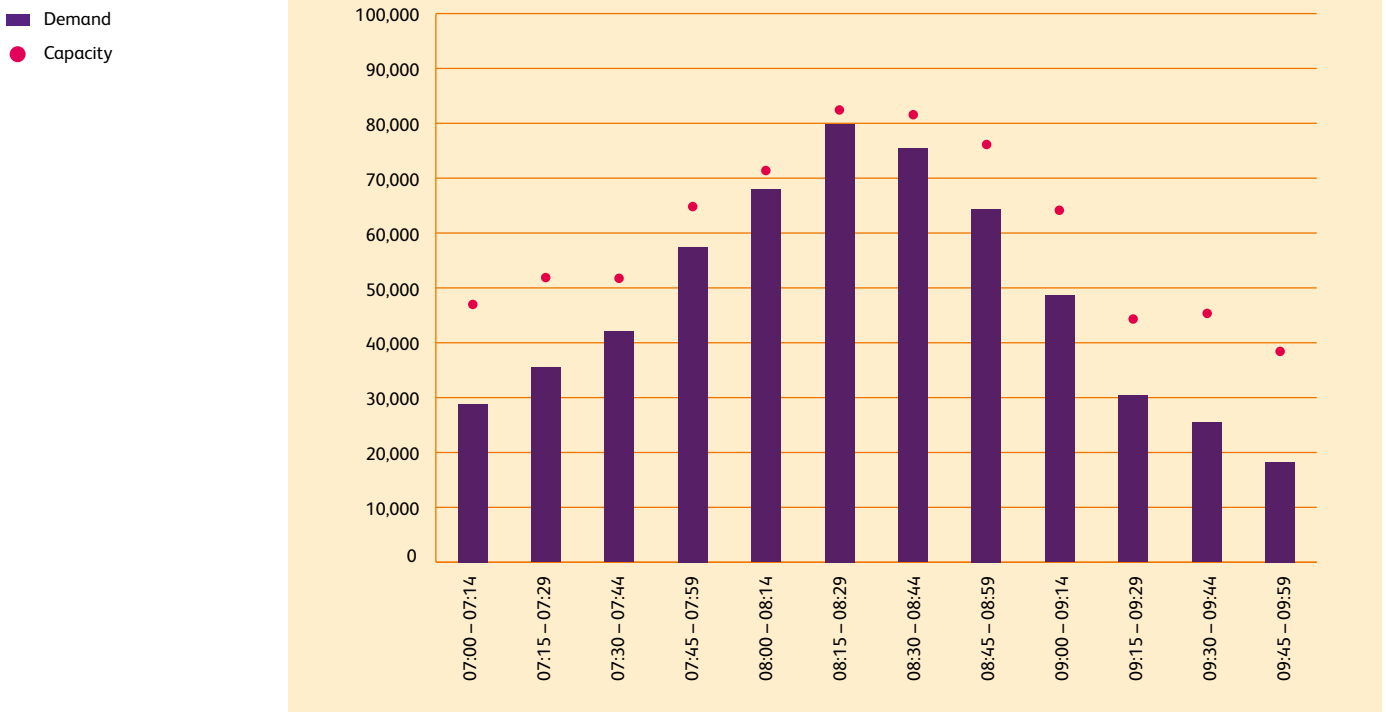
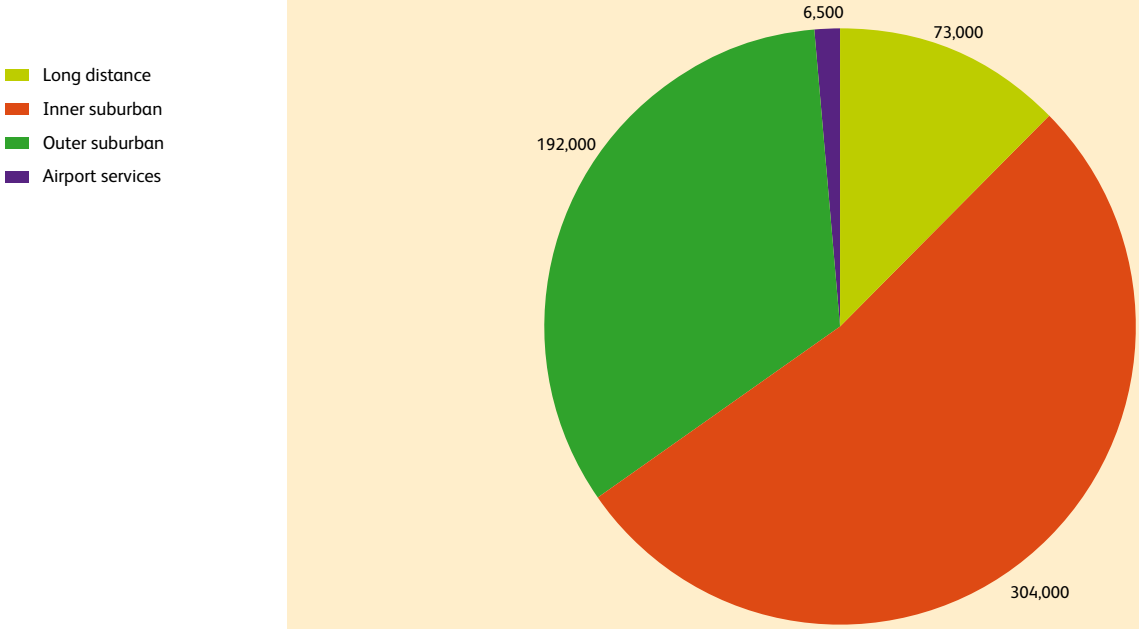


Figure 4.5 – Passenger demand into London in the morning peak by service group type



4.4 Route-by-route train capacities and loadings

4.4.1 This section presents the capacity and demand baseline for each key route corridor, together with indicators of current overcrowding for each in the morning peak period. The information is based upon on-train loadings measured in autumn 2010.

4.4.2 The route-by-route breakdown of peak Central London demand is shown in **Table 4.2**. For the three hour peak and the busiest hour this shows the total capacity, total demand and aggregate utilisation (total demand/total capacity). It also shows an overcrowding indicator, which is based on individual train loadings.

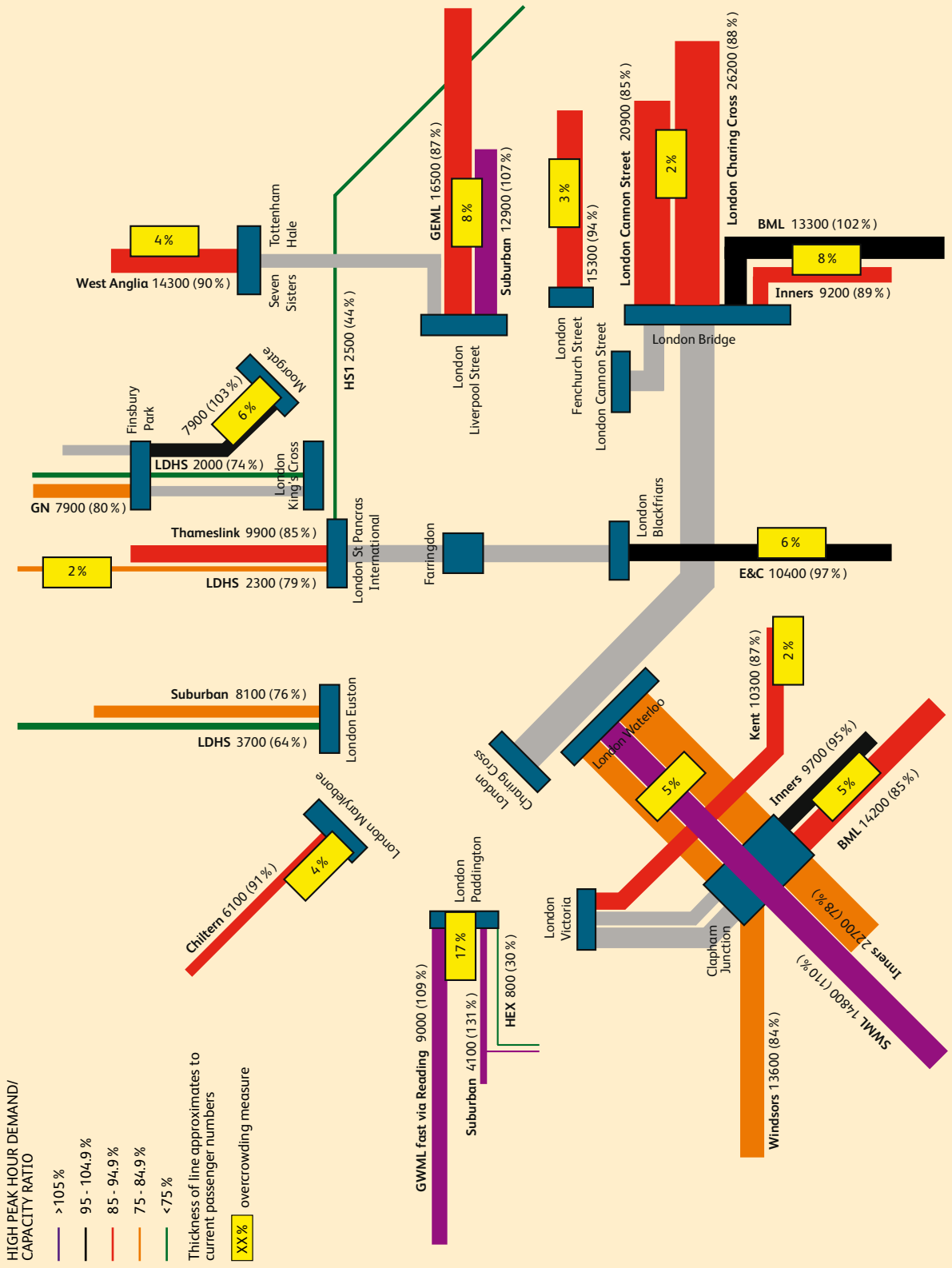
4.4.3 The demand figures are based on the numbers of passengers on trains at the critical load point. The capacity figures are seated capacity, with an allowance for standing space where this is appropriate to the service pattern concerned. The overcrowding indicator is the total number of passengers above the total on-train capacity, on a train by train basis, as a proportion of the passenger demand.

4.4.4 **Figure 4.6** demonstrates these existing route-by-route loadings for the busiest hour in as a geographic representation.

Table 4.2 – Morning peak demand and capacity (2010) for each London terminus/cordon

		3 hour weekday morning peak				Busiest 1 hour in morning peak			
Route into	Service group	Total capacity	Total demand	Total demand/ total capacity	Overcrowding indicator	Total capacity	Total demand	Total demand/ total capacity	Overcrowding indicator
London Paddington	Relief line trains	9,900	9,900	100 %	12 %	3,100	4,100	131 %	17 %
	Main line + other fast trains	18,600	18,400	99 %		8,300	9,000	109 %	
	Heathrow Express	8,400	2,500	30 %		2,800	800	30 %	
London Marylebone	All services	14,100	11,500	82 %	3 %	6,700	6,100	91 %	4 %
London Euston	Long Distance	12,400	7,500	60 %	0 %	5,800	3,700	64 %	0 %
	Suburban	22,100	15,000	68 %		10,600	8,100	76 %	
London St Pancras International	High Speed 1 (domestic)	13,800	5,700	41 %	0 %	5,700	2,500	44 %	0 %
	Thameslink MML	27,900	19,600	70 %	0 %	11,700	9,900	85 %	0 %
	MML Long Distance	5,500	4,400	80 %	0 %	2,900	2,300	79 %	2 %
London King's Cross	Great Northern	21,700	15,800	73 %	0 %	9,800	7,900	80 %	0 %
	ECML Long Distance	7,500	4,800	65 %	0 %	2,700	2,000	74 %	0 %
Moorgate	All Services	17,000	15,300	90 %	4 %	7,700	7,900	103 %	6 %
London Liverpool Street	West Anglia	41,900	28,900	69 %	2 %	15,800	14,300	90 %	4 %
	Great Eastern Main Line	42,000	32,700	78 %	6 %	18,900	16,500	87 %	8 %
	GE Inners	29,400	27,700	94 %		12,100	12,900	107 %	
London Fenchurch Street	All services	34,800	29,100	84 %	3 %	16,200	15,300	94 %	3 %
London Bridge	Charing Cross	61,400	50,100	81 %	1 %	29,800	26,200	88 %	2 %
	Cannon Street	57,900	41,200	71 %	1 %	24,500	20,900	85 %	2 %
	Thameslink	3,900	3,100	80 %	2 %	0	0	N/A	N/A
	Terminating (fast via East Croydon)	28,700	25,700	89 %	6 %	13,000	13,300	102 %	8 %
	Terminating (inners)	25,700	16,000	62 %		10,400	9,200	89 %	
London Blackfriars	All services (via Elephant & Castle)	26,000	19,800	76 %	4 %	10,700	10,400	97 %	6 %
London Victoria	Kent routes	28,800	20,400	71 %	1 %	11,800	10,300	87 %	2 %
	Fast trains via East Croydon	40,100	29,000	72 %	3 %	16,700	14,200	85 %	5 %
	Stopping trains via Balham	23,700	18,400	78 %		10,300	9,700	95 %	
London Waterloo	Windsor Lines (all services)	40,700	28,600	70 %	3 %	16,200	13,600	84 %	5 %
	Stopping trains via Wimbledon	74,100	44,800	60 %		29,200	22,700	78 %	
	South West Main Line	32,600	29,600	91 %		13,400	14,800	110 %	
Radial Routes Totals		**773,600**	**575,500**	**74%**		**326,800**	**288,600**	**88%**	
Main Orbital routes	West London Line	6,800	5,700	84 %	7 %	2,500	2,700	105 %	13 %
	East London Line	15,900	8,800	55 %	4 %	5,300	4,200	79 %	8 %
	North London Line	8,000	6,600	83 %	2 %	2,700	2,700	100 %	4 %

Figure 4.6 – Current passenger loadings, overall capacity utilisation and overcrowding measure by route (busiest morning peak hour)



4.5 Guideline for gap definition: 85 per cent high peak hour load factors

4.5.1 Analysis of train loadings from **Table 4.2** and **Figure 4.6** indicates that, as a generalisation, crowding levels typically rise beyond industry standards (around 3–4 per cent of passengers) on service groups where the aggregate route corridor level of capacity utilisation over the three-hour morning peak reaches a figure of 85 per cent or more. This reflects the fact that the busiest trains are significantly more heavily loaded than trains at the start and the end of the morning peak. It also illustrates the difficulty in exactly matching capacity with demand on a train-by-train basis, given that capacity increments tend to occur in large chunks (eg three trains per hour calling at a given station rather than two, or train lengthening from eight-car to 10-car), whereas demand increments occur with each additional passenger.

4.5.2 At the height of the peak high demand levels tend to be more evenly spread across all services, since capacity in terms of train lengths is standardised as far as possible with maximum length trains on most routes. As a result capacity matches demand more closely, so the aggregate route corridor utilisation rate at which overcrowding levels on individual trains becomes unacceptable is higher, at between 85 and 90 per cent, although this varies by corridor and service type.

4.5.3 However, a further factor to consider is that it is the railway industry's planning aim to avoid passengers needing to stand for any longer than 20 minutes. During normal operations this is far more likely to occur in the busiest peak hour than at other times and this counteracts the effect described above which would otherwise suggest that an aggregate capacity utilisation figure of 90 per cent or more might be appropriate in the busiest hour. The RUS therefore utilises an approximation whereby peak hour demand exceeding 85 per cent of overall capacity (including a standing allowance where appropriate), is its definition of a strategic level gap in **Chapter 7** at route corridor level.

4.6 Freight operations

4.6.1 South East England sees a significant volume and variety of freight traffic, including imported goods from ports such as Southampton, Felixstowe and the Isle of Grain in the Thames Estuary, plus flows from the Channel Tunnel. Additionally, a large volume of manufacturing and construction materials, fuel and waste products and specialist flows (such as retail) is transported to or from various handling facilities within the RUS area.

4.6.2 The following freight operating companies operate services of relevance to this RUS:

- DB Schenker (UK) which is the largest freight operator in the UK and also has a licence to operate European services. DB Schenker runs services for a wide range of markets including energy, construction, industrial, consumer goods, intermodal traffic and Royal Mail
- Freightliner Group, comprising Freightliner Limited and Freightliner Heavy Haul Limited, serving primarily the deep sea shipping containerised goods and domestic bulk goods markets respectively
- GB Railfreight moves goods from a wide range of customers, including bulk goods for heavy industrial and construction industries, as well as general commodities
- Direct Rail Services which transports a variety of commodities. In the last few years the company has expanded into running services for the domestic intermodal market

4.6.3 In addition to the above some smaller specialist freight operators run services from time-to-time in parts of the South East.

4.6.4 Freight has experienced significant growth in many parts of the South East over recent years. However, all the major routes used by freight are also used by passenger trains and the recent growth in passenger services means that, on certain routes, there is now limited scope for further growth without additional infrastructure. In addition, many routes remain constrained by restrictions on loading gauge, train length, axle weight, traction types and diversionary routes, as explored later in this RUS.

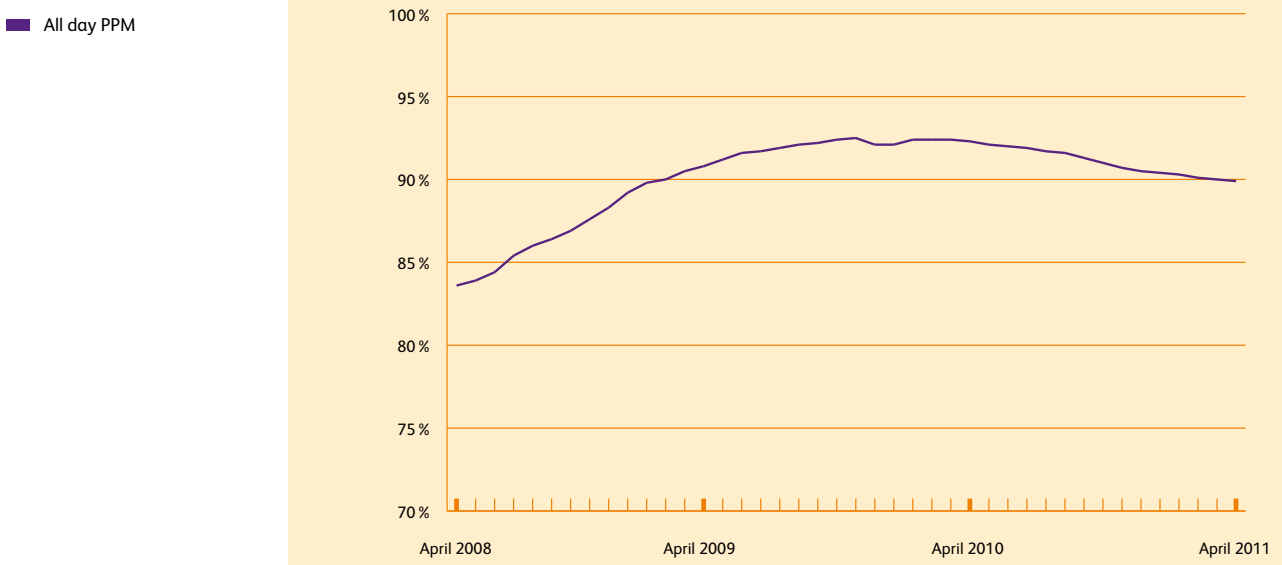
4.7 Overview of recent performance trends for passenger services

4.7.1 Services covered by this RUS operate on one of the busiest railway networks in the world. In order to accommodate the large commuter flows into the capital, timetables seek to operate the maximum achievable number of trains, with intensive infrastructure utilisation and complexity of operations throughout the morning and evening peaks in particular. This results in even a small incident, during these times, having the potential to cause major disruption. Peak train performance is as a result, in general at lower levels than in the off-peak on most routes.

4.7.2 Train performance during the London peaks is particularly affected by major constraints such as track layouts, terminal station capacity and the interaction of numerous different service groups. Timetables are developed that offer the best compromise between capacity and performance, whilst serving all the various converging routes combining into a small number of corridors into Central London. The margins available to maintain a robust service are extremely tight and therefore any incident during critical periods can result in knock-on effects from one service group to another.

4.7.3 The industry measures punctuality and reliability through the Public Performance Measure[2] (PPM). Across the London terminals, there is a wide variation in PPM, reflecting the issues highlighted above. **Figures 4.7** to **4.18** provide an overview of all day performance.

Figure 4.7 – First Great Western performance



2 PPM provides an all-industry metric for overall passenger train punctuality and reliability and is expressed as a percentage of all trains arriving on time at destination, compared to the total number of trains planned. For long distance services 'on time' describes trains up to 10 minutes late, for shorter distance services a five-minute margin is used.

Figure 4.8 – Chiltern Railways performance

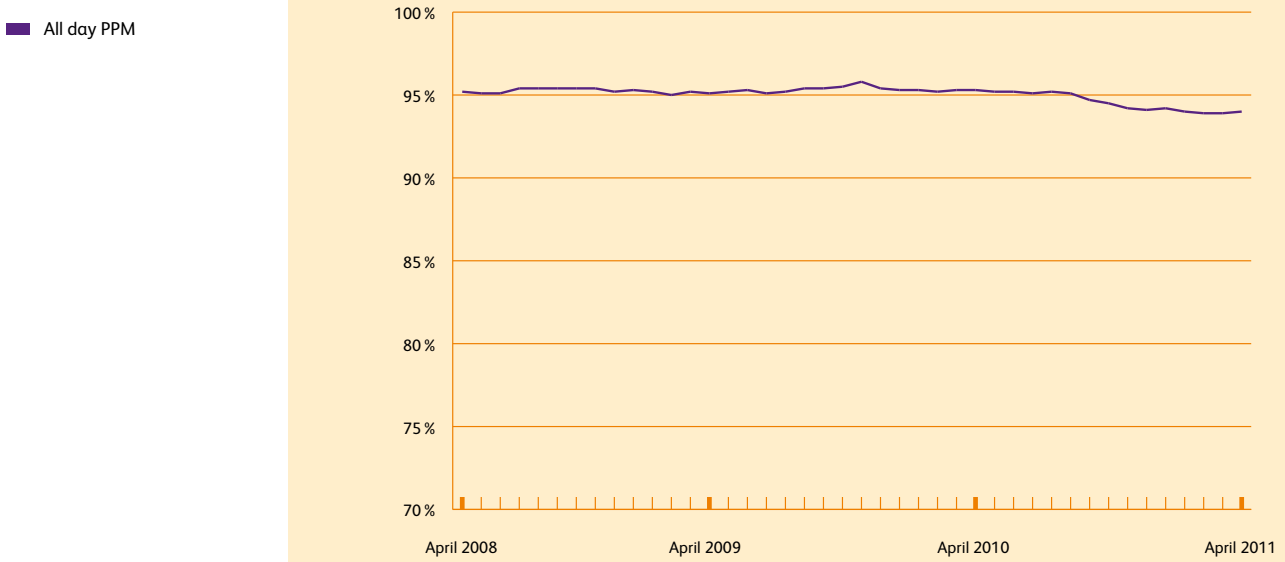


Figure 4.9 – London Midland performance

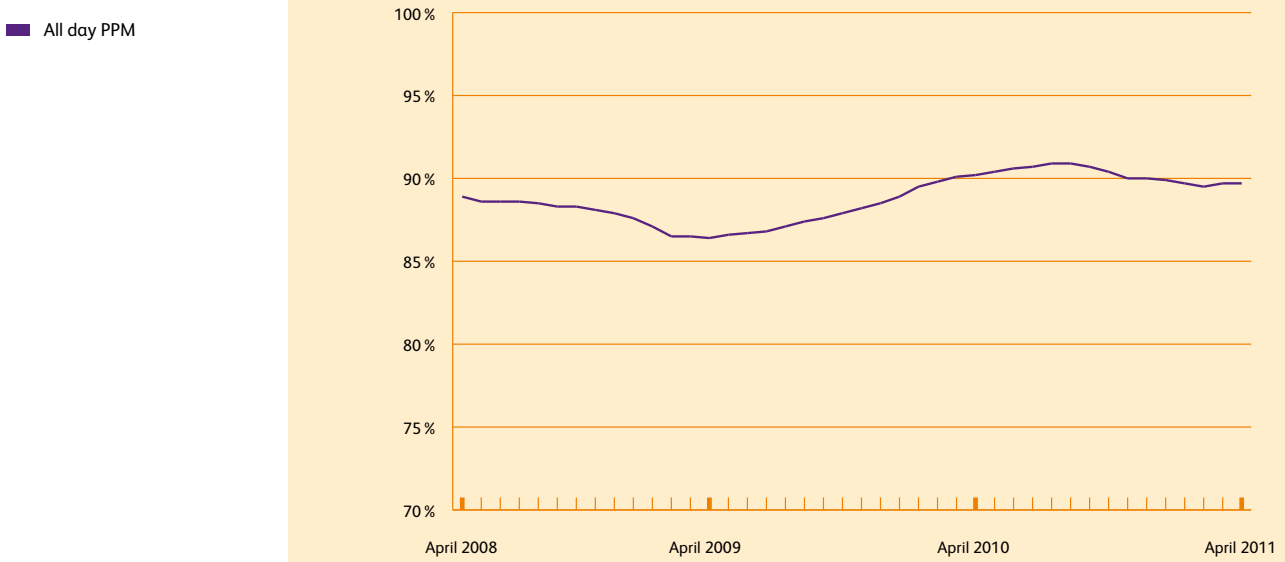


Figure 4.10 – Virgin Trains performance

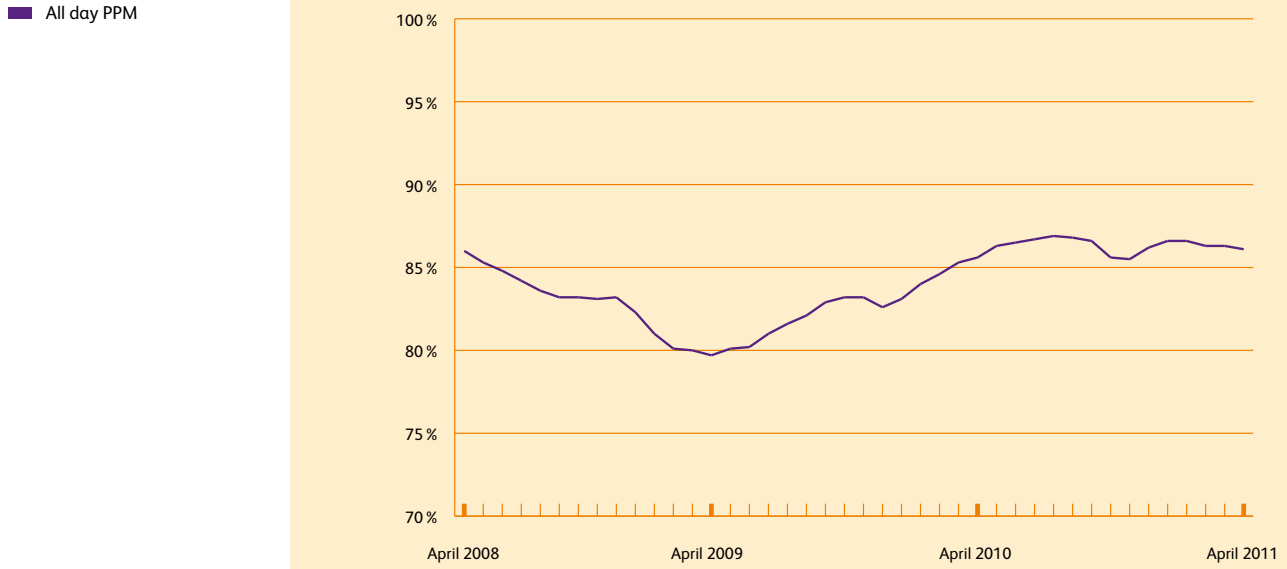


Figure 4.11 – East Midlands Trains performance

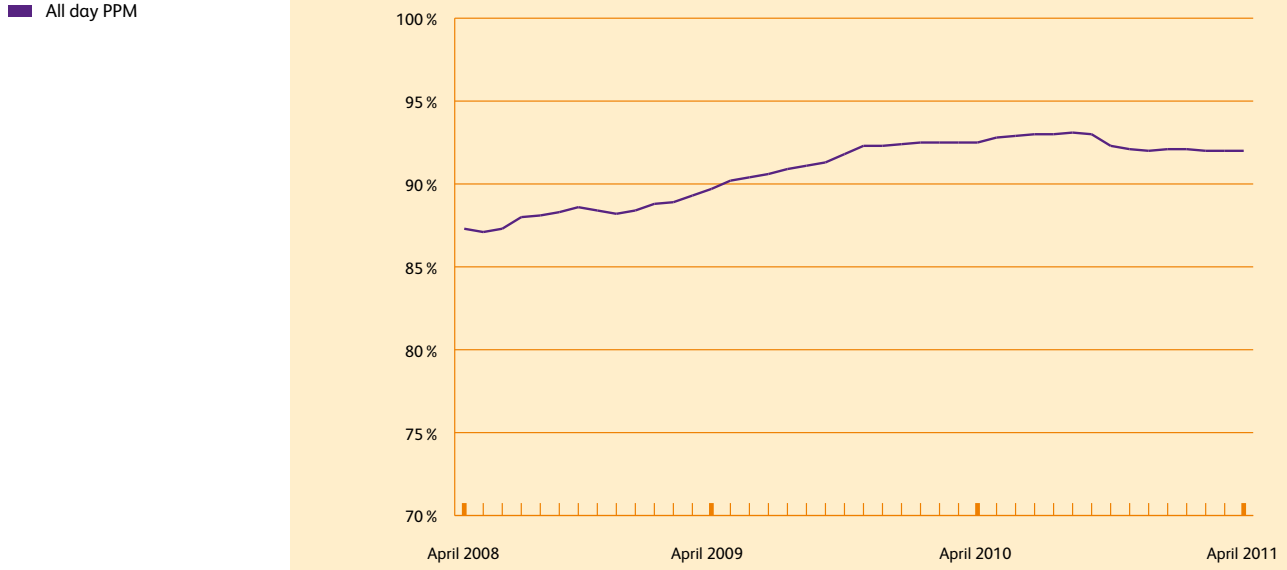


Figure 4.12 – First Capital Connect performance

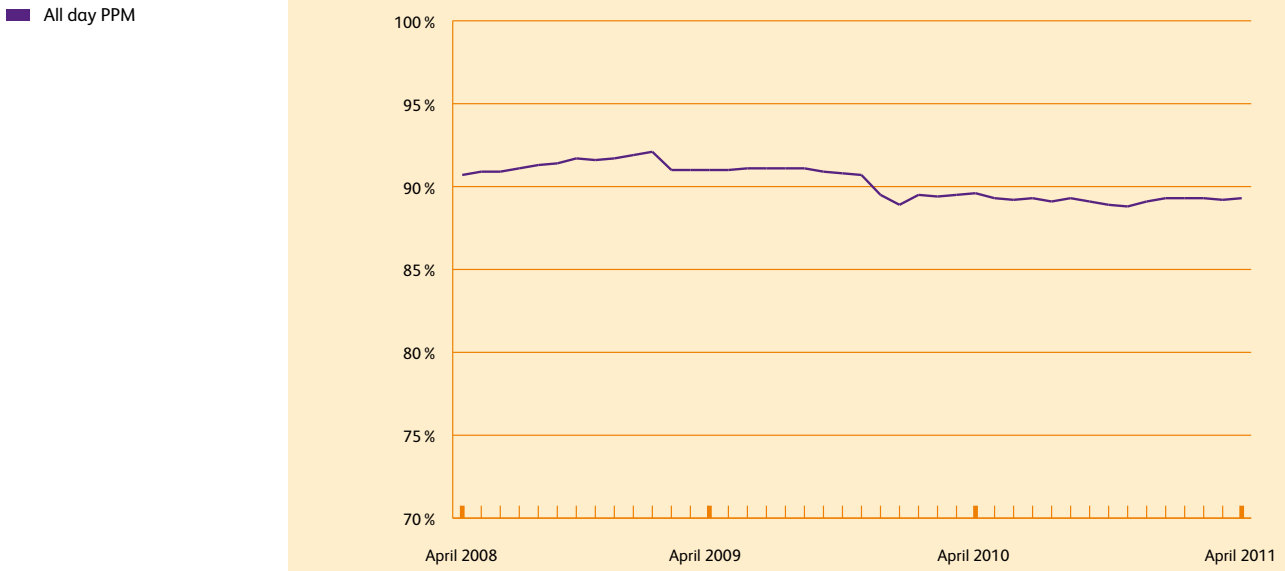


Figure 4.13 – East Coast performance

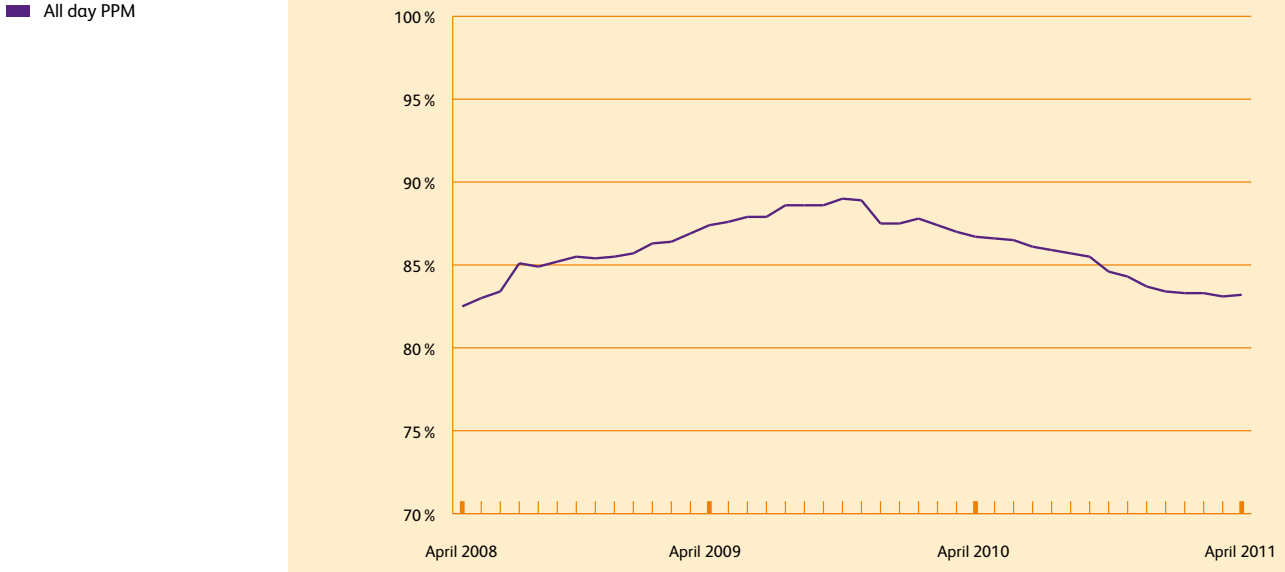


Figure 4.14 – c2c performance

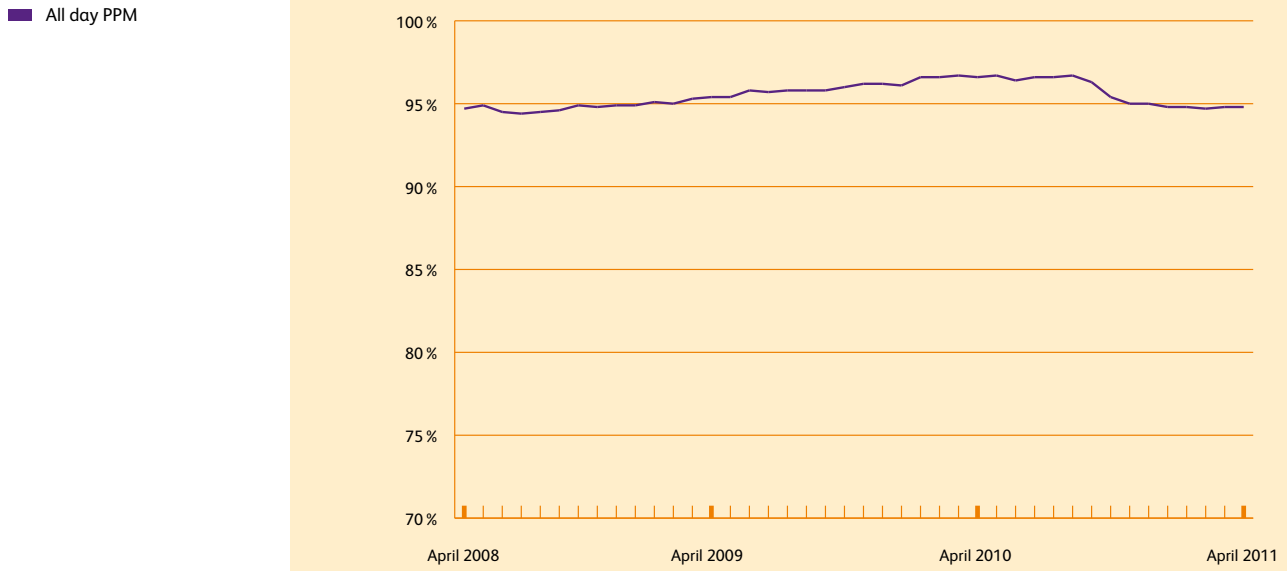


Figure 4.15 – National Express East Anglia performance

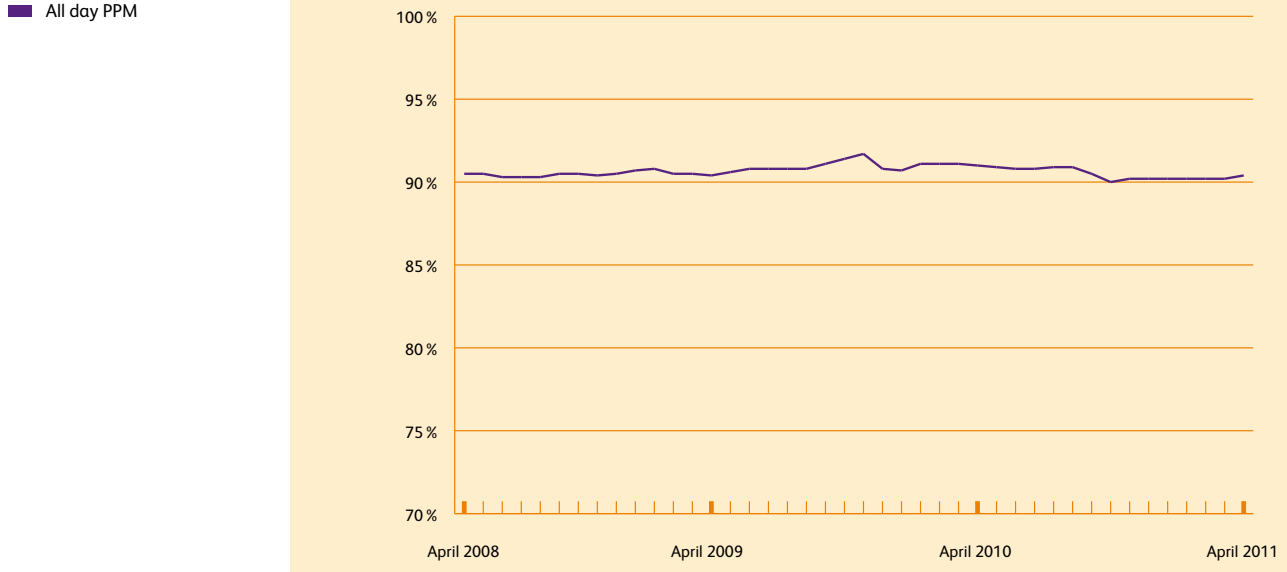


Figure 4.16 – Southeastern performance

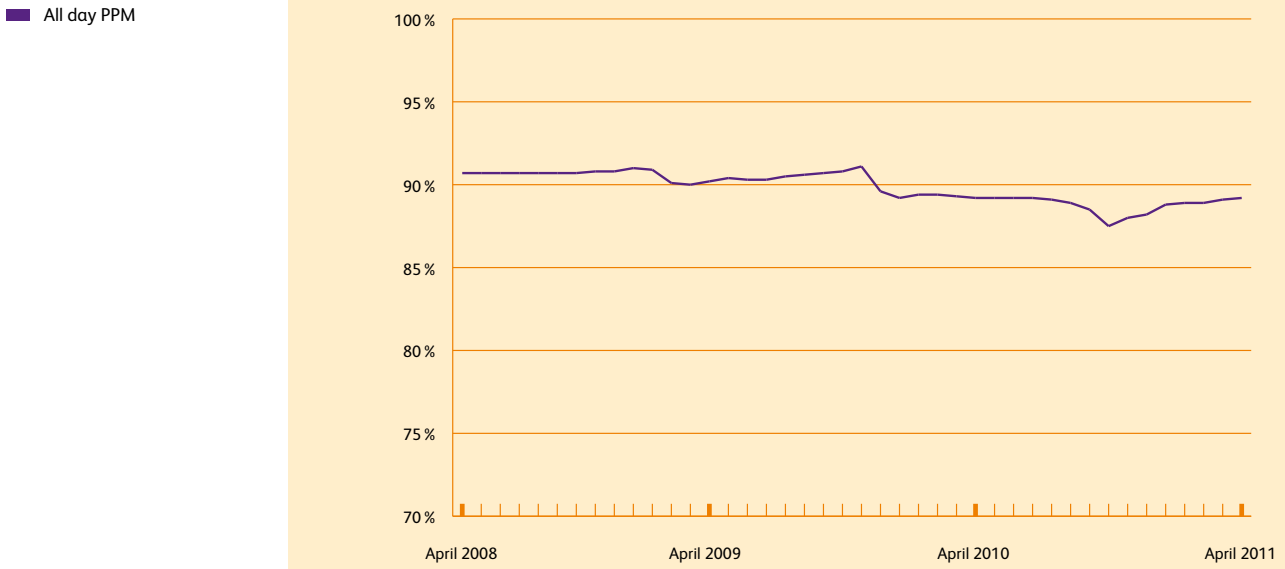


Figure 4.17 – Southern performance

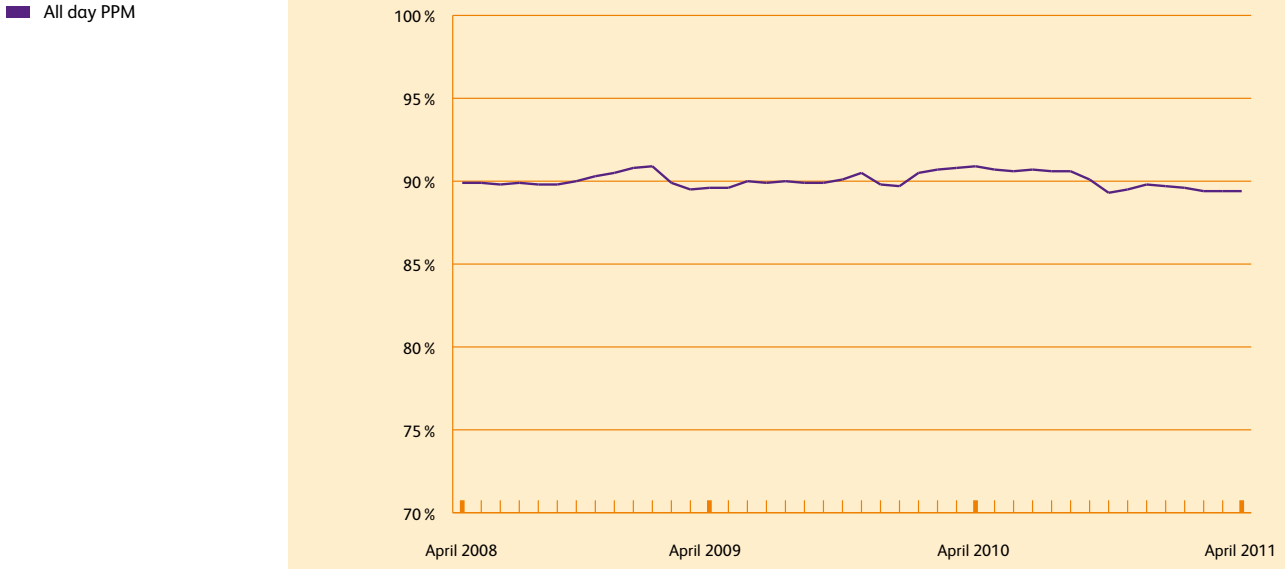
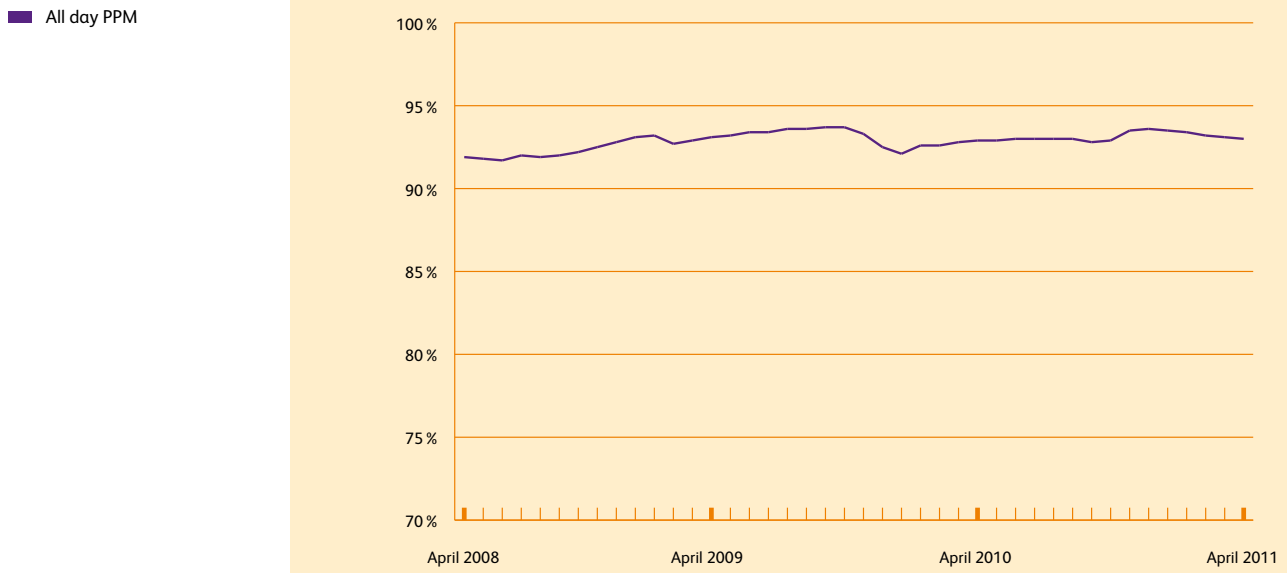


Figure 4.18 – South West Trains performance

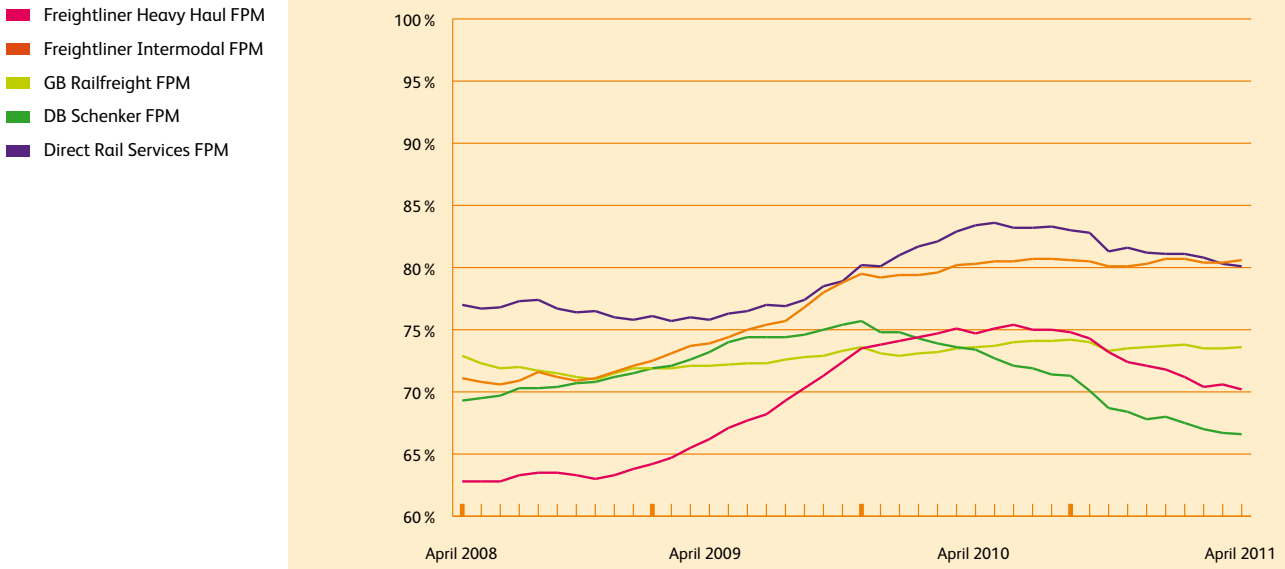


4.7.4 Despite the congested nature of the network, it can be seen from the above that the industry has a good record of improving performance over the last 10 years, with most train operators showing ongoing PPM improvements. The RUS does not therefore in general consider train performance to be a strategic level gap on a typical day, but emphasises the desirability of bringing peak train performance up to off-peak levels, together with the desirability of bringing the worst performing individual routes up to levels which are experienced elsewhere on the network.

4.7.5 Infrastructure solutions to further improve performance are possible in some cases, but are often expensive and do not generally have a robust economic case when performance is already good. It is therefore unlikely that widespread infrastructure capacity upgrades purely for performance reasons can at present be justified across the network, other than possibly at time of renewal or on any particularly poor performing routes.

4.7.6 As a result, on most routes improving existing reliability beyond current levels will tend to need to focus on factors such as improved maintenance of current assets, the design of renewals, achieving system reliability during adverse weather conditions, optimising the timetable structure to minimise conflicts and through better recovery from disruption caused by external incidents. However, further improvements to performance are anticipated through committed capacity schemes and other RUS strategy as described in **Chapter 5**, since the processes for capacity interventions consider the need for robust train performance as part of the implementation process.

Figure 4.19 – Freight operator performance



4.8 Freight performance

4.8.1 In addition to passenger services, the RUS area sees a significant volume of freight on a daily basis. Much of this traffic currently runs over the congested London commuter network, with no adequate alternative being available for many flows. Careful timetabling is undertaken to make sure that the potential for disruption to either passenger or freight traffic is minimised, but delays do occur in the event of incidents on these routes.

4.8.2 The rail industry has recently introduced a Freight Performance Measure (FPM) to evaluate freight operations. This is a national measure for each freight operator and cannot be disaggregated for London and the South East. The national FPM for each relevant freight operator is provided in **Figure 4.19**.

4.8.3 In a similar manner to passenger trains, the RUS does not see future freight performance as a strategic gap, but emphasises the need for attention on those freight flows which are less reliable than the average or are particularly time-critical in nature.

5. Morning peak to London – committed schemes and other previous strategy

5.1 Introduction

5.1.1 This chapter describes existing capacity strategy, as covered in previously established Route Utilisation Strategies (RUSs), other relevant planning documents and through the detailed development of ongoing schemes. As described in **Chapter 2**, the RUS focuses primarily on morning peak passenger capacity into London, so only the interventions of relevance to this are described in detail.

5.1.2 In general, previous strategy for capacity enhancement is rolled forward as an input into this RUS, though updates to planning assumptions are made in cases where new information has become available. The RUS assumes that committed schemes will happen as planned and they therefore form part of the baseline, or 'do-minimum' scenario. Similarly the RUS considers that other existing industry strategy will also occur in due course once funding becomes available, so this is considered as the 'baseline-plus' scenario for all analysis.

5.1.3 Any further interventions proposed by the RUS (the options described in **Chapter 7**) are therefore assessed against this baseline-plus scenario to build on previous strategy, rather than against the present situation or against currently committed schemes only.

5.1.4 The chapter outlines the committed schemes forming the do-minimum baseline and the uncommitted schemes forming the baseline-plus.

5.2 Committed schemes (Do-minimum)

5.2.1 Network Rail's Control Period 4 (CP4) Delivery Plan, updated regularly on Network Rail's website, sets out current commitments with respect to the scope and timing of infrastructure enhancement for the majority of existing schemes in the period to 2014.

5.2.2 Franchise agreements between the Department for Transport (DfT) and train operating companies set out contractual commitments for service improvement, typically using this new infrastructure and additional rolling stock being introduced into franchises.

5.2.3 Certain major projects extending beyond 2014 are subject to separate bespoke arrangements, for example the Thameslink Programme, Crossrail and the Intercity Express Programme. These schemes are also fully committed, however by their nature such schemes also have significant secondary effects which would otherwise be major interventions in their own right, for example the need for major timetable rewrites or rolling stock cascades.

5.2.4 Linked to the above, in certain cases infrastructure projects are currently committed, but franchise changes or additional rolling stock to implement the associated additional capacity are not. In these cases the RUS has made assumptions about the deployment of new and/or cascaded rolling stock, and this additional capacity is part of the RUS do-minimum baseline. These assumptions will be kept under review as the position with respect to rolling stock becomes clearer.

5.2.5 The peak capacity increases assumed by this RUS which result from committed schemes are described below.

5.3 Overview of peak capacity to London assumed from committed schemes

5.3.1 The main additional capacity into London will result from new rolling stock being procured as a result of the Thameslink Programme (approximately 1,200 vehicles) and Crossrail (approximately 600 vehicles). These programmes will enable additional and longer trains to run on both the north-south and east-west axes, and incremental infrastructure enhancements elsewhere (principally a major programme of platform lengthening) will enable several other routes in and around the capital to benefit from the resulting rolling stock cascade.

5.3.2 It is important to emphasise that the specific number of additional vehicles operating in the London area following the combination of Crossrail and the Thameslink Programme is not currently known, since some trains are likely to be deployed elsewhere, principally following electrification schemes. The RUS do minimum baseline is therefore an estimate, generally based on the assumption

that high-peak trains into the capital will all be lengthened to run at the maximum possible length. In the event that insufficient rolling stock is available to do this the first recommendation of this RUS would be that additional rolling stock for the high-peak would still be required in the future, which would be the baseline-plus scenario. As the gap identification process in **Chapter 7** is based on the baseline-plus scenario this would not be affected.

5.3.3 Based on the above approximation, the do-minimum baseline includes nearly 45,000 additional seats in the busiest peak hour into London by 2031 when compared to autumn 2010. This represents close to a 20 per cent increase in seats in the busiest peak hour on the National Rail system once the Thameslink Programme, Crossrail and other major programmes of work are completed. The increase for shoulder-peak capacity is likely to be significantly more than this figure, as there are more train lengthening opportunities existing at such times, though this is more highly dependant on rolling stock availability.

5.3.4 When standing space is included there will be a much greater capacity gain than the above increase in seats. This is due to the Thameslink and Crossrail train fleets, which are anticipated to be configured for relatively short distance commuting in the London suburbs, with over 1,700 people able to be accommodated on a Thameslink 12-car train. As a result the committed schemes deliver capacity (seats plus standing) for more than 125,000 extra people in the busiest hour on the National Rail system into London, when compared to autumn 2010, close to a 40 per cent increase.

5.3.5 Despite the above major improvements, the planned capacity increase varies significantly by route corridor and service group into London. The Thameslink and Crossrail Programmes in particular will result in a large step-change over some of the routes concerned, though many of the trains running though Central London will be alterations to existing services rather than additional train paths and the extra standing space described above is of less relevance to journeys originating from outside the London suburbs. Other routes will benefit greatly from train lengthening; utilising recently commenced platform lengthening works and existing or cascaded stock.

5.3.6 However, whilst most routes will benefit from ongoing schemes, the RUS notes that several radial routes already have full length trains throughout the busiest part of the peak at present and, since the maximum practical number of trains is, in nearly all cases, already running, these corridors will see a much lesser capacity increase than elsewhere as a result of committed schemes. Unsurprisingly, these routes are where the future capacity gaps identified in **Chapter 7** generally arise. This issue tends to relate to main line and outer suburban routes, with services closer to London benefitting from platform lengthening opportunities and additional or higher capacity trains following completion of the Thameslink and Crossrail programme.

5.3.7 **Table 5.1** shows the anticipated increases in capacity for each service type on key route corridors arising from committed schemes between 2010 and 2031.

5. Morning peak to London – committed schemes and other previous strategy

Table 5.1 – Additional capacity anticipated by the RUS Do-minimum baseline

Route into	Service group	High peak hour capacity 2010		High peak hour capacity 2031	
		seats	seats + standing	seats	seats + standing
London Paddington	Crossrail GW route	n/a	n/a	7,800	17,600
	Relief line trains (excl Crossrail)	2,500	3,100		
	Main line + other fast trains	8,000	8,300	8,600	9,200
	Heathrow Express	2,800	2,800	2,800	2,800
London Marylebone	All services	5,700	6,700	6,500	7,800
London Euston	Long Distance	5,800	5,800	6,900	6,900
	Suburban	7,600	10,600	8,100	11,400
London St Pancras	High Speed 1 (domestic)	4,200	5,700	4,200	5,700
	Thameslink MML	8,500	11,700	8,700	24,500
	MML Long Distance	2,900	2,900	2,900	2,900
	Thameslink ECML	n/a	n/a	8,200	16,300
London King's Cross	Great Northern	8,000	9,800		
	ECML Long Distance	2,700	2,700	4,900	4,900
Moorgate	All services	5,600	7,700	5,600	7,700
London Liverpool Street	West Anglia	11,400	15,800	13,500	18,500
	Great Eastern Main Line	16,700	18,900	18,600	22,900
	GE Inners	8,900	12,100	10,900	23,300
	Crossrail GE route	n/a	n/a		
	Crossrail Abbey Wood route	n/a	n/a	7,100	18,100
London Fenchurch Street	All services	12,100	16,200	14,900	20,100
London Bridge	Charing Cross	19,200	29,800	19,200	29,800
	Cannon Street	15,500	24,500	16,800	26,500
	Thameslink Kent	n/a	n/a	2,500	6,900
	Thameslink Sussex	nil in peak	nil in peak	11,900	28,100
	Terminating (fast trains via East Croydon)	8,600	13,000		
	Terminating (inners)	7,100	10,400	9,800	13,300
London Blackfriars	All services (from Elephant & Castle route)	8,000	10,700	7,900	14,100
London Victoria	Kent routes	9,500	11,800	8,400	12,500
	Fast trains via East Croydon	11,800	16,700	12,900	18,600
	Stopping trains via Balham	7,100	10,300	11,500	15,200
London Waterloo	Windsor Lines (all services)	7,800	16,200	9,000	19,300
	Inner suburban (via Wimbledon)	13,000	29,200	15,100	34,700
	South West Main Line	13,400	13,400	13,400	13,400
RADIAL ROUTES TOTALS		**234,400**	**326,800**	**278,600**	**453,000**
Main Orbital routes	West London Line	1,200	2,500	1,300	3,000
	East London Line	1,800	5,300	2,300	7,100
	North London Line	900	2,700	1,200	3,500

Figure 5.1 – additional seats arising from committed schemes by line of route

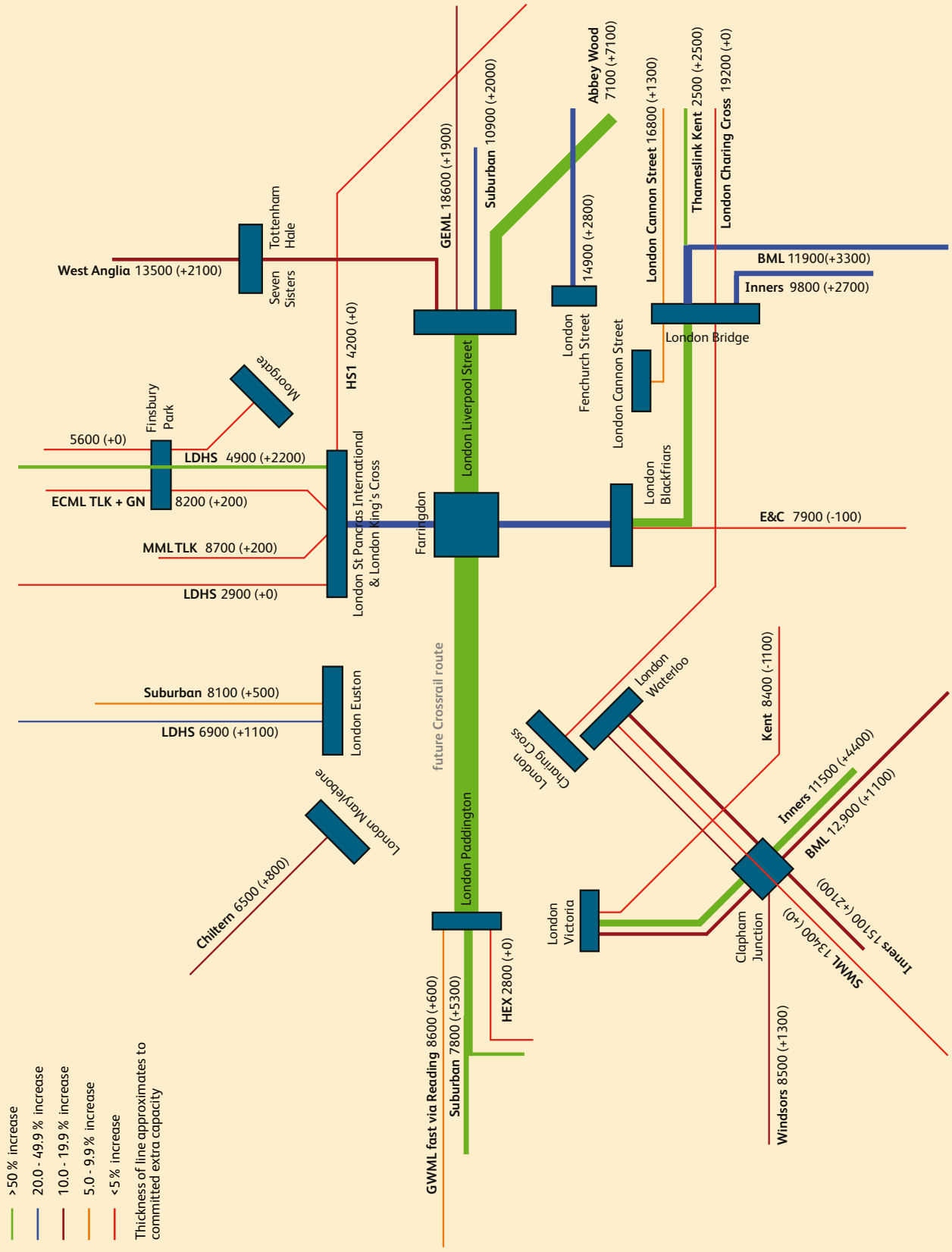
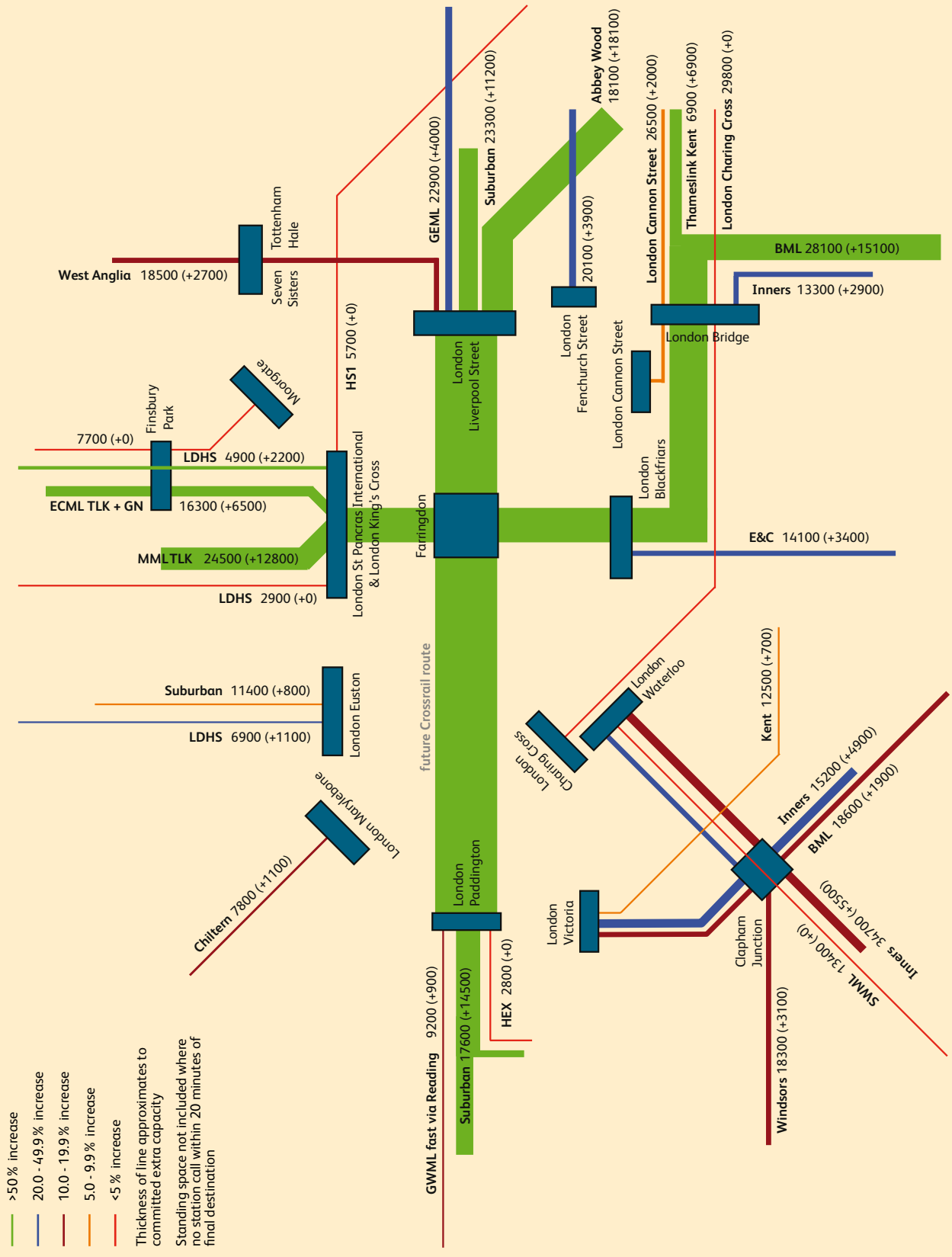


Figure 5.2 – additional capacity (seats+standing) arising from committed schemes by line of route



5.3.10 **Figure 5.1** and **Figure 5.2** illustrate the anticipated increases in capacity from committed schemes geographically, in terms of additional seats and additional capacity respectively.

5.3.11 The sections below provide an overview of the key committed capacity schemes (Crossrail, the Thameslink Programme, train lengthening and the Intercity Express Programme), followed by line-of-route breakdowns of the additional peak capacity provided.

5.4 Crossrail

5.4.1 Crossrail will provide a new service linking Maidenhead and Heathrow Airport with Shenfield and Abbey Wood via a new tunnel through Central London, with completion planned for 2018. As described earlier approximately 600 new carriages are anticipated, all of which will be in 10-car fixed formations with capacity for 1,500 people on each train.

5.4.2 Crossrail will provide major improvements in connectivity, reductions in journey times, frequency improvements and significant congestion relief to the London Underground system, especially the Central Line.

5.4.3 There will be 24 Crossrail trains in the high-peak hour across the capital between Paddington and Whitechapel. Beyond this Central London section, 12 of these will replace most inner services on the Great Eastern Main Line (GEML) and 10 will replace most inner services (including Heathrow Connect) on the Great Western Main Line (GWML) route. There will also be 12 trains in the high-peak hour via a new cross-river tunnel route to Abbey Wood via Canary Wharf.

5.4.4 It can be seen from the above that 14 of the 24 peak Crossrail trains will run no further west than sidings just outside Paddington. Options in **Chapter 7** and **Chapter 8** explore possible ways of extending additional trains westward from this point.

5.5 Thameslink Programme

5.5.1 The Thameslink Programme is close to the completion of works to enable longer trains to run on the core Elephant & Castle to London St Pancras International route. This includes the complete reconstruction of London Blackfriars station and the Thameslink element of major works at Farringdon (works associated with Crossrail will remain ongoing). This phase facilitates increased capacity through 12-car operations on the core Bedford – Brighton route, and makes provision for a future frequency increase through the central London tunnels.

5.5.2 The next stage is focussing on the reconstruction of the London Bridge area, where works associated with the Shard of Glass development are already well underway and the new Borough Market viaduct is now in place. However the remodelling of the London Bridge station area itself and associated track approaches represents a major engineering challenge, with works not anticipated for completion until 2018. Provision of a connection between the East Coast Main Line (ECML) and the Thameslink tunnels is anticipated within similar timescales.

5.5.3 As described in **Chapter 3**, during the RUS consultation, stakeholders sought additional information regarding the assumptions made in connection with the timetable structure which might be implemented upon completion of the Thameslink Programme in 2018. It is emphasised that no decisions have been taken in this regard and timetable development work is ongoing. Based on analysis undertaken to date, the 24 trains per hour Thameslink core service as described in **Table 5.2** has been assumed by the RUS in this assessment.

Sussex Route
Kent Route
Midland Main Line
East Coast Main Line

Table 5.2 – indicative services assumed to operate through the Thameslink core in 2018

No	South of London		North of London		Length	Times
1	Brighton	semi-fast	Bedford	semi-fast	12-car	All day
2						
3	Brighton	stopping	Bedford	semi-fast	12-car	All day
4						
5	Three Bridges	via Redhill	Peterborough	semi-fast	12-car	All day
6						
7	Horsham		Cambridge	semi-fast	12-car	All day
8						
9	East Grinstead		Bedford	semi-fast	12-car	Peak only
10						
11	Caterham	fast north of Norwood Junction	St Albans	stopping	8-car	All day
12						
13	Tattenham Corner		Welwyn Garden City	stopping	8-car	All day
14						
15	Tunbridge Wells	via Tonbridge	Bedford	semi-fast	12-car	Peak only
16						
17	Ashford International		Luton	semi-fast	12-car	Peak only
18						
19	Maidstone East	semi-fast via Catford	Welwyn Garden City	stopping	8-car	All day
20						
21	Sevenoaks	skip-stop via Catford	Luton	stopping	8-car	All day
22						
23	Bellingham	stopping via Catford	St Albans	stopping	8-car	All day
24						

5.5.4 In addition to the Thameslink service structure a number of major changes are assumed to other services on the Sussex, Kent, Midland Main Line (MML) and ECML routes at the same time as the Thameslink Programme completion. This includes the following indicative assumptions, which are included in the detailed route-by-route analysis later in this chapter.

- additional trains from the Tulse Hill route to London Bridge
- an eight trains per hour peak service into the Blackfriars bays (a four trains per hour all-day service via Tulse Hill, a two trains per hour peak stopping service via Kent House and a two trains per hour peak service between the Medway Towns and Blackfriars)
- a Kent route timetable which is generally based on a peak 15/30 minute repeating pattern, rather than 20 minutes on many routes as at present
- a significant increase in service levels on the Hertford Loop, for which extra capacity will become available at Moorgate as a result of many Welwyn Garden City stopping services being rerouted to the Thameslink network.

5.5.5 Further feasibility work on a potential post-Thameslink timetable structure is ongoing. The DfT expects to consult on the proposed timetable structure in due course, as part of the Thameslink franchise replacement, before firm decisions are made.

5.6 Train Lengthening/High Level Output Specification

5.6.1 Network Rail's CP4 funding settlement included provision for a significant platform lengthening programme on many routes in and around the capital. The scope and timings of this work are described in detail in regular updates to the CP4 Delivery Plan (available on Network Rail's website), and are treated as committed schemes by the RUS.

5.6.2 The principal routes benefiting from platform lengthening are as follows:

- suburban routes to London Waterloo (lengthening from eight-car to 10-car trains)
- suburban routes to London Victoria via Balham (lengthening from eight-car to 10-car trains)
- suburban routes to London Bridge via Sydenham (lengthening from eight-car to 10-car trains)
- suburban routes to London Charing Cross and London Cannon Street (lengthening from 10-car to 12-car trains, albeit with some significant operational constraints still remaining)
- the East Grinstead Line (lengthening from eight-car to 12-car trains)
- the Tilbury Loop (lengthening from eight-car to 12-car trains)
- Brighton to Bedford services (lengthening from eight-car to 12-car trains as part of the Thameslink Programme)
- outer West Anglia services (lengthening of most stations from eight-car to 12-car trains)
- outer Great Eastern services (further 12-car capability)
- West Coast Main Line Class 390 services (lengthening from nine-car to 11-car trains).

5.6.3 On a small number of routes additional peak trains are possible within existing infrastructure constraints or with committed upgrades. For example an additional peak train is planned by South West Trains once the disused previous international platforms at London Waterloo are bought back into use.

5.6.4 This programme of work will enable the industry to meet the Department for Transport's High Level Output Specification (HLOS) for additional London peak capacity in CP4.

5.7 Intercity Express Programme

5.7.1 This RUS only generally covers the London commuting area[1], but it incorporates policy regarding long distance services from further afield since these provide a significant proportion of capacity on principal main line routes into the capital. Two such routes, the GWML and ECML, will have new Intercity Express Programme (IEP) trains to replace most existing High Speed Trains (HSTs) and enable all day frequency increases.

5.7.2 The GWML and ECML will both greatly benefit from the IEP Services, which will provide faster, better and higher capacity rolling stock. However in general any additional trains into Central London will not be in the busiest part of the commuter peak, since very few or no extra high-peak arrivals into London are viable over the infrastructure, regardless of train type. This is a significant issue with respect to future commuting patterns from areas such as the Thames Valley, especially given that additional passengers will be attracted by the IEP trains themselves.

5.7.3 Linked to the new rolling stock the industry will also deliver significant associated works including electrification of the GWML, and platform extensions, rolling stock clearance and depot works at various locations. There are also significant interfaces with the Thameslink Programme and Crossrail works on the ECML and GWML respectively. IEP will provide more frequent services on some routes and better journey times.

5.7.4 On the GWML the expectation following the implementation of IEP is that nine of the current 15 main line timetable slots in the busiest hour will be operated by IEP trains, comprised of a mixture of electric vehicles for wholly-electrified routes and bi-mode vehicles to allow operation beyond the electrified network.

5.7.5 Replacement of long distance rolling stock by IEP on the ECML will be more limited, since IEP will operate alongside existing Class 91 locomotives and Mark IV trainsets. However, implementation of IEP will also enable an upgrade of fast Cambridge services to 'intercity' standard, whilst Thameslink focuses on semi-fast services on this route. In total six IEP services are therefore anticipated as operating into London King's Cross in the busiest peak hour, plus four other long distance services.

5.8 Capacity to/via London Paddington

5.8.1 On the GWML, in addition to the IEP services, there will be ten 10-car Crossrail trains each peak hour, four of which will be from Maidenhead, four from Heathrow Terminal 4 and two from West Drayton. Crossrail services will replace Heathrow Connect and all other relief line services, with the exception of two residual services into London Paddington in each hour from Reading, together with one peak service from each of Bourne End and Henley-on-Thames. Crossrail services will commence in 2018. The scheme also includes various infrastructure works, including significant remodelling at Maidenhead.

5.8.2 The Reading station area redevelopment is designed to deliver significant performance improvements for GWML, cross-country and freight services as well as passive provision for future main line service increases, a Crossrail extension and potential future links to Heathrow Airport. These works are due for completion in 2016. However it is emphasised that at present the redevelopment alone does not result in additional high-peak trains into London Paddington (though it could potentially facilitate them later as discussed in **Chapter 7**).

5.8.3 Electrification of the GWML from Airport Junction to Oxford, Newbury, Bristol and Cardiff is now committed and will be subject to a rolling programme of works over the coming years, linked to both Crossrail and IEP implementation.

1 Broadly speaking, the area served by train operators traditionally grouped togther as the 'London & South East' Sector

5.8.4 The combined impact of new IEP trains and new or cascaded Electric Multiple Units (EMUs) following electrification will increase main line capacity. The RUS do-minimum scenario includes, in addition to the nine IEP arrivals at London Paddington in the busiest hour, five 8-car outer suburban EMUs and one retained High Speed Train running from the West of England. Since this is the same number of main line peak trains (15) as the current service structure it is the higher capacity of most of the trains concerned, rather than additional services, which provides the improvement.

5.8.5 Further from London, schemes are planned on the GWML, for example redoubling of single track sections on both the North and South Cotswold routes. However, whilst such schemes will enable improved operational robustness and timetabling opportunities over these lines they will not enable additional trains into London at peak times.

5.8.6 The assumed do-minimum changes in capacity into London Paddington for the busiest hour in the morning peak are shown in **Table 5.3**. However, the final timetables and the rolling stock strategy for this route are subject to significant uncertainties at present, so these figures are subject to change.

Table 5.3 – London Paddington busiest morning peak hour capacity RUS do-minimum baseline

Service group	High-peak hour capacity 2010		High-peak hour capacity 2031		Change	
	seats	seats + standing	seats	seats + standing	Seats	seats + standing
Crossrail	n/a	n/a	7,800	17,600	+5,300	+14,500
Relief line trains (excl Crossrail)	2,500	3,100				
Main line + other fast trains	8,000	8,300	8,600	9,200	+600	+900
Heathrow Express	2,800	2,800	2,800	2,800	nil	nil
TOTALS	**13,300**	**14,200**	**19,200**	**29,600**	**+5,900**	**+15,400**

5.9 Capacity to London Marylebone

5.9.1 The 'Evergreen 3' project is the third phase of an investment programme to deliver faster journeys between London Marylebone and Birmingham Moor Street/Snow Hill and to provide an additional two trains per hour all day service between Oxford and London Marylebone over a new route via Bicester Town. Infrastructure enhancements include remodelling in the South Ruislip area and linespeed improvements. The RUS capacity baseline assumes the Oxford service will be operated utilising four-car Class 168 (Diesel Multiple Units), with the last stop before London at High Wycombe. In the morning high-peak hour only one extra London Marylebone arrival overall is anticipated.

5.9.2 In addition train lengthening is anticipated (20 extra vehicles overall in the morning peak, eight in the busiest hour).

5.9.3 The anticipated change in capacity into London Marylebone for the busiest peak hour is shown in **Table 5.4**. Further details can be found in the West Midlands and Chilterns RUS, published by Network Rail in May 2011.

Table 5.4 – London Marylebone busiest morning peak hour capacity RUS do-minimum baseline

Service group	High-peak hour capacity 2010		High-peak hour capacity 2031		Change	
	seats	seats + standing	seats	seats + standing	Seats	seats + standing
All services	5,700	6,700	6,500	7,800	+800	+1,100

5.9.4 In addition to the above the committed upgrade to the London Underground Metropolitan Line also adds significant capacity on the London approaches on this corridor, together with improvements to journey quality for outer suburban passengers as a result of the new London Underground (LU) 'S' stock.

5.10 Capacity to London Euston

5.10.1 Opportunities exist to lengthen long distance trains on this route with additional standard class vehicles, and to implement very limited capacity increments on outer suburban trains. The following improvements are anticipated.

5.10.2 With respect to long distance services, the do-minimum scenario includes the 31 Class 390 EMU train sets being lengthened from nine-car to 11-car trains (two additional standard class vehicles), and the provision of four new 11-car Class 390 train sets. Given that the rolling stock is on order, the RUS assumes this will proceed in due course.

5.10.3 London Midland has largely replaced its Class 321 stock with Class 350 vehicles, which are of a higher quality but have a lower overall seating capacity.

5.10.4 The operator has proposed further changes to the DfT, including train lengthening to increase outer suburban capacity. The details are not finalised but the following is assumed by the RUS:

- 36 extra vehicle arrivals in the morning peak, eight of them between 08:00 and 09:00
- 48 extra vehicle arrivals in the evening peak, 16 of them between 17:00 and 18:00.

5.10.5 The change in capacity into London Euston for the busiest hour is shown in **Table 5.5**. Further details of the strategy for this route can be found in the West Coast Main Line RUS, published by Network Rail in July 2011.

Table 5.5 – London Euston busiest morning peak hour capacity RUS do-minimum baseline

Service group	High-peak hour capacity 2010		High-peak hour capacity 2031		Change	
	seats	seats + standing	seats	seats + standing	Seats	seats + standing
Long Distance	5,800	5,800	6,900	6,900	+1,100	+1,100
Inner & outer suburban	7,600	10,600	8,100	11,400	+500	+800
TOTALS	**13,400**	**16,400**	**15,000**	**18,300**	**+1,600**	**+1,900**

5.11 Capacity to London St Pancras International (high level station)

5.11.1 No capacity changes are planned on either the MML (East Midlands Trains services) or Southeastern's services on High Speed 1 (HS1), with capacity levels shown in **Table 5.6**.

Table 5.6 – London St Pancras International (high level domestic) busiest morning peak hour capacity: RUS do-minimum baseline

Service group	High-peak hour capacity 2010		High-peak hour capacity 2031		Change	
	seats	seats + standing	seats	seats + standing	Seats	seats + standing
High Speed 1 (domestic)	4,200	5,700	4,200	5,700	nil	nil
MML Long Distance	2,900	2,900	2,900	2,900	nil	nil

5.12 Capacity via London St Pancras International low level (MML and ECML Thameslink services)

5.12.1 **Table 5.7** shows that the Thameslink Programme will more than double on-train capacity in the busiest hour into London St Pancras International low level from the MML, also providing a new route to the ECML. The majority of the increase results from the higher capacity rolling stock being used.

Table 5.7 – London St Pancras International (low level Thameslink platforms) busiest morning peak hour capacity from the north: RUS do-minimum baseline

Service group	High-peak hour capacity 2010		High-peak hour capacity 2031		Change	
	seats	seats + standing	seats	seats + standing	Seats	seats + standing
Thameslink MML	8,500	11,700	8,700	24,500	+200	+12,800
Thameslink ECML	n/a	n/a	4,100	11,700	+4,100	+11,700
TOTALS	**8,500**	**11,700**	**12,800**	**36,200**	**+4,300**	**+24,500**

5.12.2 As illustrated earlier in **Table 5.2** the RUS assumptions, incorporated into its baseline, include the following illustrative morning peak service following the completion of work on the Thameslink Programme. This is based on initial operational feasibility work and will be subject to detailed stakeholder consultation and consequent refinement, through future franchising processes.

- MML stopping services (from St Albans/Luton)
  - six x eight-car trains
- MML semi-fast services (from Luton/Bedford)
  - ten x 12-car trains
- ECML stopping services (from Welwyn Garden City)
  - four x eight-car trains
- ECML semi-fast services (from Cambridge/ Peterborough, generally running fast between Stevenage and Finsbury Park)
  - four x 12-car trains.

5.12.3 All the above would be fixed-formation trains, configured for significantly higher standing capacity than those currently in operation, with over 1700 passengers on a 12-car train. However, this figure implies large numbers of passengers standing, so operation with such loads would only be appropriate over relatively short distances.

5.13 Capacity to London King's Cross

5.13.1 First Capital Connect's December 2010 timetable recently provided increased capacity on the Cambridge line, including additional Class 321 peak operations.

5.13.2 Long distance timetables have recently been improved through the May 2011 timetable and will, in the longer term, be further improved by major infrastructure enhancements at several locations along the route. This will enable eight long distance arrivals into London in the 08:00 to 08:59 period, a significant capacity increment.

5.13.3 IEP on the ECML will replace HST services and fast trains to Cambridge. This change in rolling stock will provide a further 200 – 500 extra seats in the busiest peak hour.

5.13.4 Beyond 2018, the Thameslink Programme will alleviate suburban capacity constraints and improve connectivity, by enabling commuter services to continue through the Thameslink tunnels, rather than needing to terminate at London King's Cross. However, no (or very few) additional peak trains relative to today will be able to run through the critical Welwyn viaduct area, so it is likely that frequency increases in the morning peak will generally be restricted to inner suburban services. These will benefit from a combination of the Thameslink Programme and committed infrastructure enhancements in the Finsbury Park to Alexandra Palace area, with six fully usable tracks planned.

5.13.5 The introduction of the planned ECML Thameslink services results in trains being diverted away from London King's Cross and running through Central London instead. London King's Cross station itself therefore sees a slightly lower level of train service following the Thameslink Programme, but the planned capacity increase at London St. Pancras International low level from the ECML is greater than this reduction, especially if standing space is included.

5.13.6 Following the completion of the Thameslink Programme the following morning peak train service (14 trains per hour) is anticipated as remaining in operation into London King's Cross:

- Cambridge stopping services, running via Welwyn Garden City
  - two x eight-car trains operated by Class 377 stock (maximum acceleration is particularly important on this service group, given the need for calls at Welwyn North)
- Peterborough fast services
  - two x 12-car trains operated by Class 365 stock
- Ely/Kings Lynn fast services
  - two x 10-car new IEP trains
- Long Distance High Speed (LDHS)
  - eight x LDHS trains, up to half of which would be IEP at certain times, with the others formed of existing Mark IV sets.

Note that the Cambridge and Peterborough semi-fast services were included in **section 5.12** so are not included in the above. The Welwyn Garden City services are included in a mix of **sections 5.12** and **5.14** so are also not included.

5.13.7 Whilst this RUS only considers in detail the London commuting area it interfaces with the wider ECML improvements scheme. This includes the construction of a new flyover at Hitchin to remove conflicts between the main ECML and Cambridge line services, additional platforms at Peterborough, remodelling at other major constraints on the route, and upgrading of the GN/GE Joint Line route via Lincoln to enable additional freight services to utilise that route in preference to the main ECML.

5.13.8 The anticipated changes in capacity into London King's Cross for the busiest hour are shown in **Table 5.8**.

Table 5.8 – London King's Cross busiest morning peak hour capacity RUS do-minimum baseline

Service group	High-peak hour capacity 2010		High-peak hour capacity 2031		Change	
	seats	seats + standing	seats	seats + standing	Seats	seats + standing
Great Northern route	8,000	9,800	4,000	4,600	-4,000	-5,200
ECML Long Distance	2,700	2,700	4,900	4,900	+2,200	+2,200
TOTALS	**10,700**	**12,500**	**8,900**	**9,500**	**-1,800**	**-3,000**

5.13.9 **Figure 5.4** provides an indicative peak service structure for the ECML long distance services following IEP.

5.14 Capacity to Moorgate

5.14.1 Following completion of the Thameslink Programme it is assumed that the current peak service into Moorgate will remain at 12 trains per hour as today. However, several of the existing Welwyn Garden City to Moorgate/London King's Cross services are anticipated as being re-routed through the Thameslink route tunnels as described in **section 5.5**. Capacity would be freed up on the Moorgate branch if this element was implemented, enabling a frequency increase to 10 trains per hour on the Hertford Loop.

5.14.2 The 2010 and 2031 capacity into Moorgate for the busiest hour is shown in **Table 5.9**. Whilst no difference in capacity is shown overall it is emphasised that the Hertford Loop is assumed by the RUS analysis as seeing a significant capacity increase, as outlined above, whilst the reduction shown on the Welwyn Garden City route is due to the diversion of trains through the Thameslink tunnels and therefore included in **Table 5.7**.

Table 5.9 – Moorgate busiest morning peak hour capacity RUS do-minimum baseline

Service group	High-peak hour capacity 2010		High-peak hour capacity 2031		Change	
	seats	seats + standing	seats	seats + standing	Seats	seats + standing
Hertford Loop	3,700	5,100	4,700	6,400	+1,000	+1,300
Welwyn Garden City route	1,900	2,600	900	1,300	-1,000	-1,300
TOTALS	**5,600**	**7,700**	**5,600**	**7,700**	**nil**	**nil**

5.15 Capacity to/via London Bridge

5.15.1 London Bridge will see significant capacity changes arising from the combined interaction of the Thameslink Programme and train lengthening.

5.15.2 The principal benefits of the Thameslink Programme in this area will be to enable many terminating trains to become through trains, to enable all trains to London Charing Cross to call, to provide a station with increased pedestrian capacity (complementing other developments in the area) and to improve performance and service robustness. There will also be a significant high-peak increment through extra trains, longer trains and higher density vehicles.

Table 5.10 – anticipated services at/through London Bridge after completion of the Thameslink Programme

Route to	Number of trains in busiest morning peak hour	
	2011	2018
London Charing Cross	29 (16 calling at London Bridge)	28 (all calling at London Bridge)
London Cannon Street	25	22
via London Blackfriars from Kent route	0	4
via London Blackfriars from Sussex route	0 (off-peak service only)	14
London Bridge (terminating)	30	20
TOTAL	**84**	**88**

5.15.3 Overall high peak service levels anticipated at London Bridge are shown in **Table 5.10**. The RUS notes that no additional train paths from the Kent routes via London Bridge have been identified, given that constraints such as the Lewisham area and the two-track Orpington – Tonbridge corridor will still apply, as outlined in the Kent RUS. The Kent Thameslink trains are therefore effectively diversions away from London Cannon Street. On Sussex routes four additional train paths per hour are considered likely to be available (two of which are diversions away from the Elephant & Castle route), but the East Croydon area represents a major barrier to further growth as outlined in the Sussex RUS.

5.15.4 Train lengthening on non-Thameslink services is anticipated as a result of the rolling stock cascade when the new trains are introduced, due to the extra vehicles which will be in operation overall as described earlier. The RUS assumes that this will enable some high-peak suburban trains into London Charing Cross and London Cannon Street to be lengthened to 12-car, the majority of Sussex route fast services to be lengthened to 12-car and all peak suburban trains via Sydenham to be lengthened to 10-car.

5.15.5 Lengthening of suburban operations to 12-car on Kent routes is not currently a franchise commitment and is also particularly dependent on resolution of operating issues at London Charing Cross and elsewhere. The RUS has made assumptions in this regard since it can be expected that rolling stock will be freed up by Thameslink operations in this area, but these assumptions are subject to a significant level of uncertainty at present.

5.15.6 All services to and via London Bridge will need timetable changes during the Thameslink Programme construction works and after the project is completed. On Kent routes peak services in southeast London will need to be recast into a 15/30-minute repeating pattern, rather than the existing 20-minute pattern on many routes, to tie into patterns on other Thameslink corridors. This change has the potential to affect frequencies at some stations, and the split in trains between London Charing Cross and London Cannon Street.

5.15.7 The RUS baseline assumed changes in capacity into and via London Bridge for the busiest hour is shown in **Table 5.11**. It can be seen that there is approximately a 20 per cent increase in seats in total, and a 35 per cent increase in capacity which is mainly as a result of the new Thameslink high capacity trains.

Table 5.11 – London Bridge busiest morning peak hour capacity RUS do-minimum baseline

Service group	High-peak hour capacity 2010		High-peak hour capacity 2031		Change	
	seats	seats + standing	seats	seats + standing	Seats	seats + standing
London Charing Cross	19,200	29,800	19,200	29,800	nil	nil
London Cannon Street	15,500	24,500	16,800	26,500	+1,300	+2,000
Thameslink Kent	n/a	n/a	2,500	6,900	+2,500	+6,900
KENT TOTALS	**34,700**	**54,300**	**38,500**	**63,200**	**+3,800**	**+8,900**
Thameslink Sussex	nil in peak	nil in peak	7,800	22,000	+7,800	+22,000
Terminating (fast trains via East Croydon)	8,600	13,000	4.100	6,100	-4,500	-6,900
Terminating (inners)	7,100	10,400	9,800	13,300	+2,700	+2,900
SUSSEX TOTALS	**15,700**	**23,400**	**21,700**	**41,400**	**+6,000**	**+18,000**
ALL VIA LONDON BRIDGE TOTALS	**50,400**	**77,700**	**60,200**	**104,600**	**+9,800**	**+26,900**

5.16 Capacity via Elephant & Castle

5.16.1 The Thameslink Key Output 2 timetable recast will reroute Brighton Main Line services away from the Elephant & Castle route, freeing up capacity on that route to allow increased local services to operate into the London Blackfriars bay platforms.

5.16.2 The RUS assumes that services running via Herne Hill will operate into the bay platforms, whilst those via Denmark Hill will operate through the Thameslink core, as recommended by the South London RUS. This was discussed in **Chapter 3** and is the anticipated position, given the track layout on the southern approaches to London Blackfriars.

5.16.3 The RUS baseline changes in capacity via Elephant & Castle for the busiest hour are shown in **Table 5.12**. The reduction shown on the Thameslink route is due to services being able to run via London Bridge following the completion of remodelling works there, so these services are included in the 2031 figures in **Table 5.11**.

Table 5.12 – London Blackfriars (services from the south via Elephant & Castle route) – busiest morning peak hour capacity: RUS do-minimum baseline

Service group	High-peak hour capacity 2010		High-peak hour capacity 2031		Change	
	seats	seats + standing	seats	seats + standing	Seats	seats + standing
Thameslink route	8,000	10,700	2,500	7,300	-5,500	-3,400
London Blackfriars terminators	n/a	n/a	5,400	6,800	+5,400	+6,800
TOTALS	**8,000**	**10,700**	**7,900**	**14,100**	**-100**	**+3,400**

5.17 Capacity to/via London Liverpool Street

5.17.1 From 2018 the Crossrail Programme will provide a step change in capacity with up to 24 trains per hour through a new Central London tunnel, with trains of 10-car length, 12 of these will run on the GEML to/from Shenfield, with the other 12 on a new route to Abbey Wood. A residual inner suburban peak service will remain in operation on the GEML into the existing London Liverpool Street station at peak times, complementing Crossrail services.

5.17.2 On West Anglia routes committed platform lengthening will allow 12-car trains on most peak Stansted Airport and Cambridge services and additional 8-car inner suburban services will be possible with additional rolling stock. Further potential changes (not considered in the RUS do-minimum baseline in the table below but which might be implemented in the short term) are described in **Option C1** in **Chapter 7**.

5.17.3 The overall capacity changes assumed by the modelling are shown in **Table 5.13**.

Table 5.13 – London Liverpool Street busiest morning peak hour capacity RUS do-minimum baseline

Service group	High-peak hour capacity 2010		High-peak hour capacity 2031		Change	
	seats	seats + standing	seats	seats + standing	Seats	seats + standing
West Anglia	11,400	15,800	13,500	18,500	+2,100	+2,700
Great Eastern Main Line	16,700	18,900	18,600	22,900	+1,900	+4,000
GE Inners	8,900	12,100	3,800	5,200	-5,100	-6,900
Crossrail GE route	n/a	n/a	7,100	18,100	+7,100	+18,100
EXISTING ROUTES FROM LONDON LIVERPOOL STREET TOTALS	**37,000**	**46,800**	**43,000**	**64,700**	**+6,000**	**+17,900**
Crossrail Abbey Wood route	n/a	n/a	7,100	18,100	+7,100	+18,100
LONDON LIVERPOOL STREET TOTALS	**37,000**	**46,800**	**50,100**	**82,800**	**+13,100**	**+36,000**

5.18 Capacity to London Fenchurch Street

5.18.1 The London Fenchurch Street routes have substantial scope for train lengthening. The ongoing works will see the operation of 12-car services into the Fenchurch Street once sufficient rolling stock is available.

5.18.2 **Table 5.14** shows the expected capacity change which is included in the RUS baseline.

Table 5.14 – London Fenchurch Street busiest morning peak hour capacity RUS do-minimum baseline

Service group	High-peak hour capacity 2010		High-peak hour capacity 2031		Change	
	seats	seats + standing	seats	seats + standing	Seats	seats + standing
All services	12,100	16,200	14,900	20,100	+2,800	+3,900

5.19 Capacity to London Victoria

5.19.1 Significant train lengthening to London Victoria is anticipated as a result of 10-car suburban operations on all routes via Balham, 12-car operations on the East Grinstead line, longer trains on the Redhill corridor and the rolling stock cascade following the Thameslink Programme.

5.19.2 Main line, and potentially suburban, services to London Victoria are likely to need to be significantly recast to fit into the timetable pattern after the Thameslink Programme, providing the opportunity, for example, for a four trains per hour Redhill corridor to London Victoria service at peak times. Whilst timetable studies are ongoing at present this is included in the RUS do-minimum baseline.

5.19.3 Committed track layout remodelling works at Gatwick Airport station will enable improved operational flexibility and performance in this area and potentially enable additional trains to call. However given major constraints through East Croydon and in the London area no additional train paths to the capital will be able to run as a direct result of this scheme.

5.19.4 On Kent routes to London Victoria no platform lengthening is currently planned but some train lengthening is possible with existing infrastructure. The do-minimum position includes a slight reduction in service levels into Victoria due to the planned withdrawal of the South London Line, upon completion of works to extend London Overground services to Clapham Junction.

5.19.5 Development work on the timetable that could operate upon completion of the Thameslink Programme is seeking to provide secondary benefits to passengers using these routes, by provision of a four trains per hour service from Denmark Hill/ Peckham Rye to London Victoria. In response to concerns expressed through the consultation, it is proposed that this would be achieved by means of additional services rather than calls on a main line service group, so there would be no impact on journey times for passengers to and from Kent.

5.19.6 The overall capacity changes included in the RUS baseline are shown in **Table 5.15**.

Table 5.15 – London Victoria busiest morning peak hour capacity RUS do-minimum baseline

Service group	High-peak hour capacity 2010		High-peak hour capacity 2031		Change	
	seats	seats + standing	seats	seats + standing	Seats	seats + standing
Kent routes	9,500	11,800	8,400	12,500	-1,100	+700
Fast trains via East Croydon	11,800	16,700	12,900	18,600	+1,100	+1,900
Stopping trains via Balham	7,100	10,300	11,500	15,200	+4,400	+4,900
TOTALS	**28,400**	**38,800**	**32,800**	**46,300**	**+4,400**	**+7,500**

5.20 Capacity to London Waterloo

5.20.1 Bringing the disused former international platforms into use at London Waterloo is a committed scheme, as described in Network Rail's CP4 Delivery Plan. Services on the Windsor lines are planned to be increased by one extra high-peak train (an overall increase from 15 to 16 trains in the high-peak hour) upon completion of this scheme, plus an additional train in each shoulder-peak hour.

5.20.2 Extensive 10-car inner suburban operations are anticipated as part of the HLOS implementation, on South West Main Line (SWML) suburban services (routes via Wimbledon) and on the Windsor lines (routes via Putney).

5.20.3 On main line services into London Waterloo no capacity changes are committed at present.

5.20.4 The overall committed capacity changes included in the RUS baseline are shown in **Table 5.16**.

Table 5.16 – London Waterloo busiest morning peak hour capacity RUS do-minimum baseline

Service group	High-peak hour capacity 2010		High-peak hour capacity 2031		Change	
	seats	seats + standing	seats	seats + standing	Seats	seats + standing
Windsor Lines (all services)	7,800	16,200	9,000	19,300	+1,200	+3,100
Inner Suburban (via Wimbledon)	13,000	29,200	15,100	34,700	+2,100	+5,500
South West Main Line	13,400	13,400	13,400	13,400	nil	nil
TOTALS	**34,200**	**578,800**	**37,500**	**67,400**	**+3,300**	**+8,600**

5.21 Capacity on orbital routes

5.21.1 On orbital routes the recent completion of London Overground upgrade works has provided extra capacity and new journey opportunities on the North, West and East London Lines. This is already resulting in better train services to growing areas such as Stratford and the Olympic Park area to the east and Shepherds Bush to the west. The current service structure now provides all day, four trains per hour, 4-car Class 378 services on key orbital routes, including the newly extended East London Line (ELL). The Gospel Oak – Barking line is operated by Class 172 DMUs.

5.21.2 The final stage of the ELL Extension project involves a new service linking Clapham Junction to Canada Water and beyond via Denmark Hill. Since capacity does not exist to run both this service and the existing London Bridge – Denmark Hill – London Victoria route at the same time it is planned that the latter will be withdrawn once the London Overground service on this further ELL extension is in operation. The existing service is also affected by Thameslink Programme's alterations to London Bridge and HLOS platform extensions at Battersea Park. Proposals for alternative services between Peckham Rye/Denmark Hill and Victoria are given in **paragraph 5.19.5**.

5.22 Other committed schemes

5.22.1 Several other schemes of relevance to this London and South East RUS are regarded by this RUS as committed, but do not directly add additional peak passenger capacity into Central London so are not described above. These include; other station improvement works, beyond those covered by Thameslink and Crossrail, for example at locations such as London King's Cross, East Croydon and London Cannon Street; infrastructure upgrades associated with resignalling or other renewal schemes; plus freight schemes (as described in **Chapter 9**).

5.22.2 Full details on Network Rail led schemes can be found in the CP4 Delivery Plan which is available at **www.networkrail.co.uk**.

5.23 Summary and details of currently uncommitted strategy (Baseline-plus)

5.23.1 Network Rail is nearing the completion of its first generation of RUSs, with established strategies now covering nearly all of the network. These provide a comprehensive suite of existing recommendations, many of which have been implemented or are in the process of being delivered as described in the do-minimum RUS baseline position in the section above. However, several of the recommendations remain unfunded (or otherwise uncommitted) at present. The majority of these, especially those of relevance to peak capacity, are considered by Network Rail to remain valid. They are therefore the logical next step, which the RUS has considered as the baseline-plus stage before any analysis of new options.

5.23.2 As outlined in the West Coast Main Line RUS Government and rail industry strategy has also now adopted the development of High Speed 2 (HS2) into its planning framework. The latest position regarding the future construction of HS2 is therefore also included in the baseline-plus for this RUS, initially of most relevance to the WCML, but also alleviating capacity constraints on the ECML and MML, especially as the network expands beyond the West Midlands.

5.23.3 **Table 5.17** and the section which follows summarise the key recommendations currently uncommitted from previous RUSs that have been carried forward into this London and South East RUS.

Table 5.17 – uncommitted peak capacity recommendations from existing established strategy carried forward into this London and South East RUS

Route to	Service group	Principal peak capacity recommendations and details (currently uncommitted schemes only)	Extra capacity assumed in busiest morning peak hour	Source of recommendation
London Marylebone	Outer suburban.	Potential future timetable changes to improve the overall service mix close to London, linked to resignalling of the London Underground Metropolitan Line.	Not currently quantified.	West Midlands and Chilterns RUS 2011.
London Euston	LDHS.	Very limited potential for further train lengthening. Existing strategy is to construct a new High Speed Rail network (initially London – Birmingham, then beyond) to provide new north-south capacity.	At least 10,000 seats per hour on HS2 in the long term. However the RUS assumes that some existing WCML LDHS paths would be reallocated for outer suburban traffic, so a net LDHS capacity increase of 5,000 seats is assumed.	Network Rail New Lines Study 2009 DfT High Speed Rail Consultation 2011 West Coast Main Line RUS 2011.
London Euston	Outer suburban.	Very limited potential for further timetable refinements and train lengthening. Existing strategy is to provide extra WCML calls at stations such as Milton Keynes Central following HS2, since capacity for outer suburban commuters will be released by longer distance services being transferred onto the new route.	The RUS assumes at least 5,000 peak additional outer suburban seats can be provided on WCML post-HS2, as above.	Network Rail New Lines Study 2009 DfT High Speed Rail Consultation 2011 West Coast Main Line RUS 2011.

Table 5.17 – uncommitted peak capacity recommendations from existing established strategy carried forward into this London and South East RUS

Route to	Service group	Principal peak capacity recommendations and details (currently uncommitted schemes only)	Extra capacity assumed in busiest morning peak hour	Source of recommendation
London St Pancras International (MML)	LDHS.	Short-term train lengthening as recommended in the East Midlands RUS. Eventual replacement of HST train fleet with IEP or similar vehicles following electrification, with high peak frequencies as today. Construct HS2 'Y' network to provide long distance capacity.	500 seats (excluding HS2 impact).	East Midlands RUS 2010 Network RUS: Electrification Strategy 2009 DfT High Speed Rail Consultation 2011.
London King's Cross	Outer suburban.	Further lengthening to 12-car (requires 12-car operations at complex locations such as Welwyn Garden City). See paragraph 5.26.4.	800 capacity.	East Coast Main Line RUS 2009.
London King's Cross	LDHS.	Construct HS2 'Y' network to provide long distance capacity.	Not quantified.	As above.
Moorgate	Inner suburban.	Improve headways on branch and run 2tph extra.	1,300 capacity.	East Coast Main Line RUS 2009.
London Liverpool Street (West Anglia)	Outer suburban.	Lengthen all outer peak trains to 12-car.	500 seats.	Greater Anglia RUS 2007.
London Liverpool Street (West Anglia)	Inner suburban.	Lengthen all inner peak trains to eight-car.	900 capacity.	Greater Anglia RUS 2007.
London Liverpool Street (Great Eastern)	Outer suburban.	Replace intercity stock on Norwich services with multiple units for higher capacity. Run one additional train in high-peak. Lengthen all peak trains to 12-car.	2,100 capacity.	Greater Anglia RUS 2007.
London Fenchurch Street	Outer suburban.	Full 12-car operations using CP4 infrastructure.	2,000 seats.	Greater Anglia RUS 2007.
London St Pancras International (HS1)	Outer suburban.	Extend Ebbsfleet peak shuttle to Ashford International and lengthen to 12-car.	700 seats.	Kent RUS 2010.
London Charing Cross and London Cannon Street	Inner suburban.	Full 12-car suburban operations.	Up to 5,000 capacity (assumed upper limit, requiring full resolution of constraints including at London Charing Cross).	South London RUS 2008.

Table 5.17 – uncommitted peak capacity recommendations from existing established strategy carried forward into this London and South East RUS

Route to	Service group	Principal peak capacity recommendations and details (currently uncommitted schemes only)	Extra capacity assumed in busiest morning peak hour	Source of recommendation
London Victoria (Kent routes)	Inner and outer suburban.	Additional train lengthening.	400 capacity.	Kent RUS 2010.
London Bridge and Thameslink (Sussex)	Outer suburban.	Additional diesel rolling stock for Uckfield line (10-car x 23m).	600 capacity.	Sussex RUS 2010.
London Bridge (Sussex)	Inner suburban.	Further train lengthening, including 12-car operations on the Sydenham Line. See paragraph 5.26.5.	1,200 capacity approx on Sydenham Line.	South London RUS 2008.
Elephant & Castle corridor	Inner suburban.	None.	N/A.	South London RUS 2008.
London Victoria (Sussex)	Outer suburban.	Insert Clapham Junction calls in certain peak Gatwick Express services to better balance loadings between trains and provide Brighton – Clapham Junction connectivity. Lengthen Caterham and Tattenham Corner trains to 12-car (upon joining at Purley), with 10-car as an interim stage.	700 capacity.	Sussex RUS 2010.
London Victoria (Sussex)	Inner suburban.	Further train lengthening, with 12-car operations on routes via Balham See paragraph 5.26.5.	2,800 capacity approx.	South London RUS 2008.
London Waterloo (SWML)	Inner suburban.	Further 10-car operations using CP4 infrastructure.	300 capacity.	South West Main Line RUS 2006.
London Waterloo (SWML)	Outer suburban.	Full lengthening to 12-car or 10-car operations. Primarily covers Salisbury Line services and semi-fast services on the Cobham route.	900 capacity.	South West Main Line RUS 2006.
London Waterloo (Windsor lines)	Inner and outer suburban.	10-car platforms Virginia Water – Earley. Further 10-car operations using CP4 infrastructure.	700 capacity.	South West Main Line RUS 2006.

5.23.4 High level details of uncommitted schemes are provided in the following sections. Further details are available in the relevant geographic RUS previously published.

5.24 High Speed 2

5.24.1 In summer 2008 Network Rail commenced its New Lines Programme, examining the case for the development of new high speed lines in the UK. The first phase of the New Lines Programme, completed in August 2009, established a strategic business case for a new high speed line connecting the main conurbations between London and Glasgow/ Edinburgh currently served by the WCML. The second phase of the study examined the case for a new line to Leeds and the East Midlands and found that there was a case for such a line to be taken forward.

5.24.2 The previous Government's proposed strategy for High Speed Rail was established in a Command Paper presented to Parliament and published in March 2010. The Command Paper set out the case for a new core British high speed rail network. The core strategy comprised a 335 mile core 'Y'-shaped high speed rail network between London and Birmingham/Manchester/Leeds capable of carrying trains at speeds of up to 250mph. The Command Paper stated that the London to West Midlands HS2 route would be the first stage of a new High Speed Rail network. The 'day one' service frequency was anticipated as 14 trains per hour peak paths to London, increasing ultimately to 18 trains per hour peak paths once a wider network is created. Trains would be 200 metres long (classic-compatible) having 550 seats and 400 metres long (high speed network only) having 1,100 seats.

5.24.3 The current Government is continuing to develop and strongly supports plans for HS2. In February 2011 the Government published a consultation paper on both the case for a national high speed rail network and, more specifically, its proposed route for HS2 between London and the West Midlands. The core strategy is again for a 'Y' shaped network along the lines described above. However, there were some significant differences compared to the proposals in the Command Paper of 2010, for example in the detailed alignment of the initial route to the West Midlands. Changes of particular relevance to the London area are that the strategy now also includes a link between HS1 and HS2 and an eventual connection to Heathrow Airport.

5.24.4 A key advantage of the new line is that it would free up capacity on the WCML for additional outer suburban passenger services, including from key growth areas such as Milton Keynes, together with increased opportunities for freight.

5.25 MML electrification and possible extension of the Intercity Express Programme

5.25.1 Given that electrification of the MML north of Bedford is a recommendation of the Network RUS: Electrification Strategy it can be expected that vehicles similar to the IEP vehicles might be used on that route in the future. This would provide additional capacity where needed at the south end of the route, as well as significant benefits to the whole line.

5.25.2 The rolling stock strategy for the MML would need to be reviewed in the event of electrification becoming committed.

5.26 Further train lengthening from previous RUSs

5.26.1 It is considered unlikely that the future rolling stock cascade directly associated with the Thameslink and Crossrail Programmes (ie the do-minimum baseline for this RUS) will provide sufficient additional vehicles to implement all Generation One RUS recommendations for train lengthening in their entirety. It is therefore anticipated that further rolling stock will be required and provision of such rolling stock is therefore included within the baseline-plus of this RUS. The exact split between the do-minimum scenario and the baseline-plus is only an estimated position at present, since this is dependent on unknown issues including the procurement of two major train fleets and how many vehicles currently in use in the London area might be redeployed elsewhere. However, this uncertainty does not materially affect previous RUS recommendations that train lengthening has a strong economic case.

5.26.2 Suburban train lengthening on Southeastern's routes into London Charing Cross and London Cannon Street is not currently a franchise commitment for the operator. **Table 5.11** made an assumption regarding lengthening which can be expected to be achievable within the existing train fleet once new Thameslink Programme vehicles take over the operation of certain routes, whilst **Table 5.17** makes a further assumption regarding a potential eventual upper limit with large numbers of 12-car suburban trains in operation into London Charing Cross and London Cannon Street. However, the RUS highlights that the latter is not currently proven as operationally viable, with numerous constraints including the likelihood of increased turnaround times, standage issues at key junctions and platform lengths at Woolwich Dockyard. The RUS notes that extending the boundary of 12-car operations beyond Gravesend to the Medway Towns would require additional infrastructure, which would most effectively be undertaken as part of the East Kent resignalling scheme, given complexities at Rochester.

5.26.3 Elsewhere, further train lengthening from previously established RUSs will require additional rolling stock and, in many cases, platform lengthening beyond current commitments. This would enable, for example 10-car operations to extend beyond Virginia Water to Reading, 10-car or 12-car operations on the Purley to London Victoria corridor (for Caterham/Tattenham Corner services, joining at Purley) and further 12-car trains on West Anglia routes. Many of these schemes are currently being considered by the industry for implementation in Control Period 5.

5.26.4 Lengthening eight-car semi-fast services on the ECML, calling at locations such as Welwyn Garden City, to 12-car would require major work if all platforms needed to be lengthened. This could potentially be overcome if Selective Door Operation is utilised at certain stations, but this could be problematic given the high loadings on trains in this area.

5.26.5 Further train lengthening beyond 10-car to 12-car was previously recommended by the South London RUS on the Sydenham to London Bridge route, with routes via Balham to Victoria and possibly the Tulse Hill to London Bridge route seeing further platform lengthening as later stages. Future demand on these routes is subject to uncertainty at present, so the need for these interventions, beyond the existing platform lengthening programme will need to be kept under review.

5.26.6 There are a small number of short formation services operating on the main line into London Waterloo, for example from the un-electrified Salisbury route. Lengthening of these is therefore a recommendation consistent with the analysis carried out for the South West Main Line RUS.

5.26.7 It is emphasised that many routes have specific restrictions on the types of rolling stock which are suitable for operation over them. For example the Uckfield line and the Salisbury route lengthening described above, would both require additional diesel stock unless electrified, and 12-car services into platforms 4-6 at London Charing Cross are only viable if the stock is equipped with Selective Door Operation, with retrofitting this onto existing trains generally being impractical. The RUS therefore emphasises the importance of the specific characteristics of rolling stock for the route concerned, not just the overall quantum of vehicles.

5.27 Notable uncommitted timetable changes from previous RUSs

5.27.1 Certain uncommitted timetable changes recommended by previous RUSs are carried forward into this RUS. With respect to peak capacity these include:

- an increase of one further train in the high-peak hour on the Great Eastern Main Line
- an increase from 12tph to 14tph on the route to Moorgate (albeit now at a later stage than previously anticipated)
- peak Brighton – Gatwick Airport – London Victoria trains to call at Clapham Junction
- further extension of HS1 services into Kent. Depending on the growth in demand it may be appropriate at some stage to extend the peak-only Ebbsfleet International to London St Pancras International service to start back from or via Ashford International. This would require extra Class 395 units or similar and additional domestic platform capacity at Ashford International.

5.27.2 The above changes are therefore included in the RUS baseline-plus analysis.

5.28 Upgrades on other modes

5.28.1 The demand forecasting undertaken by the RUS, as described in **Chapter 6**, includes the completion of upgrade schemes on other modes, not just those affecting the main line rail system. Committed schemes in this category include changes to bus services (including a reduction in 'bendy buses' and introduction of the 'new bus for London'), highway improvements and major improvements to the London Underground system.

5.28.2 With respect to the latter the baseline do-minimum includes the completion of all funded London Underground upgrade schemes. Some elements of TfL strategy, notably the Piccadilly Line upgrade, which is not at present funded. As the upgrade is part of existing strategy, it is considered in the baseline-plus. This example interacts with capacity on the Windsor lines in the Hounslow area which could therefore potentially require additional interventions beyond those recommended by this RUS if the Piccadilly Line upgrade scheme did not proceed.

5.29 Other strategy

5.29.1 Previously established RUSs made extensive detailed recommendations, of which only those that have significant relevance for on-train peak capacity are summarised above. Full details are available in the relevant RUSs which are available at **www.networkrail.co.uk**.

6. Morning peak to London – future demand

6.1 Introduction

6.1.1 This chapter summarises the methodology and results of the demand forecasting developed for this London and South East Route Utilisation Strategy (RUS).

6.1.2 A long-term National Rail demand forecast to 2031 has been produced through the modelling of population trends, land use changes and economic factors, together with the committed developments to the transport system as outlined in **Chapter 5**. The modelling covers all National Rail corridors into Central London, focussing on the morning peak period since, as described earlier, this is the period of greatest demand upon which strategic level planning is based.

6.1.3 As described earlier the 2031 forecast demand, together with committed capacity, forms the do-minimum baseline for this RUS. This baseline informs the gap identification process (revealing where the anticipated supply of capacity is insufficient to address forecast demand in 2031) and development of options in **Chapter 7** in response to such gaps.

6.2 Context

6.2.1 The key driver of change in rail use by commuters into Central London is the future level of employment within the centre of the Capital. The RUS is therefore based upon projections which show increasing numbers of workers in key traditional office areas (for example in the City of London), together with the continued development of growth areas such as the Docklands and around London Bridge.

6.2.2 A further driver of change in the demand for travel is the overall population in and around the capital and the distribution of this population on an area-by-area basis. This is in turn linked to housing and wider societal policies of Government.

6.2.3 Certain geographical areas are nominated for future developments and this is considered in the demand forecasting. For example much of the Thames Gateway is currently brownfield, ex-industrial land, so continuing development is planned, resulting in additional demand for travel. Similar issues apply with respect to growth areas around Ashford and Milton Keynes.

6.2.4 On the transport system itself the committed schemes described in **Chapter 5** will increase the capacity of the existing network and implement new routes such as Crossrail. The demand forecasting in this RUS reflects the significant impact of such schemes on patterns of demand over the longer term. For example major new routes and capacity upgrades will redistribute commuting patterns, as some households and employers will seek to relocate near to locations with the best transport links.

6.3 Demand forecasting methodology

6.3.1 The RUS has utilised a combination of methods in developing demand forecasts for 2031. Transport for London's (TfL's) multi-modal models, London Transportation Studies (LTS) and RailPlan have been used as these provide the best available detailed representation of public and private transport networks across Greater London. However, rates of growth for some rail markets, principally long distance flows from outside London and the South East, have been modified to reflect, in aggregate, rates of growth which would be suggested by an approach based upon the Passenger Demand Forecasting Handbook (PDFH).

6.3.2 The LTS model is a multi-modal model focussed on Greater London and the area within the M25 motorway. LTS is the only current demand model to combine trip generation, distribution and modal choice across the whole of this area in detail, combining both public transport usage and highway assignment choices for road users. RailPlan is a public transport assignment model, which forecasts the specific routes that travellers take to make their journeys. It provides more detail than LTS on demand assigned to the public transport network for Inner London in particular. Together, the two models provide the best tools for modelling and future predictions for the majority of the London peak market.

6.3.3 For the longer distance market, which is not the main focus of LTS and RailPlan, a PDFH based approach has been used. The PDFH is an industry document that summarises the effects of journey quality, fares and external factors on rail demand. It incorporates extensive research on these issues and has been used in the majority of rail passenger forecasts made in recent years. These methods are commonly accepted in the rail industry.

6.3.4 Network Rail is grateful to TfL for the support it has provided with the deployment of LTS and RailPlan throughout the RUS. However, responsibility for the inputs to and outputs from the models and for the presentation of the results, lies with Network Rail alone

6.4 Drivers of change

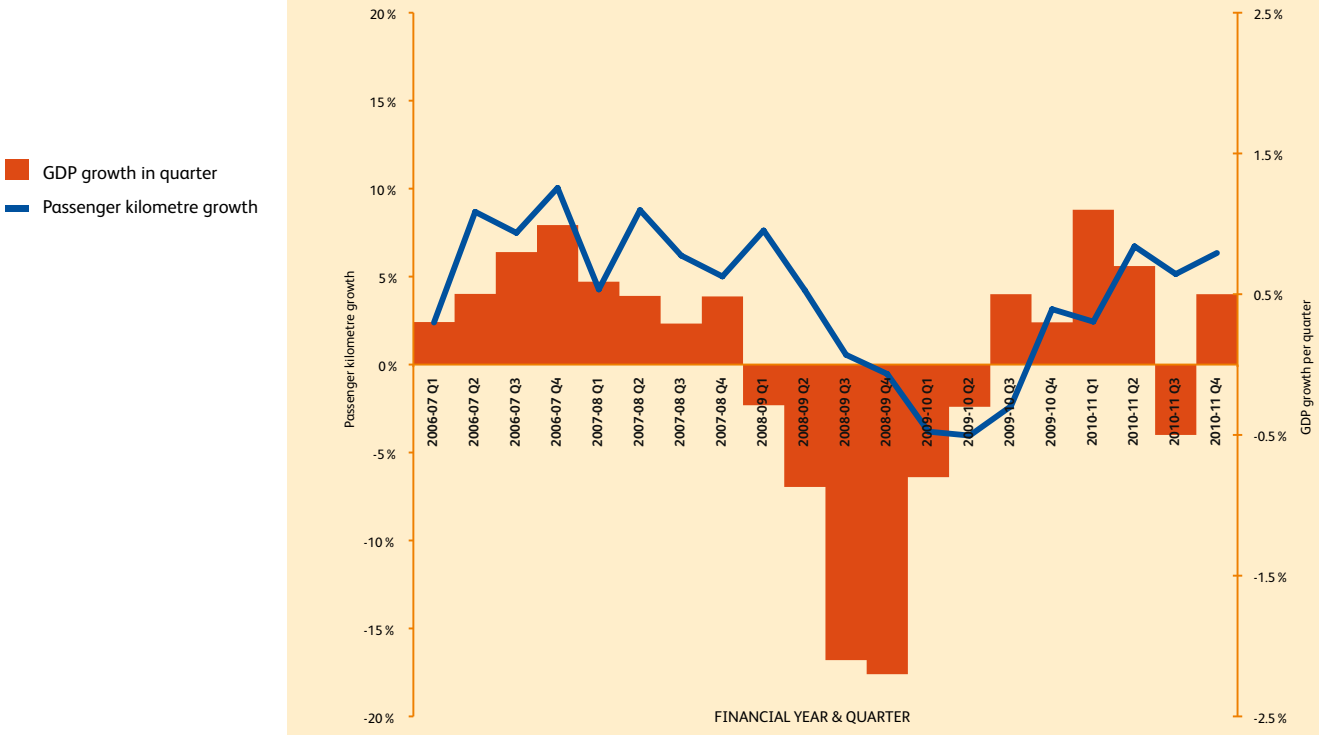
6.4.1 This section considers the key factors affecting the demand forecasts to 2031, and their impact on peak demand for rail travel into Central London.

The 2008-2009 recession

6.4.2 Starting in the second quarter of the 2008 calendar year national Gross Domestic Product (GDP) contracted, marking the start of the recent recession. In total, GDP contracted for six consecutive periods with a peak to trough fall in output of over six per cent. Economic growth resumed in the fourth quarter of 2009 for both London and the UK as a whole. The economy has now expanded in each of the succeeding quarters, with the exception of the final quarter of 2010 when economic growth was again negative.

6.4.3 The impact of the recession on rail demand is illustrated in **Figure 6.1**. The data refers to passenger kilometres in the London and South

Figure 6.1 – rail demand in London and the South East before, during and after the recession



East sector as a whole (as defined by the Office of Rail Regulation (ORR) in National Rail Trends), and includes some rail markets other than Central London commuting, but is a good approximation of wider trends in this regard.

6.4.4 Passenger demand in the London and South East sector contracted over four consecutive quarters, returning to growth in quarter four of the financial year 2009/10 and thereafter (with the exception of the very adverse weather affecting the third quarter of 2010/11). The sector has now grown strongly over the last 18 months and passenger numbers have in most cases recovered to above pre-recession levels. However, there is a lag between recovery in the economy, as measured by GDP, and the recovery of employment levels. The effect of this lag on the demand for rail can be seen in **Figure 6.1**. On some routes current loadings, as shown in **Chapter 4**, therefore remain lower than the 2008 information presented in the Draft for Consultation, pending the effects of this lag to fully work through to the employment market.

Table 6.1 – Greater London Authority long-run employment projections

Location	Employment 2007 (millions)	Employment 2031 (millions)	Change (2007 – 2031, millions)	Change (average per year)
Central and Inner London	2.6	3.2	0.6	0.9 %
Outer London	2.0	2.2	0.2	0.3 %
Total	**4.7**	**5.5**	**0.8**	**0.6%**

Factors affecting London commuting – employment growth

6.4.5 Four out of every five National Rail passengers arriving in Central London during the morning peak are travelling to their normal place of work. As described earlier the overall size of the Central and Inner London employment markets is therefore the principal determinant of rail demand.

6.4.6 The latest set of economic forecasts prepared for the rail industry by Oxford Economics show that the key driver of peak demand, Central London employment, is forecast to resume growth in 2011, expanding by about 10 per cent over the next five years. This continued growth in Central London employment will result in additional travel demand for rail trips into Central London at peak times.

6.4.7 The Greater London Authority's (GLA) long-run employment projection to 2031, which is reflected in the Mayor's Draft London Plan 2009, indicates that the level of employment in Greater London will grow by 17 per cent, representing an additional 775,000 employees. As shown in **Table 6.1**, this growth will be concentrated on Central and Inner London boroughs, whose employment levels are forecast to grow by 24 per cent over the same period. Growth is projected to be driven primarily by the business services sector. The impact of the recent recession is included in this forecast, which predicts continuing recovery and employment growth.

Factors affecting business travel into London

6.4.8 London has a significant non-commuting market of one-off or irregular users, typically in excess of 100,000 passengers each weekday morning, many of whom are making business trips into the Capital. Such business trips are made for a specific purpose and are often more significantly affected by economic conditions than those trips made on a daily basis to the normal place of work.

6.4.9 Growth in the market for business travel is generally correlated to overall volume of business activity, as measured by GDP. For these markets, this RUS used underlying demand forecasts described in the Network RUS: Scenarios and Long Distance Forecasts. This non-commuting market is relatively more important to long distance rail services, so mostly affects London Paddington, London Euston, London St Pancras International and London King's Cross stations. As described in **Chapter 4** these have a higher proportion of usage by those making longer distance trips from cities away from South East England.

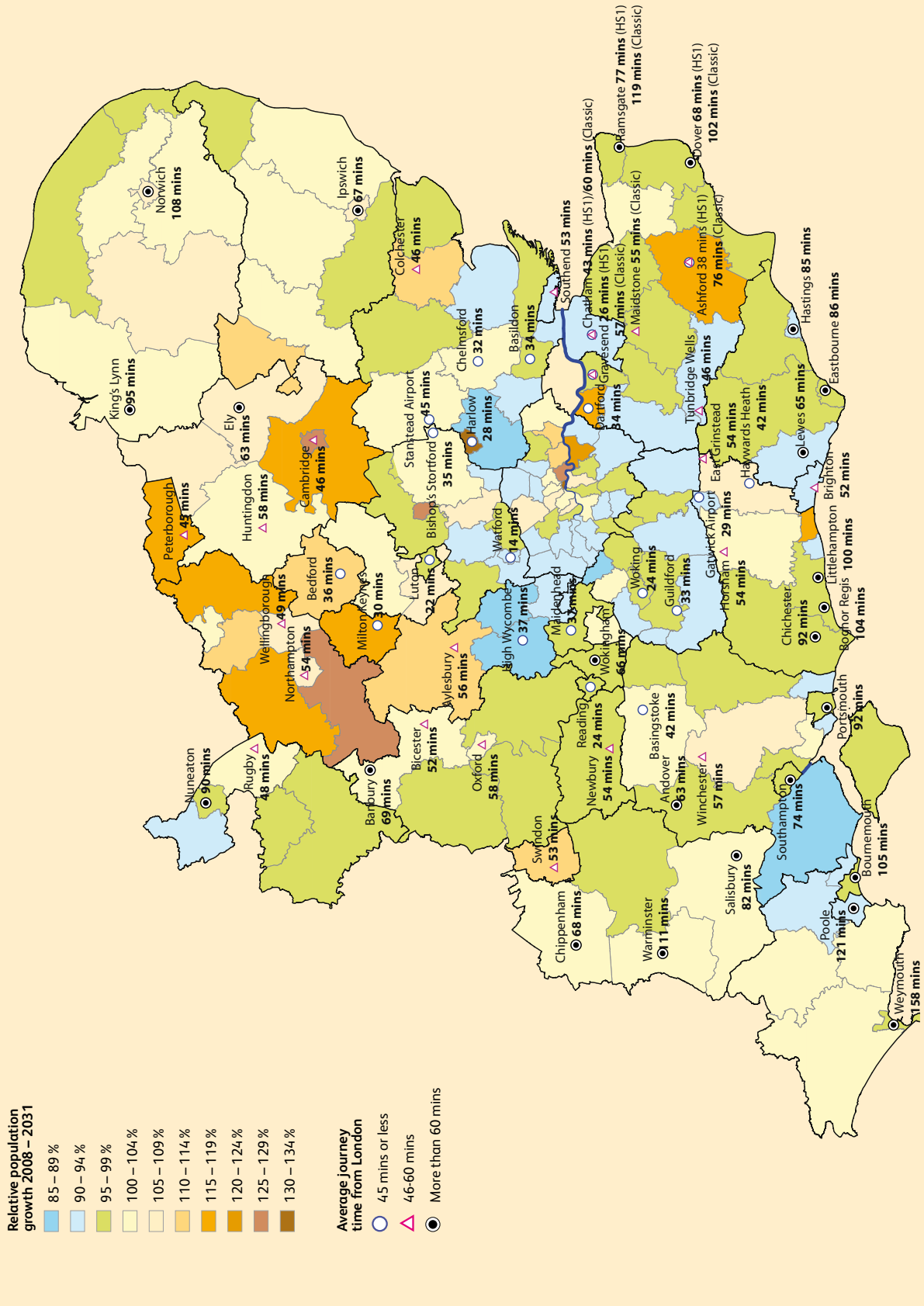
Population changes

6.4.10 The principal determinant of the overall size of the central London commuter market is the level of employment in the centre of the Capital. Population growth plays a smaller part in promoting overall growth in this market since people are only likely to travel into the city centre at peak times if there are jobs to go to, though clearly population growth and employment are interlinked.

6.4.11 However, future changes to the spatial distribution of the population of South East England, as well as within London itself, are important factors influencing the pattern of commuting by rail. Rail corridors serving areas of relatively high population growth, for example due to major housing developments, can be expected to see higher rates of growth than those where such factors do not apply.

6.4.12 **Figure 6.2** illustrates how the distribution of population across the South East is expected to change over the longer term. Areas highlighted by browns and oranges represent the areas of fastest population growth. Areas with relatively low growth forecasts, for example the 'green belt' around Outer London, are shown by blues and greens.

Figure 6.2 – relative rates of longer-term population growth across London and the South East



Changes in demand due to transport system baseline schemes

6.4.13 The RUS demand forecast assumes that the rail interventions described as committed, ie part of the do-minimum RUS baseline, in **Chapter 5** will be delivered. The major service improvements associated with both the Thameslink and Crossrail Programmes are expected to drive additional demand in their own right, as people and employers relocate over the long term to take advantage of such changes. Similar affects also apply with respect to smaller scale changes.

6.4.14 Some details of major enhancement schemes are not yet finalised, such as the post-Thameslink timetable specification for affected routes and the future rolling stock allocation across operators. **Chapter 5** shows the assumptions made for the RUS forecast and gap identification purposes. The capacity provided will influence future demand patterns and hence the forecast gaps, so the modelling will need to be revised as necessary in the future as decisions are made.

6.4.15 The forecast also considers the impact of committed transport interventions on other modes, including on the London Underground system. The planned upgrade to several lines interacts with demand for the main line rail system, since many route corridors parallel each other in certain areas.

Demand from non-committed schemes

6.4.16 The RUS demand modelling does not take into account non-committed service improvements, including those which are recommended by this RUS. As additional schemes become committed they will influence demand for rail in their own right. The extent to which this applies depends on the nature of the scheme concerned. For example introducing trains on a new route which does not currently exist, like High Speed 2, will result in a step-change in demand and new economic activity, whilst the effects of interventions such as train lengthening are more subtle as passengers benefit from improvements to the journey experience. The demand effect of running additional trains on an existing route would lie somewhere between these two examples.

6.5 Demand forecasts

6.5.1 The RUS modelling results in forecasts of passenger demand growth for the busiest hour in the morning peak (generally 08:00 – 08:59 arrivals in Central London) on National Rail services as shown in **Table 6.2**.

6.5.2 The forecasts in **Table 6.2** show the expected level of growth at the busiest point of each route. The growth rate is applied to the observed demand from autumn 2010 train counts, to show the forecast demand at the busiest point of each route in the future. The strategy must be designed to cope with the demand at the busiest points of the route, so this peak demand is the focus of the RUS.

6.5.3 It can be seen from **Table 6.2** and **Figure 6.4**, when read in conjunction with **Chapter 5**, that the high levels of forecast growth are in general on routes linked to committed service improvements. The largest growth includes those as below for this reason:

- Crossrail inner suburban services on an east west axis
- Thameslink outer suburban services on a north south axis
- continuing demand shift onto High Speed 1, as passengers in Kent continue to gradually switch from classic routes to faster routes to London St Pancras International
- long distance service on the Great Western Main Line partly linked to service improvements resulting from electrification and the Intercity Express Programme, but also the improved connectivity at London Paddington arising from Crossrail
- long distance service on the Great Eastern Main Line, linked to the improved connectivity of London Liverpool Street as a result of Crossrail, but also the continuing development of the Docklands and the Stratford area.

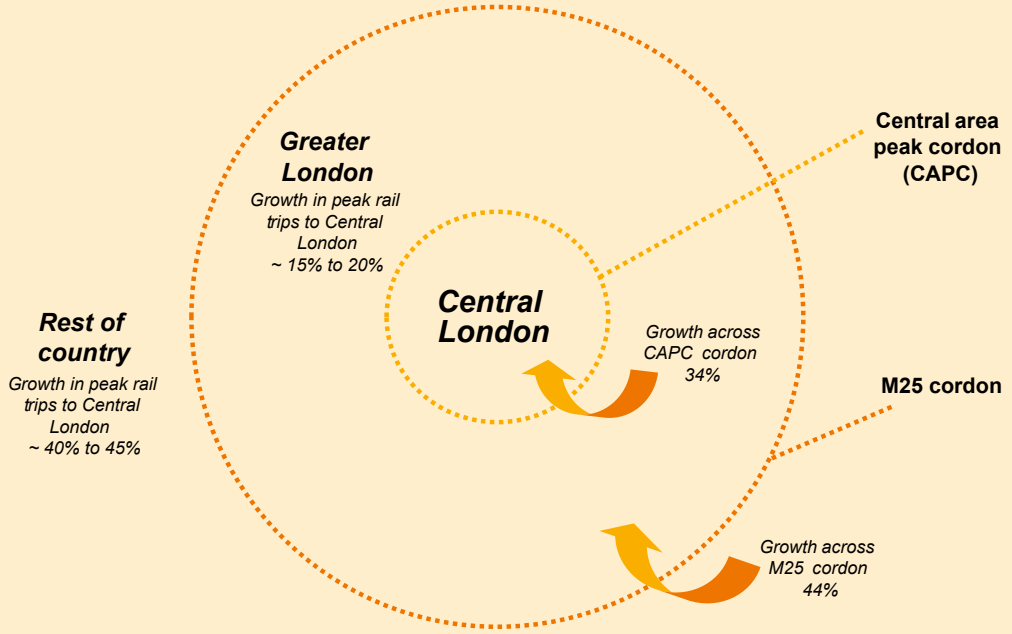
6.5.4 It can also be seen that significant growth is forecast from the West Coast Main Line from areas such as Milton Keynes, linked to the anticipated above-average growth in population in these areas.

Table 6.2 – busiest morning peak hour growth forecasts (committed schemes only)

Route into	Service group	Passengers on route in busiest morning peak hour			
		2010 total	2031 total	Extra passengers	Growth
London Paddington	Crossrail GW route	n/a	12,800	8,700	211 %
	Relief line trains (excl Crossrail)	4,100			
	Main line + other fast trains	9,000	13,600	4,600	51 %
	Heathrow Express	800	1,300	500	55 %
London Marylebone	All services	6,100	7,800	1,700	28 %
London Euston	Long Distance	3,700	6,500	2,800	76 %
	Suburban	8,100	12,100	4,100	50 %
London St Pancras	High Speed 1 (domestic)	2,500	5,300	2,800	111 %
	Thameslink MML	9,900	14,700	4,800	49 %
	MML Long Distance	2,300	3,800	1,500	68 %
	Thameslink ECML	n/a	13,000	5,100	66 %
London King's Cross	Great Northern	7,900			
	ECML Long Distance	2,000	3,000	1,000	52 %
Moorgate	All services	7,900	8,000	100	1 %
London Liverpool Street	West Anglia	14,300	18,000	3,700	26 %
	Great Eastern Main Line	16,500	24,600	8,100	49 %
	GE Inners	12,900	21,000	8,100	63 %
	Crossrail GE route	n/a			
	Crossrail Abbey Wood route	n/a	11,900	11,900	n/a
London Fenchurch Street	All services	15,300	17,000	1,700	11 %
London Bridge	Charing Cross	26,200	50,900	3,800	8 %
	Cannon Street	20,900			
	Thameslink Kent	n/a			
	Thameslink Sussex	n/a in peak	24,400	11,100	83 %
	Terminating (fast trains via East Croydon)	13,300			
	Terminating (inners)	9,200	11,500	2,300	25 %
London Blackfriars	All services via Elephant & Castle	10,400	11,900	1,500	15 %
London Victoria	Kent routes	10,300	8,700	-1,600	-16 %
	Fast trains via East Croydon	14,200	19,500	5,300	37 %
	Inner Suburban (via Balham)	9,700	10,300	600	6 %
London Waterloo	Windsor Lines (all services)	13,600	17,100	3,500	26 %
	Inner Suburban (via Wimbledon)	22,700	25,500	2,800	13 %
	South West Main Line	14,800	18,300	3,500	24 %
Radial routes totals		288,600	392,500	103,900	36 %
Main Orbital routes	West London Line	2,700	5,500	2,800	109 %
	East London Line	4,200	9,800	5,600	132 %
	North London Line	2,700	3,000	300	11 %

6.5.5 In general, the RUS expects National Rail growth from outside the Greater London area to be higher than growth from within Greater London, as summarised in **Figure 6.3** below.

Figure 6.3 – forecast peak rail demand growth into Central London 2031



6.5.6 One reason for this is the trend for commuting over longer distances, meaning a greater number of passengers will be travelling across the M25 cordon each day. **Figure 6.2** shows that the many of the regions of highest relative population growth are outside of Greater London, yet only 45-60 minutes away from Central London by train.

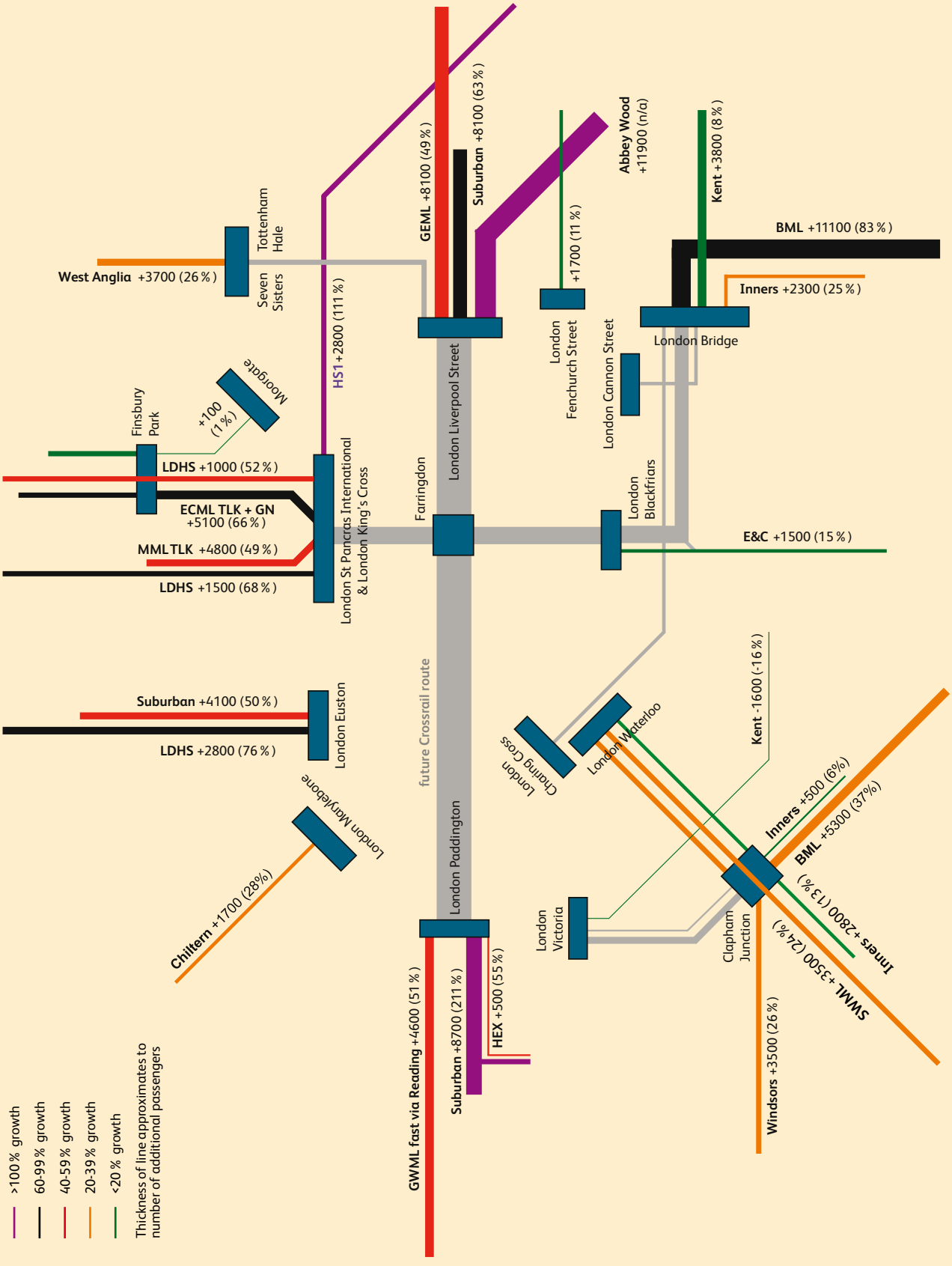
6.5.7 Combined with this, non-commuting trips including at peak times, eg business and leisure travel, typically grow quite robustly during economic expansion. This has led to particularly high growth rates on the East Coast, Midland, West Coast and Great Western Main Lines, these being the long distance routes with a higher proportion of non-commuting flows.

6.5.8 The RUS has only considered growth rates affecting the busiest points on routes at the busiest times of the day. It is likely that substantially different growth rates will apply for passengers not travelling into central London, and for those not travelling in the busiest hour of the commuter peak. The figures shown in **Table 6.2** should not be used to infer rates of growth other than in the busiest peak hour at the critical load point.

6.5.9 The demand forecasts are also illustrated geographically in **Figure 6.4**.

These are then utilised in the gap identification process, as described in **Chapter 7**.

Figure 6.4 – passenger growth forecasts to 2031 split by line of route



7. Capacity gaps and options beyond previous strategy

7.1 Introduction

7.1.1 This chapter describes the approach taken by this Route Utilisation Strategy (RUS) to develop options so that peak services in the busiest locations have sufficient capacity to cater for the future demand which is forecast in **Chapter 6**.

7.1.2 The starting point is the quantification of gaps (between committed capacity and forecast demand) for each route corridor. The majority of the gaps result from the anticipated growth in passenger numbers, though it should be noted that many routes already have, to a certain extent, a peak capacity gap, as indicated by current overcrowding indicators.

7.1.3 This stage in the analysis is followed by the quantification of the peak capacity impacts of implementing existing uncommitted strategy from previous RUSs, as described in **Chapter 5**. In most cases these interventions remain relevant, so they are carried forward into this strategy as recommendations.

7.1.4 This RUS then identifies route corridors where implementing all remaining uncommitted previous strategy would still be insufficient to bridge the forecast gap to 2031 and develops new options to address any shortfall where practical.

7.1.5 The RUS has sought to develop options which bridge the key peak capacity gaps identified by the demand forecasting analysis. In several cases options which increase capacity would also improve journey opportunities, so the economic analysis (where undertaken) of peak capacity options includes such benefits or disbenefits, where appropriate, as well as those solely from crowding relief.

7.1.6 The RUS has undertaken infrastructure design work, timetable development and business case analysis as appropriate to the options considered, and now makes recommendations accordingly.

7.2 Process for quantification of gaps

7.2.1 As described in **Chapter 6**, London Transportation Studies (LTS) and RailPlan modelling has been used to forecast future peak on-train loadings, based on currently anticipated capacity (including assumptions made regarding rolling stock cascades following the Thameslink and Crossrail Programmes).

7.2.2 The results of the above indicate that morning and evening peak crowding on the busiest corridors into and out of Central London will remain an issue – and will worsen on several routes – even after currently committed schemes are implemented. Peak crowding is therefore the principal gap which has been considered in detail in this RUS.

7.2.3 **Table 7.1** combines the additional capacity provided by committed schemes from **Chapter 5** with the passenger growth forecasts from **Chapter 6**. This provides an indication of the overall utilisation ratio, and the forecast peak hour gap, based on the 85 per cent planning guidance described in **Chapter 4**.

Table 7.1 – 2031 morning peak busiest hour demand, capacity, route utilisation and gap forecasts (do-minimum)

Route into	Service group	2031 Capacity and Demand in high peak hour			
		Capacity (anticipated) from Chapter 5	Demand (forecast) from Chapter 6	Demand/ Capacity utilisation ratio	Forecast gap (based on 85% utilisation)
London Paddington	Crossrail GW route	17,600	12,800	73 %	0
	Relief line trains (excl Crossrail)				
	Main line + other fast trains	9,200	13,600	148 %	5,800
	Heathrow Express	2,800	1,300	46 %	0
London Marylebone	All services	7,800	7,800	100 %	1,200
London Euston	Long Distance	6,900	6,500	94 %	600
	Suburban	11,400	12,100	107 %	2,500
London St Pancras	High Speed 1 (domestic)	5,700	5,300	93 %	500
	Thameslink MML	24,500	14,700	60 %	0
	MML Long Distance	2,900	3,800	133 %	1,400
	Thameslink ECML	16,300	13,000	80 %	1,500[1]
London King's Cross	Great Northern				
	ECML Long Distance	4,900	3,000	60 %	0
Moorgate	All services	7,700	8,000	104 %	1,400
London Liverpool Street	West Anglia	18,500	18,000	97 %	2,300
	Great Eastern Main Line	22,900	24,600	107 %	5,100
	GE Inners	23,300	21,000	90 %	0[2]
	Crossrail GE route				
	Crossrail Abbey Wood route	18,100	11,900	65 %	0
London Fenchurch Street	All services	20,100	17,000	84 %	0
London Bridge	Kent	63,200	50,900	81 %	1,000[3]
	Thameslink Sussex	28,100	24,400	87 %	500
	Terminating (fast trains via East Croydon)				
	Terminating (inners)	13,300	11,500	87 %	300
London Blackfriars	All services via Elephant & Castle	14,100	11,900	84 %	900[4]
London Victoria	Kent routes	12,500	8,700	70 %	0
	Fast trains via East Croydon	18,600	19,500	105 %	3,700
	Stopping trains via Balham	15,200	10,300	68 %	0
London Waterloo	Windsor Lines (all services)	19,300	17,100	89 %	900
	Stopping trains via Wimbledon	34,700	25,500	73 %	0
	South West Main Line	13,400	18,300	137 %	7,000
Main Orbital routes	West London Line	3,000	5,500	186 %	3,000
	East London Line	7,100	9,800	138 %	2,700
	North London Line	3,500	3,000	83 %	0

Notes:
1 On the ECML the gap is shown due to high loadings on the Peterborough/Cambridge route
2 The 85 per cent utilisation guidance is not considered appropriate for Crossrail inner suburban services, for which no gap is shown
3 On London Bridge Kent route a gap is shown due to passenger standing for over 20 minutes
4 On London Blackfriars routes a capacity gap is shown for the route via Herne Hill

7.2.4 It can be seen from **Table 7.1** that a number of significant peak capacity gaps are forecast by this RUS in 2031, based on currently committed schemes only. The size of the gap shown is an approximation of the capacity which would need to be provided in addition to committed schemes, in the busiest morning peak hour, in order to reduce the levels of overcrowding to industry benchmark levels on the corridor concerned.

7.2.5 **Figure 7.1** provides a graphical representation of the on-train loadings in **Table 7.1**.

7.2.6 Where a crowding gap is forecast to remain (following the completion of all currently funded schemes) the logical step is to then consider the additional interventions previously appraised as delivering value for money by previous established RUSs and other similar studies. Recommendations in this category remain uncommitted at present but would help address these gaps, so the case for them is re-stated in this RUS.

7.2.7 Further details are provided on the route corridors with unresolved peak capacity gaps in **Table 7.2**. This shows the above forecast gap with committed schemes only in the column shaded in pink, followed by a summary of outstanding recommendations (where relevant) in the column shaded in green. Further details of these recommendations were discussed in **Chapter 5** and more information can also be found for many of the schemes in the specific RUSs concerned, available on Network Rail's website at **www.networkrail.co.uk**. Finally the column shaded in blue shows the reduced gap following implementation of previous recommendations carried forward into this RUS, in addition to currently committed schemes.

7.2.8 It can be seen that some of the peak capacity gaps can be resolved by previous strategy without additional interventions being required. For example the forecast growth in rail usage between London and the Midlands/North of England/ Scotland would be accommodated by construction of High Speed 2 (HS2) and other services on the West Coast Main Line (WCML) and other north south routes would benefit from the capacity freed up by that scheme. At a smaller scale several previously recommended train lengthening and timetable modifications would reduce or eliminate many of the other gaps.

7.2.9 However **Table 7.2** demonstrates that not all gaps are forecast to be resolvable to 2031 by established RUS strategy. In particular whilst extra capacity would be provided on the Great Western Main Line (GWML) and Great Eastern Main Line (GEML) routes through new intercity-type rolling stock, this would not be enough to address the relevant gaps. Similarly the additional capacity planned on the South West Main Line (SWML) does not appear to be sufficient to address the forecast gap on services using the fast lines on this route. Smaller, but still significant, gaps also exist on the Brighton Main Line (BML), West Anglia routes and the Windsor lines. Closer to Central London high levels of standing are forecast on orbital routes and on the Elephant & Castle corridor.

7.2.7 The remainder of this chapter therefore considers options that seek to respond to the capacity shortfall as shown in **Table 7.2**.

Figure 7.1 – 2031 demand, capacity utilisation and gaps (do-minimum committed schemes only), busiest peak hour

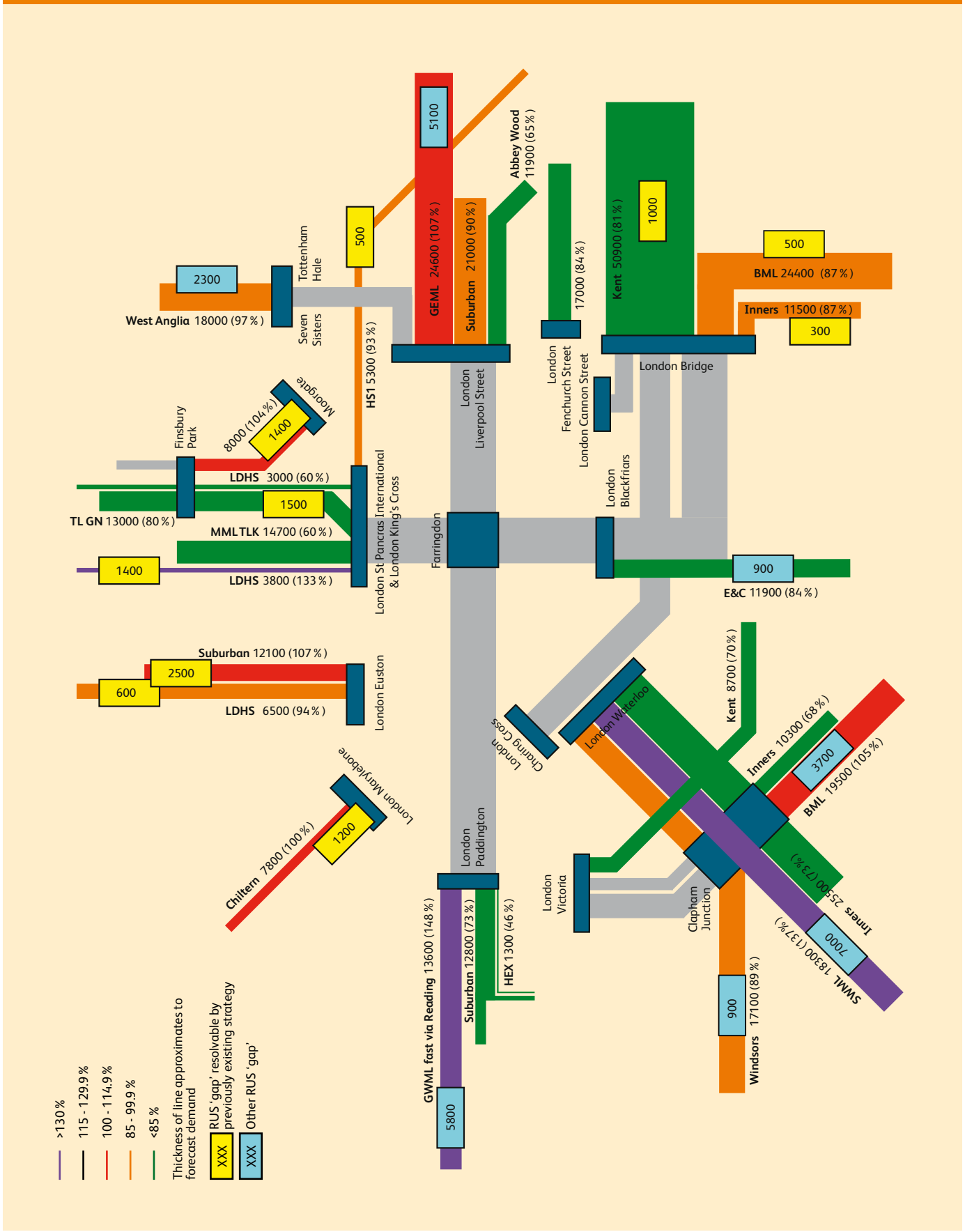


Table 7.2 – forecast capacity shortfall in busiest morning peak hour in 2031: following implementation of committed schemes only / with previous RUS recommendations

Route to	Service group	Overall capacity shortfall with committed schemes only[1]	Established RUS (or equivalent other strategy) uncommitted recommendations carried forward into this RUS	Anticipated capacity shortfall with previous RUS recommended schemes	Shortfall basis (seats/ standing)
London Paddington	Long distance high speed (LDHS)	5,800	None	5,800	Seats (standing capacity included from Maidenhead on certain trains).
	Outer suburban				
London Marylebone	Outer suburban	1,200	Potential for future timetable changes and further train lengthening, as described in West Midlands and Chilterns RUS (final published in May 2011).	Dependent on specific intervention, but gap broadly resolvable.	Seats.
London Euston	LDHS	600	Further very limited Class 390 lengthening in the short term. Construct HS2 (initially London – Birmingham, thence 'Y' network to Manchester and Leeds).	Gap resolved by High Speed Rail.	N/A
	Outer suburban	2,500	Minor timetable modifications, as outlined in the WCML RUS. Extra WCML fast line calls at Milton Keynes Central etc following HS2 opening.	Gap resolved by High Speed Rail.	N/A
London St Pancras International	LDHS	1,400	IEP or similar rolling stock following electrification. Construct HS2 (initially London – Birmingham, thence 'Y' network to Manchester and Leeds).	Gap reduced to 900 following electrification/ IEP. Gap resolved by High Speed Rail.	Seats.
London King's Cross	LDHS	None[2]	Construct HS2 (initially London – Birmingham, thence 'Y' network to Manchester and Leeds).	Gap resolved by High Speed Rail.	N/A
London King's Cross (GN/ Thameslink)	Outer suburban	1,500	12-car operations of the London King's Cross to Cambridge semi-fast service (requiring calls at locations such as Welwyn Garden City which would involve complex platform extensions). Extra ECML fast trains calling at locations such as Stevenage following HS2 'Y' network.	Gap reduced to 700 if all outer-suburban services can be lengthened to 12-car. Gap also fully resolved by High Speed Rail.	Seats (standing capacity included Potters Bar to Finsbury Park).
Moorgate	Inner suburban	1,400	Improve headways and reduce turnaround times on the Moorgate branch to run 2tph additional.	100[3]	Seats + standing.

1 Based on the 85 per cent capacity utilisation guidance as described in Chapter 4.
2 in morning high-peak. Evening peak and all day LDHS loadings not covered by RUS methodology
3 Modelling suggests that the extra capacity provided by the additional 2tph to Moorgate would abstract from London Underground services, so a high load factor may still remain in the Alexandra Palace to Finsbury Park corridor (dependent on calling pattern).

Table 7.2 – forecast capacity shortfall in busiest morning peak hour in 2031: following implementation of committed schemes only / with previous RUS recommendations

Route to	Service group	Overall capacity shortfall with committed schemes only[1]	Established RUS (or equivalent other strategy) uncommitted recommendations carried forward into this RUS	Anticipated capacity shortfall with previous RUS recommended schemes	Shortfall basis (seats/ standing)
London Liverpool Street (West Anglia)	Inner suburban	2,100	Lengthen all peak inner services to 8-car.	1,400	Seats + standing.
	Outer suburban	200	Lengthen all peak trains (Harlow Town line) to 12-car.	0	Seats (standing capacity included Broxbourne to Tottenham Hale).
London Liverpool Street (Great Eastern)	Outer suburban	5,100	Replace intercity stock on Norwich trains with multiple units for higher capacity. Run one further extra train in high-peak. Lengthen all peak trains to 12-car.	3,000	Seats (standing capacity included Shenfield to Stratford).
London Charing Cross and London Cannon Street	Inner and outer suburban	1,000	Lengthen most suburban trains to 12-car.	0	Seats + standing.
London St Pancras International (High Speed 1)	Main line	500	Extend Ebbsfleet – St Pancras service to start back from Ashford International or beyond and lengthen to 12-car (requires additional Class 395 vehicles and extra platform capacity at Ashford).	0	Seats.
London Bridge (Sussex)	Outer suburban	500	Additional diesel rolling stock for Uckfield line (10-car x 23m).	0	Seats (standing capacity included from East Croydon).
	Sydenham line	300	Lengthen trains to 12-car. See also **Option I4** later.	0	Seats + standing.
London Victoria (Sussex)	Outer suburban	3,700	Insert Clapham Junction calls in certain peak Gatwick Express services. Lengthen Caterham and Tattenham trains to 10-car upon joining together at Purley (possibly 12-car later).	3,000	Seats (standing capacity included from East Croydon).
London Blackfriars (via Herne Hill)	Inner suburban	900	None.	900	Seats + standing.
London Waterloo (SWML)	Outer suburban/ main line	7,000	Lengthen all peak trains to 12-car (or 10-car x 23m).	6,100	Seats (standing capacity included from Surbiton).

Table 7.2 – forecast capacity shortfall in busiest morning peak hour in 2031: following implementation of committed schemes only / with previous RUS recommendations

Route to	Service group	Overall capacity shortfall with committed schemes only[1]	Established RUS (or equivalent other strategy) uncommitted recommendations carried forward into this RUS	Anticipated capacity shortfall with previous RUS recommended schemes	Shortfall basis (seats/ standing)
London Waterloo (Windsors)	Inner and outer suburban	900	10-car trains from Reading to London Waterloo (requiring platform lengthening Virginia Water – Earley). Further 10-car operations using CP4 infrastructure. LUL Piccadilly Line upgrade.	200	Seats (standing capacity included Richmond to Clapham Junction).
West London Line	Inner suburban	3,000	None.	3,000	Seats + standing.
East London Line	Inner suburban	2,700	None.	2,700	Seats + standing.

7.3 Corridors not fully addressed by existing established RUS strategy

7.3.1 From the blue column in **Table 7.2** it can be seen that, even if all elements of previous RUS strategy (including HS2) are funded, the modelling approach used forecasts that the following routes will still have a peak capacity gap (defined by this RUS as described in **Chapter 4** – ie total demand exceeding 85 per cent of total capacity at a route corridor level over the high-peak hour) in 2031 – unless further interventions are implemented:

- GWML services between London Paddington and South Wales/the West Country. The RUS anticipates significant crowding problems with Reading area to London Paddington commuters, in particular, unless further capacity is provided. Note that this conclusion has only marginally been affected by the recent funding announcement regarding electrification and the Intercity Express Programme (IEP), since additional trains into London Paddington in the high-peak hour over the fast lines are not operationally achievable regardless of train type
- GEML outer services, with no track capacity available on the London approaches (in particular through the Stratford area) to run further peak trains. Significant crowding problems are therefore anticipated from the Chelmsford/Wickford areas inwards unless further capacity is provided
- outer services on the SWML. Significant crowding problems are anticipated inwards from Basingstoke/Guildford to London Waterloo on these trains. It should be noted that this conclusion appears to apply regardless of what works are undertaken at London Waterloo station, since the RUS analysis identifies that the fast lines are capacity constrained over the whole of the Surbiton to London Waterloo corridor, not just at the London terminal
- the West Anglia corridor. The capacity gap anticipated on this route is now forecast to be mainly driven by increased London commuting, rather than by the extra demand at Stansted Airport associated with aviation growth. As a result only the train lengthening elements of the Greater Anglia RUS strategy have been carried forward to this RUS as shown in **Table 7.2**. If these are all implemented the key crowding problem is then anticipated to be insufficient capacity towards Central London from locations on the Lea Valley corridor such as Broxbourne/Cheshunt and also into Seven Sisters. Stakeholders have emphasised during the consultation that peak capacity is only one of many issues on this line, and the options newly considered in detail in this chapter reflect this

- orbital services, with peak West London Line trains, in particular, crowded towards Shepherds Bush from both the north and south. In addition there will also be significant crowding at other times, for example during Christmas shopping at Shepherds Bush, events at Earls Court or football matches in Chelsea. Similar crowding issues are likely to emerge on the North London Line, the East London Line and the Gospel Oak – Barking line, which have all experienced significant growth in recent years as demand has increased in response to service improvements. The RUS also notes that demand on certain orbital flows can be expected to increase significantly in the event of a new interchange station being provided to the HS2 route and Crossrail in the Old Oak Common area
- the Herne Hill/Elephant & Castle corridor, with trains restricted to eight-car, significant physical obstructions preventing platform lengthening and no spare capacity at key locations for additional trains
- the Brighton Main Line (BML), principally on the London Victoria corridor. Utilisation of high-capacity Thameslink rolling stock is a key element of current plans on the BML, providing extra capacity on the busy Redhill corridor, the BML, the East Grinstead Line and outer services via Purley, with lengthening to 12-car on most routes as described in **Chapter 5**. Other RUS strategy includes further lengthening (Caterham/Tattenham Corner to London Victoria trains and on the Uckfield line). However, the existing significant capacity gap would not be fully resolved by this combination of committed schemes and other existing strategy, so standing on journeys of longer than a 20 minute duration will remain. The new Thameslink rolling stock, which will be widely used on the BML, is designed to maximise the on-train space available for use by passengers
- suburban services on the Windsor Lines into London Waterloo, on which crowding is anticipated to remain a problem, even with the planned increase from 8-car to 10-car capability for most services using this route. Due to the proximity to the Piccadilly Line, planned London Underground upgrade of this route crowding levels would be higher in the event of the upgrade not proceeding.

7.3.2 In addition to the above the RUS notes that the following would be capacity gaps in the absence of HS2:

- commuter capacity on outer suburban and longer distance routes into London Euston, which would be resolved by capacity reallocation on the WCML following HS2, providing significant benefits to commuters from areas such as Milton Keynes.
- commuter capacity on the MML, which would be resolved by demand between the East Midlands and London shifting to HS2.
- long distance and Great Northern outer suburban services on the East Coast Main Line (ECML). Without HS2 the modelling forecasts a capacity gap on services on this route, even if the complexities associated with 12-car operations of all services calling at Welwyn Garden City, Hatfield etc could be resolved. Given the size of the gap and the time before the north east spur of the HS2 'Y' network is implemented the RUS considers it prudent to outline potential tactical interventions in advance of HS2, building on the established East Coast Main Line 2016 Capacity Review, so a gap is included in the below.

7.3.3 **Sections 7.4** to **7.12** consider interventions by line of route, based on the above corridors where peak capacity gaps still remain after implementing the interventions shown in **Table 7.2**. Following extensive further development after publication of the Draft for Consultation many of these options have now been redefined and/or re-numbered. Where economic analysis has been undertaken monetary values are presented in 2002 prices, as required by the DfT's appraisal guidance.

7.4 Gap A: Reading/outer Thames Valley

7.4.1 **Table 7.2** forecasts that capacity will need to be found for a further 5,800 people in the high-peak hour, primarily commuters between the outer Thames Valley area and London. This figure is after the implementation of IEP and Crossrail (to Maidenhead). The RUS has developed options in detail as a means of addressing this gap. These are now presented below.

7.4.2 The first test undertaken has been to identify whether the extension of additional relief line services to Reading would resolve the capacity gap (or be recommended for any other reason). This would utilise the additional track capacity planned at Reading in the ongoing Control Period 4 (CP4) scheme and would build on the planned electrification of the GWML.

Assessment of Option A1 – extend relief line services beyond the committed Crossrail terminus of Maidenhead to Reading	
Concept	This option would involve services running between Reading and the new Central London Crossrail tunnel. The proposed train service in connection with this option has been amended following further analysis during the consultation period. This is because modelling has identified passenger disbenefits if the currently planned London Paddington – Reading 'residuals' (the separate limited stop London Paddington – Maidenhead – Reading and Slough – Reading all day services which would otherwise be necessary) were removed entirely, so an approach based on completely removing these trains does not appear to have a robust economic case over the longer term. This option now proposes that the residuals are replaced by additional trains running through the Crossrail Central London tunnels from the GWML route, at least in the longer term. The resulting peak service pattern on the relief lines is therefore assumed to be: • 4tph Heathrow Airport Terminal 4 (stopping) • 4tph Reading (semi-fast east of Slough) • 2tph Slough (stopping) • 2tph West Drayton (stopping). Under the specific option appraised all the above would run through the new Central London Crossrail tunnel.
Operational analysis	Following the committed remodelling of the Reading station area, capacity will exist there to allow a 4tph relief lines service. The incorporation of the relief line residuals (into the main service pattern on the route is likely to simplify operations. Running all such services into the London Crossrail tunnel would free up platform capacity (albeit at short platforms) at London Paddington and safeguard performance by reducing conflicts with longer-distance services on the approach to London Paddington. The service pattern described above would result in 12 of the 24 trains through the London Crossrail tunnel in peak hours starting in the sidings near Paddington, rather than the currently planned 14 of 24. Having exactly half the trains terminating is potentially simpler operationally. Analysis suggests that if this option were implemented, there would still be capacity for one peak direction train to/from each of Bourne End and Henley-on-Thames.
Infrastructure required	The above service pattern would require construction of a new 10-car or more east-facing bay platform at Slough, which is not planned at present. However the cost of this would be outweighed by a significant cost saving in that the following committed infrastructure enhancement schemes would not be required: • major track and signalling changes on the relief lines at Maidenhead for terminating Crossrail services • the new bay platform at Maidenhead for Marlow branch services (since these could be accommodated by existing infrastructure) • the west-facing bay at Slough station • the stabling and servicing facilities at Maidenhead. Implementation of this option would therefore result in an infrastructure cost saving of around £31 million, though clearly this would require a decision to be made quickly over the coming months, before construction works in the Maidenhead area commence.
Passenger impact	Under the option appraised passengers from Reading and Twyford for destinations beyond London Paddington would benefit as the need to change would be removed. Passengers at several stations between Maidenhead and Ealing Broadway would also benefit as all trains would run through the Central London tunnels, rather than 2tph only running to Paddington. However this option does not result in any more trains in operation than the committed do-minimum base. Whilst extending Reading stopping services through the London Crossrail tunnels would provide new journey opportunities they would still not be attractive to the majority of Reading to London commuters, given that these trains run on the relief lines and call at several stations (journey times would be 25 – 30 minutes longer than main line trains to London Paddington). As a result of these issues **Option A1** does not resolve the peak capacity gap from the Reading area.

Freight impact	None identified.	
Financial and economic analysis	The following table outlines the appraisal results. The analysis assumes that the 12tph peak Crossrail service west of Paddington is implemented upon Crossrail opening, though it is possible that a 10tph service may be sufficient initially (this would minimise the need for changes to the Crossrail project for 2018). Note: All figures are presented in 2002 prices, as required by DfT guidance. The capital cost saving in 2011 prices would be £31million. This option is financially positive as cost savings and generated revenue are higher than the additional operating costs.	
	30-year appraisal	**Present value £m**
	Costs (present value)	
	Investment cost	-24
	Operating cost	23.1
	Revenue	-21.6
	Total costs	**-22.6**
	Benefits (present value)	
	Rail users benefits	16.5
	Non users benefits	13
	Other Government impacts	-4.1
	Total quantified benefits	**25.4**
	NPV	**48.0**
	Quantified BCR	**Financially positive**
	This option is financially positive as cost savings and generated revenue are predicted to be higher than the additional operating costs. This finding is, however, sensitive to the assumptions made in the appraisal.	
Link to other options	This option as appraised removes all relief line trains (other than potentially one each from the Henley-on-Thames & Bourne End branches) from the platforms at London Paddington, so helps to facilitate capacity at the London terminal for increased main line operations as considered under **Option A5** later.	
Conclusion	Recommended, since this option saves capital cost, provides passenger benefits, simplifies operations and potentially helps to facilitate **Option A5** at a later date. However in isolation this option does not resolve the peak capacity gap for Reading area commuters so other interventions are required.	

7.4.3 Whilst the RUS recommends that the GWML relief lines service from Reading should run through the new Crossrail tunnels it does not have a view on who should be the operator of such a service, which could be operated on the GWML by a franchised operator if appropriate.

7.4.4 The Draft for Consultation then presented two relatively small-scale options for progressively increasing service levels and lengthening trains following on from the initial introduction of IEP on the GWML in 2018. These were designed around the intention of reducing the peak capacity gap from the outer Thames Valley as far as possible without more significant changes. Following further clarity on the IEP service specification now proposed, these have now been modified as shown on the next page.

Assessment of Option A2 – increase peak main line service via Reading to 16tph following IEP	
Concept	This option would increase the main line service level east of Airport Junction to 20 trains in the busiest peak hour following IEP (9 IEP, 1 High Speed Train from the West of England, six outer suburban Electric Multiple Units (EMUs), 4 Heathrow Express). This represents an extra EMU train above the anticipated post-IEP position.
Operational analysis	20 trains (including 4 Heathrow Express) is the maximum level of main line service considered achievable on the route, so an increase from the planned 15 to 16 peak trains via Reading is likely to be viable.
Infrastructure required	None identified.
Passenger impact	The extra train would provide extra capacity and reduce some standing from the Reading area to a limited degree. However given the size of the forecast gap this would not provide sufficient capacity to 2031, even when combined with **Option A3** below.
Freight impact	Freight does not generally run in the peak so no impact identified.
Financial and economic analysis	No economic analysis has been undertaken, since this is a tactical level intervention not requiring significant changes. If confirmed as operationally viable this option is likely to have a strong economic case when assessed as demand arises.
Link to other options	None
Conclusion	The RUS anticipates that this option will be implemented at some stage following the initial introduction of IEP, prior to further interventions being needed.

Assessment of Option A3 – lengthening of Thames Valley outer suburban EMUs to 12-car	
Concept	This option would lengthen at least four of the six outer suburban EMUs in the busiest peak hour (resulting from **Option A2** above) to 12-car, utilising Class 377 or similar rolling stock. This would result in all the 16 main line trains in the busiest peak hour via Reading being formed of rolling stock of the maximum realistic length.
Operational analysis	This would require a 12-car capable EMU train to be available for use on these routes. No further impacts identified.
Infrastructure required	Platform lengthening would potentially be required at certain stations, though this is dependent on the calling pattern. Alternatively Selective Door Operation (SDO) might be a viable solution.
Passenger impact	The lengthened trains would provide significant extra capacity and reduce standing from the Reading area. However, even if all trains were lengthened, given the size of the forecast gap the combination of this option and **Option A2** above would not provide sufficient capacity to 2031.
Freight impact	No impact identified.
Financial and economic analysis	No economic analysis undertaken at present. This option is likely to have a strong economic case as demand increases in the future, though specific costs will be dependent on the rolling stock strategy.
Link to other options	None.
Conclusion	The RUS recommends further development, but further interventions are still needed.

7.4.5 The conclusion from the above is that **Option A2** and, to a greater extent, **Option A3** have potential to provide additional capacity in the medium term, but fall a considerable way short of resolving the gap, with significant numbers of standing passengers still anticipated from Reading. Additional interventions are therefore required, with at least four extra peak trains appearing necessary into London in the busiest hours. The RUS notes that capacity at the Reading end will exist for this, but capacity in Central London is not available within the existing timetable structure.

7.4.6 Following feedback received during the consultation period the RUS now describes an option enabling additional trains to run, without involving fundamental changes to existing services. This would involve a major infrastructure upgrade to the London approaches and at London Paddington, in both cases requiring the use of significant land outside the current railway boundary. This is described further in **Option A4** below.

Assessment of Option A4 – infrastructure upgrade to the Great Western Main Line between London Paddington and Airport Junction to enable peak additional trains	
Concept	This option would enable four additional Reading to London Paddington peak shuttle services, without impacting on other existing services. This would be achieved through major infrastructure works (rather than a rebalancing of services between the existing main and relief lines and between trains terminating at London Paddington and those running through the Crossrail tunnels).
Operational analysis	This option requires a resolution to the following existing issues: • insufficient main line paths between London Paddington and Airport Junction to run additional trains • insufficient platforms at London Paddington to run additional trains terminating at this location. Without any rebalancing of main/relief line and London Paddington/Crossrail services an infrastructure upgrade is required to resolve the above.
Infrastructure required	This option requires: • two additional tracks between Ladbroke Grove and Airport Junction. This would involve major engineering works over approximately 10 miles in a heavily built up area, with locations such as Ealing Broadway presenting a significant challenge. In addition there would need to be significant changes to the HS2 proposals for the Old Oak Common station area to accommodate such tracks • two additional long platforms at London Paddington. This would require expansion of the station footprint which would involve a major engineering challenge in a confined location • other potential requirements could include grade separation on the London Paddington approaches, to facilitate an increased level of relief line services running into the terminal station, rather than running via Crossrail. This would avoid conflicts at Westbourne Park and Portobello Junctions. These works would impact on stakeholders adjacent to the railway and would be extremely complex and expensive.
Passenger impact	This option would provide significant peak capacity in response to the forecast gap. This would result in major disruption to services while works are taking place.
Freight impact	The additional tracks would create additional flexibility for freight operations on the route.
Financial and economic analysis	This option would involve very high capital cost. The RUS has therefore not undertaken an economic appraisal, since **Option A5** below would resolve the gap within broadly existing infrastructure.
Link to other options	This option would involve significant interaction with HS2 plans for the Old Oak Common area.
Conclusion	The RUS does not consider this option appropriate, given that **Option A5** on next page would provide the additional capacity in a more efficient manner.

7.4.7 The conclusion from the previous page is that the RUS has not pursued a major infrastructure upgrade to the London Paddington – Airport Junction section, given that service change options exist which solve the peak capacity gap in a significantly more efficient manner, whilst improving access by Crossrail between Central London and Heathrow Airport. However, it is possible that some smaller scale interventions of additional tracks may be appropriate at key locations, to enable relief line overtaking moves. Further consideration regarding whether there might be a case for such interventions is recommended, but not as a way of addressing the gap.

7.4.8 The proposed service change options have been consolidated in this RUS into a single option which has now been developed in detail as **Option A5** below. The option shown is based around running as many trains as practicable on existing infrastructure, evening out the numbers of trains between the main and relief lines to achieve the maximum overall capacity. The service structure is based on 20 trains in the busiest peak hour for main line services (all of which would run to London Paddington) and 16 trains in the busiest peak hour for relief line services (all of which would run through Central London). This would represent nearly a 25 per cent increase in the overall numbers of trains on the route in the busiest hour compared to today and, in conjunction with the higher capacity trains in operation, is considered to provide broadly an appropriate level of capacity to match future demand growth.

Assessment of Option A5 – implement 20tph main line/16tph relief line service	
Concept	This option is based around a new 4tph Reading/outer Thames Valley to London Paddington peak service, with Heathrow Airport served by a 10tph Crossrail service. An indicative peak 20tph main line service specification would be: • ten trains from long distance destinations (9 IEP, 1 HST) • six trains formed of high capacity EMU stock from outer destinations such as Oxford and Newbury, all of which would be able to run non-stop from Reading (or potentially beyond) • four new trains formed of high capacity EMU stock running from the Reading area. These would call at Twyford (alternate trains), Maidenhead and Slough (alternate trains). Based on implementation of **Option A3** most of the outer suburban EMUs would be 12-car length, with a high seating capacity and capable of at least 100mph operations (110mph preferred). The four additional trains would cross from the relief lines to the main lines at Maidenhead or Slough, with the other 16 trains running on the main lines from Reading. To free up the capacity necessary to operate the above increased main line service level the existing Heathrow Express service would be replaced by a significantly increased Heathrow Airport to Crossrail service (10tph rather than 4tph as currently planned), all of which would run, at peak times, on the relief lines. At peak times the Heathrow Airport services would need to be skip-stop to maximise relief lines capacity overall, whilst in the off-peak four trains per hour could run non-stop on the main lines. As well as providing increased peak capacity on the GWML a further aim of the option is to improve services between much of Central London and Heathrow Airport, by increasing frequencies to a total of 10tph and running all of these through the Central London Crossrail tunnels. The resulting peak 16tph Crossrail service pattern has been assumed to be as follows, though other variations may exist: • 8tph Heathrow Airport Terminal 5 (running limited stop on the relief lines) • 2tph Heathrow Airport Terminal 4 (running skip-stop on the relief lines) • 4tph Reading (running skip-stop on the relief lines), based on **Option A1** being implemented • 2tph Slough (running skip-stop on the relief lines). The number of Crossrail services terminating in the Westbourne Park area from the east would be further reduced from the currently planned 14tph to 8tph at peak times.

Operational analysis	Following the completion of remodelling works at Reading station and its approaches capacity will be available to allow additional fast services to London Paddington, as well as the extended relief line service outlined in **Option A1**. The train service changes proposed under this option would free up the necessary platform capacity at London Paddington (two long platforms) and capacity on the main lines between Paddington and Airport Junction for a 20tph peak main line service via Reading. The 16tph relief lines service would fill the relief lines to capacity (given the need for station calls), so minimising journey times to Heathrow Airport is best achieved through the use of a skip-stop service pattern with all relief line trains having similar journey times between London Paddington and Airport Junction, since this avoids fast trains catching up with those calling at all stations. In the off-peak the RUS anticipates that a 4tph Crossrail non-stop service to Heathrow Airport would run on the main lines. This would allow sufficient capacity on the relief lines for freight paths and would minimise the London – Heathrow Airport journey time. In addition to this 6tph to the airport would run on the relief lines for local passengers, at least 2tph of which could be semi-fast. However other permutations may be possible. The peak 20tph main line/16tph relief line service would be the maximum capacity achievable on the route. As a result the Bourne End and Henley-on-Thames branches would need to have the direct peak services to London replaced by good connections at Twyford/ Maidenhead into the fast EMUs to London Paddington and/or relief line services running beyond Paddington.
Infrastructure required	None identified as a specific absolute requirement (assuming the east facing bay at Slough is already provided by **Option A1** at this stage). However the following further enhancements have been identified as highly desirable to improve performance robustness: • increased main-to-relief turnout speeds at Dolphin and Maidenhead East Junctions (currently 40mph) • a new crossover at Acton to allow main to relief crossing moves as a parallel move with freight access to Acton yard.
Passenger impact	The 20tph main line service structure would provide significant extra peak capacity on the GWML, reducing much of the standing which is otherwise anticipated from the outer Thames Valley. This would provide a major improvement for Thames Valley commuters, in turn freeing up capacity for long distance passengers to South Wales and the West Country on the IEP trains, especially at the busiest times such as the Friday evening peak. However, many Heathrow Express passengers would potentially see disbenefits as a result of this option, especially those heading for the immediate area around Paddington station. Heathrow Airport Limited have expressed concern that such passengers would switch to private car and taxis in significant numbers. More detailed analysis of this is required. It is recognised that the quality of the passenger experience, together with the need for an easily comprehensible train service, is an important priority for aviation passengers. This has a significant effect on modal choice and would require further assessment before implementation of this option. As far as the West End, City of London and Canary Wharf areas are concerned, the frequency of services to and from Heathrow Airport would be significantly improved, with 10tph Crossrail route services to the airport throughout the day, all of which would run via the Central London tunnels, with most running to Heathrow Terminal 5 which will not otherwise be served by Crossrail.
Freight impact	No capacity for freight would be available in the busiest part of the passenger peak, but four freight paths per hour would be available in the off-peak. This is considered sufficient to accommodate the anticipated freight demand.
Financial and economic analysis	At present insufficient information is available to robustly quantify the benefits and any dis-benefits, with such calculations being sensitive to the assumptions used regarding Heathrow business travellers. The option also interacts significantly regarding ongoing planning in connection with the Old Oak Common area. Further development is required.

Link to other options	This option potentially interacts with the strategy for HS2, since the proposed future infrastructure at Old Oak Common is designed around Heathrow Express trains (and other services) calling on the GWML main lines. If Heathrow Airport were served solely by Crossrail services then it may be possible for the design of Old Oak Common station to be simplified, though this requires further detailed consideration.
Conclusion	This option appears likely to be required for implementation in the mid 2020s to respond to crowding from the outer Thames Valley. It would broadly resolve the GWML capacity gap and improve journey opportunities to Heathrow in many aspects, but certain groups of airline travellers may be adversely affected. Further development is recommended.

7.4.9 From the above analysis the emerging conclusion for GWML capacity is the likely need for a new peak Thames Valley – London Paddington shuttle, using rolling stock configured for commuters rather than long distance travellers. A total of 20 peak trains on the GWML via Reading is forecast to broadly provide sufficient capacity to cater for the anticipated demand growth, based on nine long distance IEPs, one HST from the West Country and ten outer suburban EMUs (from a mixture of origins at Oxford, the Newbury area, Reading and potentially Basingstoke).

7.4.10 In order to create space for the 20 peak main line trains on the London approaches and at London Paddington station itself, the RUS advises that an appropriate solution appears to be to introduce a new Crossrail Express service to Heathrow Airport, with frequency improvements for many passengers to the airport through the provision of a ten trains per hour service, all of which would operate through the Central London Crossrail tunnels. The airport services would operate semi-fast on the relief lines at peak times, with four trains per hour running non-stop via the main lines for the rest of the day. This approach would provide sufficient all-day capacity for freight on the relief lines, albeit with some retiming of some existing services needed to avoid the passenger peaks.

7.4.11 Implementation of **Option A1** is recommended to coincide with Crossrail opening in 2018 (as the business case is largely based upon the capital cost saving of avoiding major works at Maidenhead). **Option A2** and **A3** are anticipated as tactical interventions shortly thereafter, subject to the emerging rate of growth in demand and rolling stock availability, though detailed work is recommended with respect to 12-car outer suburban EMU operations. Beyond this in order to respond to anticipated crowding, which will arise as a result of Thames Valley demand growth, **Option A5** is currently considered by the RUS to be the most cost-effective and practical solution for implementation in the mid 2020s, though more detailed consideration will be required.

7.4.12 Further improvements to journey opportunities to Heathrow Airport are considered later in this RUS, under **Options J2** and **J3** which would extend some or all of the above eight trains per hour Heathrow terminal 5 service westwards from that point.

7.5 Gap B: East Coast Main Line – London approaches

7.5.1 As described in **Chapter 5** the Thameslink Programme will improve connectivity on the ECML by enabling many services to continue through the Thameslink tunnels rather than needing to terminate at London King's Cross. In addition to this the grade separation of Hitchin Junction, together with improvements between Finsbury Park and Alexandra Palace, will alleviate key infrastructure constraints at the south end of the route, greatly improving operational flexibility. However, very limited additional peak trains relative to today are likely to be able to run through the critical Welwyn viaduct area, so the main commuter capacity gains arising from the above will be on inner suburban services, rather than longer distance trains or the outer suburban Peterborough and Cambridge routes. A total peak hour ECML capacity gap of 1,500 people is forecast in **Table 7.2**.

7.5.2 As a result of the constraint at Welwyn (and south thereof) remaining outer suburban capacity increases will be mostly restricted to those gained through running all trains at maximum length, as recommended by the East Coast Main Line RUS. If fully implemented, this approach would be a significant step towards resolving the forecast capacity gap, reducing it to 700 people in the busiest peak hour. However the RUS notes that entire 12-car operations would create significant complexities if certain platforms such as those at Welwyn Garden City required extension. Beyond this a full solution to ECML outer suburban capacity is reliant on the construction of HS2 (including the extension to Leeds) which will shift north south long distance demand away from London King's Cross to London Euston, enabling additional main line calls at stations such as Stevenage and Peterborough for outer suburban commuters at the southern end of the ECML.

7.5.3 However, the HS2 extension to Leeds is not proposed to be completed until 2033. Moreover, capacity issues on trains on the ECML occur throughout the day, rather than (at a strategic level) being confined to the recognised morning and evening commuter peaks as on many London and South East routes. The RUS therefore considers it prudent to explore longer-term options for ECML capacity (ie before completion of HS2), working within existing infrastructure constraints on the London approaches.

7.5.4 The current rolling stock strategy for the ECML is based on the implementation of IEP vehicles to replace existing HSTs and the Class 365 units currently used on London King's Cross – Cambridge/Kings Lynn fast services, together with the implementation of new Thameslink vehicles for the Cambridge, Peterborough and Welwyn Garden City routes. The Mark IV coaching stock currently used on most long distance services is expected to remain in use for many years. Prior to HS2 opening replacement of these trains (ideally with their re-use elsewhere) may therefore provide an opportunity for further extra capacity on the ECML, since additional space on any new train would be available as passenger space. The RUS therefore proposes this as a medium-term **Option B1** for future consideration, as discussed below.

Assessment of Option B1 – ECML rolling stock replacement (beyond replacing HST sets with IEP)	
Concept	This option would involve replacing the current ECML Mark IV trainsets with IEP vehicles or similar, creating additional capacity by utilising the front and rear vehicles for carrying passengers. In addition other short formation services on the ECML could be extended by utilising longer rolling stock (potentially splitting and joining en route if necessary).
Operational analysis	Limited impact anticipated. Any longer services formed by splitting/joining on the main ECML route would require specific timetable investigation.
Infrastructure required	No impact anticipated.
Passenger impact	An extra two passenger vehicles would be provided on most ECML trains. These currently comprise a Class 91 locomotive, nine Mark IV carriages and a Driving Van Trailer. This approach would potentially represent an increase in seats of around 20 per cent per train. Lengthening of other services would also provide significant extra capacity.
Freight impact	No impact anticipated.
Financial and economic analysis	No appraisal undertaken.
Link to other options	None.
Conclusion	This option should be considered for further investigation, following the IEP programme.

7.5.5 **Option B1** would provide additional all-day capacity on the ECML, so further consideration of appropriate long term rolling stock for the ECML is recommended closer to the time that the existing Mark IV vehicles become due for renewal.

7.5.6 In the shorter term the planned implementation of new technology through the European Rail Traffic Management System (ERTMS) on the ECML between London King's Cross/ Moorgate and Doncaster (exclusive) in 2018-19 may offer opportunities for improved exploitation of the infrastructure in place from that time, although the capacity benefit of ERTMS to long distance services is likely to be limited because the mix of train speeds on the route is a more important capacity constraint than signalling headways. Full details of ERTMS implementation on primary routes in the UK remains under development at present.

7.5.7 With respect to inner suburban services these are anticipated to benefit from frequency enhancements following a combination of the Thameslink Programme and committed infrastructure enhancements in the Finsbury Park to Alexandra Palace area. These services are not directly constrained by capacity over the Welwyn viaduct and hence the train service frequency on both the Hertford Loop and to Welwyn Garden City can be expected to increase once the Finsbury Park to Alexandra Palace section comprises six fully usable tracks and additional capacity overall is provided at London King's Cross through the connection to the Thameslink tunnels. During the consultation stakeholders have emphasised the benefits of frequency increases on the Hertford Loop in particular, with many making mention of the desirability of a four trains per hour off-peak service following the completion of the Thameslink Programme.

7.5.8 The Moorgate branch is restricted to six-car trains by underground station platforms so the usual RUS capacity option of train lengthening is not available once all trains are at that length. As a result, in the longer term, the East Coast Main Line RUS recommendation for increasing the overall peak frequency to Moorgate (which required the installation of additional signals on the branch but will more likely now be met by the planned resignalling with ERTMS as described in **7.5.6**) is re-emphasised as a necessary measure to resolve the capacity gap towards the end of this RUS period. In the shorter term direct Thameslink trains from the Potters Bar corridor to Farringdon/City Thameslink can be expected to alleviate crowding on the Moorgate branch.

7.5.9 With respect to the ECML in the long term there will be significant transfer of long distance demand to HS2, with passengers from Leeds, Newcastle and Scotland in particular seeing additional capacity and significant journey time reductions to London. HS2 would also release capacity on the southern end of the ECML for medium distance commuter services, resolving the forecast gap, and potentially for additional freight services.

7.6 Gap C: West Anglia route

7.6.1 **Table 7.2** indicates that overcrowding will be a concern on the West Anglia route, with a capacity shortfall of some 1,400 passengers north of Tottenham Hale/Seven Sisters in the busiest peak hour, affecting Lea Valley line services and the Southbury Loop. This assumes progressive implementation of previous Greater Anglia RUS recommendations for 12-car operations on all peak services on the main line route via Harlow Town and 8-car operations on all peak suburban services.

7.6.2 The RUS has not automatically carried forward the recommendation from the Greater Anglia RUS for a Lea Valley four-tracking scheme, given that Stansted Airport growth is now forecast at much lower levels than previously assumed, due to Government policy not now allowing an additional runway. Many stakeholders disagreed with this approach during the consultation period, but it is emphasised that such a scheme is only likely to progress if it has a robust business case, based on the latest available information. Potential interventions up to and including the full four-tracking scheme are now treated as options by this RUS, with the aim of identifying a viable scheme for progression in Network Rail's Control Period 5 (CP5).

7.6.3 The RUS recognises that peak capacity is not the only concern on this route and many stakeholders have highlighted this during the consultation period. Other potential service characteristics which have been considered during the option identification phase are: reducing journey times, providing a four trains per hour service at all Lea Valley line stations (including Angel Road and Northumberland Park which have a very limited service at present), improving service resilience and providing additional trains to Stratford. It is recognised that development plans for the Lea Valley area, parts of which have poor public transport links at present, interact with the level of train service improvement which can be provided and this is considered in the analysis. The RUS also recognises that local service improvements on the Lea Valley have potential to alleviate crowding on the Southbury Loop, given the close proximity between the two routes.

7.6.4 The following options therefore seek to respond to the capacity, connectivity and other strategic gaps on this corridor. The option definitions (and numbering) have been modified during the consultation phase, based on emerging information.

7.6.5 The first option tested focuses primarily on the forecast peak capacity gap, by means of running as many peak trains as operationally viable from the main West Anglia routes into London Liverpool Street. Extra paths are created by increased use of the route via Seven Sisters for outer suburban services, rather than just using the Tottenham Hale route.

Assessment of Option C1 – divert Hertford East services via Seven Sisters and run additional trains to Liverpool Street	
Concept	This option seeks to run two extra trains per peak hour from the main West Anglia routes to London Liverpool Street, whilst improving journey times for some main line passengers. It achieves this by diverting Hertford East line services from the Lea Valley (via Tottenham Hale) route to run via the Southbury Loop (via Seven Sisters) route, freeing up capacity on the former for additional trains from Broxbourne and faster main line journeys.
Infrastructure required	None.
Operational analysis	Timetable development work is ongoing at a detailed level, but this option is considered operationally viable.
Passenger impact	Diverting the Hertford East service via Seven Sisters would enable provision of a new peak 2tph Broxbourne to London Liverpool Street 8-car service via the Lea Valley route. This would provide capacity for approximately 1,600 passengers per peak hour on the Lea Valley/ Southbury Loop routes which is broadly sufficient to resolve the forecast peak capacity gap. Many longer distance trains would be accelerated, reducing journey times for many passengers. However diverting peak Hertford East services via Seven Sisters would involve a reduction in frequency at some stations on the Seven Sisters route. Stations in the lower Lea Valley would still only have a limited service, including a reduction to hourly frequencies in the peak at Angel Road.
Freight impact	No impact identified.
Financial and economic analysis	No analysis undertaken.
Link to other options	As a result of this Option the previously presented options have been withdrawn: • 12-car operations between Hertford East and London Liverpool Street, since this would be significantly harder to achieve with a re-routing via Seven Sisters • the Cheshunt to Seven Sisters peak shuttle, for which track capacity would not be available.
Conclusion	This option is operationally viable and is assumed for implementation in the December 2011 timetable.

7.6.6 The conclusion from the above is that the forecast peak capacity gap is broadly resolvable by a combination of main line train lengthening to 12-car and timetable changes under **Option C1**, neither of which requires major infrastructure interventions. Many main line platforms are being lengthened for 12-car capability in CP4, with the smaller stations anticipated as being progressed in subsequent Control Periods, although use of Selective Door Operation may be an alternative possibility. With 8-car formations being the maximum readily achievable in the suburban area some crowding problems may still exist, for which use of high density rolling stock may be necessary in the absence of further interventions.

7.6.7 However as discussed earlier, peak capacity cannot be considered in isolation from the wider potential options affecting the route. Subsequent options therefore consider increasing services beyond the approach outlined above, by considering a range of incremental infrastructure interventions on the Lea Valley line. These would not only alleviate crowding, but would also reduce journey times, improve connectivity to Stratford and in most cases provide a four trains per hour service at all Lea Valley stations, in response to stakeholder aspirations and linking in with regeneration plans for this area. However none of these options results in further additional trains on the route via Hackney Downs to London Liverpool Street, where capacity constraints would remain regardless of any infrastructure upgrade in the Lea Valley.

Assessment of Option C2a – run 4tph Lea Valley to Stratford service	
Concept	This option tests increasing frequencies to Stratford to 4tph (currently 2tph peak/1tph off-peak). Only minor infrastructure works have been considered under this option.
Infrastructure required	The timetable tested under this option was based around a new turnback facility at Brimsdown In addition, Northumberland Park level crossing would potentially need to be closed to accommodate the increased service frequency in this area. Level access for pedestrians would be provided to/from the footbridge. A power supply upgrade may be required to support the operations of the additional trains. The upgrade has a substantial capital cost attached to it, but provides benefits to many services, not just the additional 2tph in the option. Therefore a sensitivity test to include a 10% share of the power supply upgrade costs is also shown.
Operational analysis	This option is based around a Stratford destination for the additional trains, partly because no further additional trains to London Liverpool Street are operationally viable. Committed track layout changes at Stratford will allow up to 4tph to operate to/from that location solely utilising Platform 11, so minimising the interaction with the GEML as described under **Options D1 and D2** later. A timetable has been developed for a 4tph service to Stratford under this option, based on 2tph Brimsdown/1tph Broxbourne/1tph Hertford East, with varying calling patterns. However, with this infrastructure alone some outputs (such as calling patterns) will not be ideal. In particular not all stations in the Lower Lea valley would be able to receive a 4tph service at all times of the day, due to the constraint posed by the Lea Valley line still remaining as two tracks. Some stations would also have uneven intervals between trains. Furthmore, whilst a timetable has been developed by the RUS which would enable this level of service to operate with the infrastructure concerned, it has not at this stage been demonstrated to the satisfaction of industy stakeholders as operationally robust. Therefore a more detailed understanding of existing infrastructure capability would be required to confirm whether this option is capable of providing an acceptable level of timetable robustness.
Passenger impact	The extra trains to Stratford would improve connectivity to the Olympic Park area and the Docklands. The increased frequency north of Tottenham Hale would provide extra capacity to the critical load point and alleviate the peak crowding gap. Passengers for London Liverpool Street would be able to change trains at Tottenham Hale or Stratford. However, passengers using stations in the lower Lea Valley would only see limited benefits from this option. Whilst Northumberland Park and Angel Road would see major frequency improvements (compared to the existing infrequent service) there would not be a 4tph even interval service at all stations in both directions at all times.
Freight impact	No impact identified.

Financial and economic analysis	The following table outlines the appraisal results, based on implementation in 2016 .		
	60-year appraisal	**C2a Present value £m**	**C2a with power supply cost sensitivity Present value £m**
	Costs (present value)		
	Investment cost	25	35
	Operating cost	63	63
	Revenue	-30	-30
	Total costs	**58**	**67**
	Benefits (present value)		
	Rail users benefits	521	521
	Non users benefits	253	253
	Other Government impacts	-12	-12
	Total quantified benefits	**762**	**762**
	NPV	**704**	**694**
	Quantified BCR	**13.1**	**11.2**
	Note: All figures are presented in 2002 prices It should be noted that the demand models used in the analysis consider services in terms of their overall frequency, rather than a specific timetable. They are therefore unable to reflect the uneven service intervals at some stations under this option. As a result, the benefits shown above are likely to be slightly overstated. However, given the very strong BCR shown, it seems clear that, if operationally viable, this option would represent high value for money.		
Link to other options	This option should be considered in conjunction with implementation of **Option C1** and **Option D2**.		
Conclusion	This option is recommended for detailed development, with implementation before 2019 if it can be demonstrated to be operationally robust.		

Assessment of Option C2b – run 4tph Lea Valley to Stratford service, with 4tph at all stations	
Concept	This option also tests increasing frequencies to Stratford to 4tph, but in addition also provides a 4tph even interval frequency at most stations and a more robust timetable. It requires significantly more complex works than **Option C2a,** through three/four tracking of a significant section of the Lea Valley route.
Infrastructure required	The Lea Valley Line would have extra tracks and platforms added over an approximate 4½ mile length, of which approximately 2½ miles would be fully four-tracked to enable Stratford trains to pass in opposite directions. This infrastructure is shown in **Figure 7.2** • three-track from north of the disused Lea Bridge station through to south of Angel Road • four-track from south of Angel Road to north of Ponders End • three-track from north of Ponders End to Brimsdown • two additional platform faces at Angel Road and Ponders End, and one additional platform face at Tottenham Hale and Northumberland Park (all 8-car) • turnback platform at Brimsdown (8-car) • additional platforms to be connected to existing or new footbridges • close Northumberland Park level crossing and provide level access for pedestrians to/from the footbridge – road traffic would be rerouted. Additional power supply would be required to operate the increased level of service, though this is part of a wider issue. Therefore a sensitivity test to include a 10% share of the power supply upgrade costs is also shown.
Operational analysis	The 4tph Stratford service under this option would also be 2tph Brimsdown/1tph Broxbourne/1tph Hertford East, as in **Option C2a**. The additional tracks would enable the additional trains to stop at stations in the Lower Lea Valley, so all stations would be able to receive a 4tph service under this option, with better intervals between trains than under **Option C2a**. The timetable under this option would also be significantly more operationally robust.
Passenger impact	The extra trains to Stratford would improve connectivity to the Olympic Park area and the Docklands. The increased frequency north of Tottenham Hale would provide extra capacity to the critical load point and alleviate the peak crowding gap. Passengers for London Liverpool Street would be able to change trains at Tottenham Hale or Stratford. Stations up to Brimsdown would receive a 4tph all day service with good frequencies between trains, significantly improving train services in this area. Passengers from north of Cheshunt would benefit from faster journey times to London and reduced loadings, as these trains would call at fewer stations.
Freight impact	No impact identified.

Financial and economic analysis	The following table outlines the appraisal results, based on implementation in 2016.

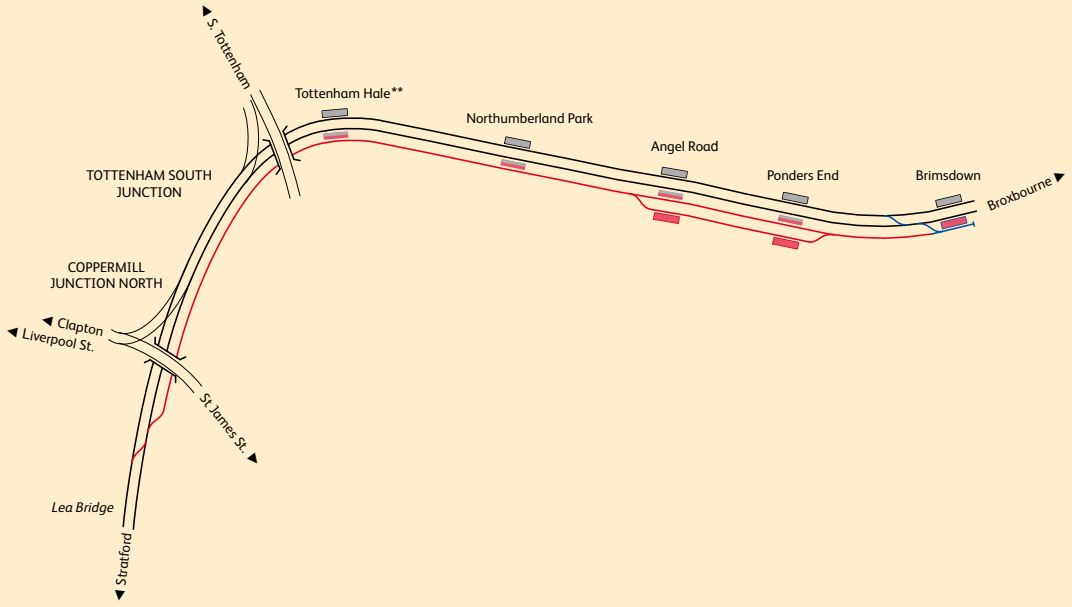
60-year appraisal	C2b Present value £m	C2b with power supply cost sensitivity Present value £m
Costs (present value)		
Investment cost	232	247
Operating cost	63	63
Revenue	-30	-30
Total costs	**265**	**280**
Benefits (present value)		
Rail users benefits	521	521
Non users benefits	253	253
Other Government impacts	-12	-12
Total quantified benefits	**762**	**762**
NPV	**497**	**4982**
Quantified BCR	**2.9**	**2.7**

Note: All figures are presented in 2002 Prices

The business case for this option is strong and it would represent high value for money, in the absense of other viable options to deliver similar outputs.

Link to other options	This option should be considered in conjunction with implementation of **Option C1** and **Option D2**.
Conclusion	This option cannot be recommended at present, since it requires significantly more expensive infrastructure than **Option C2a**, which also has potential to deliver a 4tph service to Stratford albeit with the uncertainties outlined earlier. However in the event of robust operations under **Option C2a** not being achievable without major infrastructure works than **Option C2b** would have a good value for money business case.

Figure 7.2 – Proposed Infrastructure for Option C2b



Note: Red indicates new infrastructure.

Assessment of Option C3 – run 6tph Lea Valley to Stratford service	
Concept	This option involves increasing service levels to Stratford from 4tph to 6tph, requiring an additional passing loop as an increment to the partial three/four tracking of the Lea Valley route considered in **Option C2b**. The service specification has been developed to avoid costly major infrastructure works at Tottenham Hale, where only one additional platform would be provided.
Infrastructure required	The Lea Valley line would have additional tracks and platforms added over an approximate 4½ mile length, of which up to 3½ miles would be fully four-tracked to enable Stratford trains to pass in opposite directions. This infrastructure is shown in **Figure 7.3**. Detailed development has identified that this level of service would require the following: • four tracks from north of the disused Lea Bridge station through to south of Tottenham Hale • three tracks and platforms at Tottenham Hale station • four tracks from north of Tottenham Hale station to south of Brimsdown (although a 3 track section through Angel Road station as shown in the diagram would be sufficient for normal operations so has been assumed in the costings) • one additional platform face at Tottenham Hale, one or two additional platform faces at Angel Road, two additional platform faces at Ponders End and Northumberland Park (all 8-car) • a new turnback platform at Brimsdown (8-car) • additional platforms to be connected to existing or new footbridges • close Northumberland Park level crossing and provide level access to/from footbridge – road traffic would be rerouted. Additional berthing on the West Anglia route may be required, though the infrastructure considered on the GEML under **Option D2** may be sufficient for both route corridors. Additional power supply would be required to operate the increased level of service. The upgrade has a substantial capital cost attached to it, but provides benefits to many services, not just the additional 4tph in the option. Therefore a sensitivity test to include a 10% share of the power supply upgrade costs is also shown.
Operational analysis	Building on **Options C2** the 6tph service would be 4tph Brimsdown/1tph Broxbourne/1tph Hertford East, with inner suburban stations seeing significant service improvements. A timetable has been developed around the constraint posed at Tottenham Hale, where only one additional platform would be provided. Committed track layout changes at Stratford will allow up to a 6tph West Anglia service to operate but, unlike a 4tph service, this would require use of both Platforms 11 and 12. This significantly complicates implementation of GEML **Option D2** later, since some empty stock movements from the GEML to the depot at Orient Way under that option would need to run via the High Meads Loop instead of through Stratford, interacting with North London Line services as a result. The total 6tph from the Lea Valley complicates **Option D2** significantly in this area, but is considered achievable.
Passenger impact	The additional extra trains to Stratford would further improve connectivity to the Olympic Park area and the Docklands. The increased frequency north of Tottenham Hale would provide further extra capacity to the critical load point and alleviate the peak crowding gap. Passengers for London Liverpool Street would be able to change trains at Tottenham Hale or Stratford. Stations up to Brimsdown would receive a 4tph all day service, significantly improving train frequencies in this area. Passengers from north of Cheshunt would benefit from faster journey times to London and reduced loadings, as these trains would call at fewer stations.
Freight impact	No impact identified.

Financial and economic analysis	The following table outlines the appraisal results as a standalone option and based on an increment on **Option C2a** and implementation in 2016.

60-year appraisal	C3 Present value £m	Incremental Present value £m
Costs (present value)		
Investment cost	256	230
Operating cost	145	82
Revenue	-32	-2
Total costs	**368**	**310**
Benefits (present value)		
Rail users benefits	690	169
Non users benefits	305	52
Other Government impacts	-13	-1
Total quantified benefits	**982**	**220**
NPV	**614**	**-90**
Quantified BCR	**2.7**	**0.7**

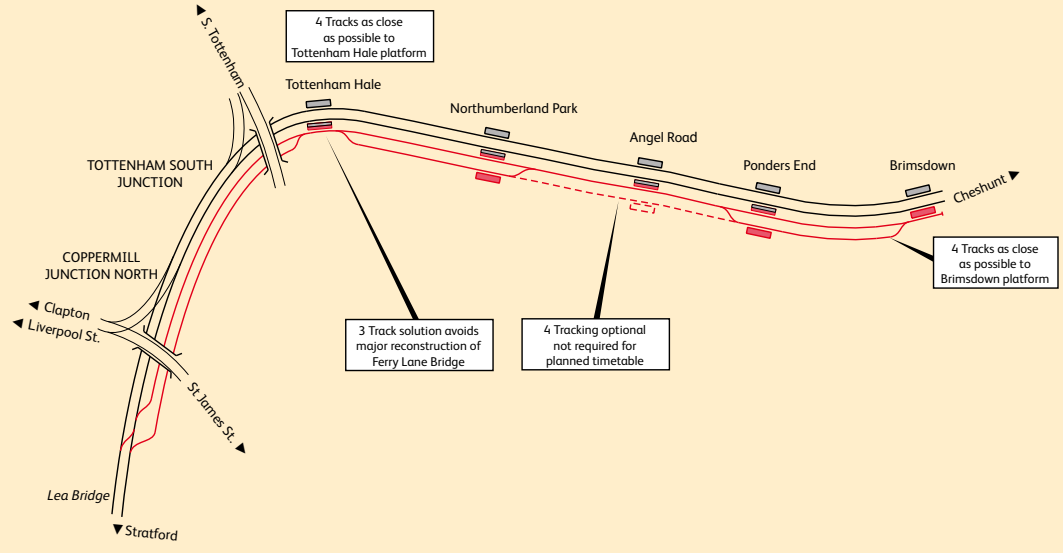
Note: All figures are presented in 2002 prices

The business case for this option is strong as a standalone scheme and it would represent high value for money. However this only applies in the event that **Option C2a** is not operationally viable, and if assessment of **Option C5** did not result in the Chingford route having a better case for two of the six paths to Stratford.

Furthermore, incremental analysis shows that a 4tph option achieves most of the benefits to passengers as the 6tph option so the recommendation of the RUS is for outputs to be prioritised on this basis.

Link to other options	This option should be considered in conjunction with implementation of **Option C1** and **Option D2**. Implementation of **Option C5** would not be possible, as an 8tph West Anglia total service to Stratford would prevent **Option D2**.
Conclusion	This option cannot be recommended at present, since it requires major infrastructure works for which the incremental case beyond **Option C2a/C2b** is unproven and there is insufficient evidence of a demand case for a 6tph Lea Valley service to Stratford. Furthermore implementation would prevent **Option C5** from the Chingford route. This conclusion should be kept under review.

Figure 7.3 – Proposed infrastructure for Option C3



Note: Red indicates new infrastructure.

Assessment of Option C4 – run 8tph Lea Valley to Stratford service	
Concept	This option describes full four tracking of the Lea Valley route which is a stakeholder aspiration as described in **Chapter 3**. The train service assumed builds on **Option C3** and provides a 8tph total service to Stratford. It would also provide a 4tph frequency at all stations and main line services would see further journey time improvements.
Operational analysis	Whilst, when considered in isolation, the committed track layout changes at Stratford would allow an 8tph West Anglia service to operate, the combined level of service between **Option C4** and **Option D2** in the Stratford/Orient Way area would not be operationally viable.
Infrastructure required	The Lea Valley Line would be four-tracked throughout. This would involve the following: • 4-tracking from north of Lea Bridge station through to Broxbourne station with a third track from Broxbourne station to Broxbourne Junction • two additional platform faces at Tottenham Hale (12-car), Northumberland Park (8-car), Angel Road (8-car), Ponders End (8-car), Brimsdown (8-car), Enfield Lock (8-car), Waltham Cross (8-car) and Cheshunt (12-car) • loop platforms at Broxbourne to be extended to 12-car (the through platforms are being extended to 12-car in CP4) • additional platforms to be connected by extending existing footbridges where they exist • close Northumberland Park level crossing and provide level access to/from footbridge – road traffic would be rerouted • close level crossings at Brimsdown, Enfield Lock, Trinity Lane, Windmill Lane and Wharf Road and replace with grade-separated crossings. Additional berthing on the West Anglia route may be required, though the infrastructure considered on the GEML under **Option D2** may be sufficient for both route corridors. Additional power supply would be required to operate the increased level of service.
Passenger impact	The extra trains to Stratford would further improve connectivity to the Olympic Park area and the Docklands, though a demand case has not been shown to exist for 8tph. The increased frequency north of Tottenham Hale would provide further extra capacity to the critical load point and alleviate the peak crowding gap. Passengers for London Liverpool Street would be able to change trains at Tottenham Hale or Stratford. Stations up to Brimsdown would receive a 4tph all day service, significantly improving train frequencies in this area. Passengers from north of Cheshunt would benefit from faster journey times to London and reduced loadings, as these trains would call at fewer stations.
Freight impact	No impact identified.
Financial and economic analysis	The capital cost of the full four tracking scheme is estimated to exceed £700 million. Given that this option prevents resolution of the Great Eastern Main Line capacity gap (by **Option D2**) and there does not appear to be demand for an 8tph service to Stratford no economic appraisal has been undertaken.
Link to other options	This option is not considered consistent with implementation of **Option D2**, due to the need for Great Eastern empty stock workings in the Stratford area to Orient Way depot.
Conclusion	This option is not recommended as it is not required by demand and an 8tph Stratford service would prevent resolution of the GEML capacity gap.

7.6.8 The economically preferred way forward from the previous page appears to be for a four trains per hour Lea Valley to Stratford service in CP5, through implementation of **Option C2a**. However with that infrastructure alone some outputs (such as calling patterns) may not be ideal, so futher development is required. If more extension works are needed by means of **Option C2b** the business case would still be strong, but affordability constraints will be more of a factor. Additional trains on the route also requires that power supply constraints in the area be resolved as part of a wider issue, though if triggered by the West Anglia route alone this would represent a significant extra cost.

7.6.9 It is conceivable that further work may prove the case for a three/four-tracking scheme south of Brimsdown, facilitating journey time improvements, better performance and a train every fifteen minutes in both directions at all stations. This partial four-tracking scheme would then deliver the majority of the benefits of the full four-tracking (ie with four platforms at Tottenham Hale and with extra tracks continuing north of Brimsdown) but at significantly lower capital cost. It is also emphasised that any infrastructure solution in this area must be consistent as far as possible with potential future full four-tracking of the route.

7.6.10 In addition to the Lea Valley analysis above the RUS also recognises that aspirations exist to provide additional services (which would be to Stratford) on the Chingford corridor. However at present, indications are that development of the main Lea Valley corridor train service would provide a higher level of benefits and to a wider area than additional trains to Chingford, so the former are considered the higher priority. It is also emphasised that there might eventually be demand for a Lea Valley to Stratford frequency of six trains per hour under **Option C3**, which requires only marginally more infrastructure south of Brimsdown than if **Option C2b** were required. This level of service would utilise all the available capacity at Stratford whilst still being consistent with **Option D2**, so would not be possible if a Chingford to Stratford service was also in operation. This analysis for the Chingford corridor is discussed further in **Option C5** below.

Assessment of Option C5 – run 2tph Chingford to Stratford service	
Concept	This option involves construction of a new 'Hall Farm curve' near Clapton station to enable a Chingford to Stratford service.
Operational analysis	This option would enable new services to Stratford from the Chingford route. At Stratford issues would be similar to those discussed under **Option C2a/C2b, C3** or **C4**, depending on the service level.
Infrastructure required	A new chord would be required to connect the Chingford line towards Stratford.
Passenger impact	The Chingford line would receive a new service to Stratford, providing a frequency increase and new connectivity to the Olympic Park area and the Docklands. Passengers from the Chingford route not travelling to Stratford, but instead interchanging with the London Underground Victoria Line at Walthamstow Central for Central London, would also gain through an increase from a 4tph to a 6tph service.
Freight impact	No impact identified.
Financial and economic analysis	The capital cost of the Hall Farm Curve scheme is estimated at £36million. Whilst Chingford to Stratford options have local merits the RUS considers that they would provide passenger benefits over a significantly smaller area than Lea Valley route to Stratford service options. As a result no economic appraisal has been undertaken at present, pending further analysis regarding there eventually being a demand case for a **Option C3** (6tph Lea Valley to Stratford service).
Link to other options	The conclusion from **Option C3** was that a 6tph West Anglia to Stratford service is the maximum achievable without preventing resolution of the peak capacity gap on the Great Eastern route. As a result a 2tph Chingford to Stratford service is consistent with a 4tph Lea Valley to Stratford service (**Options C2a** or **C2b**) but not with a 6tph Lea Valley to Stratford service (**Option C3**).
Conclusion	Due to the benefits of the Lea Valley to Stratford options affecting a wider area this option is not recommended at present. Further consideration is recommended in the light of emerging demand levels for new Lea Valley to Stratford services.

7.6.11 Given that none of the previous page options have identified additional trains to London Liverpool Street from the West Anglia route, the RUS has also tested running the additional Stratford trains in **Options C2** to **C4** through to London Liverpool Street, utilising platform capacity freed up following the Crossrail scheme and infrastructure changes considered later on the GEML.

Assessment of Option C6 – extend West Anglia to Stratford services through to London Liverpool Street off-peak	
Concept	This option tests extending services beyond Stratford to London Liverpool Street, utilising GEML capacity released following Crossrail and infrastructure changes considered later under **Option D2**.
Operational analysis	This option is not operationally viable at peak times, in a manner consistent with resolution of Gap D. However the RUS considers this option potentially worthy of further development with respect to the off-peak. During the off-peak this would involve: • extending up to 4tph West Anglia via Stratford services over the Temple Mills lines as far as Bow Junction where they would then join the main lines. At Stratford these trains would generally need to use Platform 12, to avoid conflicting with the down GEML stopping trains through Platform 10A • some current GEML trains being rerouted onto the electric lines in the Bow Junction area to the west of the planned Crossrail tunnel portal as described under **Option D2** later • all existing Electric line trains in the off-peak being rerouted into the Crossrail tunnels as planned.
Infrastructure required	The infrastructure changes proposed under **Option D2** are necessary to facilitate this option in the off-peak.
Passenger impact	This option would improve the frequency from the West Anglia route to London Liverpool Street during the off-peak, with some services routed via Hackney Downs and other services routed via Stratford. This would enable passengers at all West Anglia stations to receive regular services to London Liverpool Street for most of the day.
Freight impact	There are potentially significant interactions with freight traffic to and from the North London Line immediately west of Stratford. An acceptable timetable solution, which might depend on the wider freight routeing strategy described in **Chapter 9**, would therefore be required.
Financial and economic analysis	No appraisal undertaken. This option provides additional benefits which would add to the case presented later for **Option D2**.
Link to other options	**Option D2** is required to facilitate this option. There is a significant linkage with respect to the choice of which, if any, of **Options C2 – C5** are implemented, as that determines the quantum of trains operating from the Lea Valley to Stratford. The RUS anticipates no more than 4tph being extended to London Liverpool Street, so trains would still need to terminate at Stratford in the off-peak if **Option C3** or **Option C4** were implemented.
Conclusion	Recommended for further consideration.

7.6.12 Finally the RUS notes that the West Anglia corridor may be an eventual destination for trains using a potential variant of the safeguarded Crossrail line 2 route, as described later in **Section 8.4**. Connection of the West Anglia route to such a tunnel through Central London would remove the London terminal capacity constraint, so would enable far more additional trains to run on the West Anglia route. The possible four-tracking scheme should therefore be considered in this context in the longer term. This is the only option identified in this RUS for a significant increase in the peak service level to Central London from West Anglia routes (rather than to Stratford).

7.6.13 Following the RUS Network Rail anticipates further development to confirm viability and, if appropriate, seek funding for the Brimsdown turnback scheme, potentially with other minor works, in CP5, to facilitate **Option C2a**.

7.7 Gap D: Great Eastern Main Line

7.7.1 **Table 7.2** forecasts a significant crowding problem on GEML outer services, with 5,100 additional seats in the busiest peak hour highlighted as being needed by 2031. Assuming that the Greater Anglia RUS recommendations (to replace the current Anglia Intercity rolling stock with EMUs, run an additional train in the high-peak hour and operate all trains with 12-car formations) are implemented this shortfall would reduce but would still be a major challenge at 3,000 seats in the busiest peak hour. This would be spread between the main corridor via Chelmsford and the Southend Victoria route.

7.7.2 The following section provides analysis regarding how to respond to this gap, building on the previous recommendations described on the previous page. The aim is to increase main line service levels from today's 23 trains in the busiest hour (24 trains if previous RUS recommendations are implemented in full) to a future 28 trains, utilising capacity at London Liverpool Street freed up by the implementation of the Crossrail Programme.

7.7.3 Significant development has taken place since the Draft for Consultation and option definitions and numbering have therefore been updated in the analysis below.

Assessment of Option D1 – increase GEML outer services into London Liverpool Street to 28tph with existing infrastructure	
Concept	This option would progressively increase the GEML service level up to 28tph at peak times, based on existing infrastructure. All these trains would use the same track from Shenfield to London Liverpool Street, except at Stratford where Platforms 9, 10 and 10A allow two platforms to be available in the peak direction.
Operational analysis	Analysis regarding this option has focussed on the Stratford to London Liverpool Street section, with operation of 28tph a major challenge in this area, especially given the need for increasing services calling at Stratford in response to significant passenger demand to the Olympic Park and Docklands. 28tph operations are considered viable east of Stratford, based on 2 minute signalling headways. At Stratford traffic on the Up Main line could diverge to use Platforms 9 and 10 at Stratford alternately (platforms 10 and 10A in the evening peak) However, all 28 trains would also need to use one track between Stratford and at least Bow Junction, with trains taking longer to clear signal sections in this lower speed area than east of Stratford. This reconverging would result in any trains having extended dwells at Stratford quickly impacting on following services and would also result in significant levels of conflict between trains around the London terminal. The RUS considers that a service level above 24tph is unlikely to be operationally robust at such a critical location.
Infrastructure required	None.
Passenger impact	Option not viable, so not applicable.
Freight impact	Option not viable, so not applicable.
Financial and economic analysis	Option not viable, so not applicable.
Link to other options	Option not viable, so not applicable.
Conclusion	Service increases above 24tph are not considered operationally viable without infrastructure changes, so this option is not recommended.

Assessment of Option D2 – increase GEML outer services into London Liverpool Street to 28tph with track layout remodelling at Bow Junction and elsewhere	
Concept	This option would progressively increase the GEML service level up to 28tph at peak times. All these trains would use the same track from Shenfield to Stratford (exclusive), from where two independent main lines would be available in the peak direction to London Liverpool Street.
Operational analysis	There are a number of key constraints to consider: • as described in **Option D1** above a 28tph service would put significant pressure on the main lines over the Shenfield – Stratford section. However as no trains would call between these two stations (each of which will have two platforms available for use in the peak direction), this level of service is considered achievable and is actually slightly less than that already achieved at London Charing Cross, which also has a two-track section on its approaches • under this proposal the 28tph morning peak main line service would split into two independent routes before Stratford station as follows (similar arrangements would apply in the evening peak) • just under half of the trains would run via Stratford Platform 9 and the existing Up Main line, crossing to the Up Electric line after the Crossrail tunnel portal (where they would merge with the residual stopping service), finally using Platforms 13-15 at London Liverpool Street • the remainder of the trains would run via Stratford Platform 10 and a new Reversible Main line leading to the existing Up Main line, finally using platforms 8-12 at London Liverpool Street • Empty Coaching Stock (ECS) moves (needed to clear platforms for further arrivals at London Liverpool Street) would only have one main line platform available at Stratford (10A in the morning/9 in the evening), so additional ECS moves would be needed via the Temple Mills Lines on the West Anglia route to the Orient Way depot area. A potential site has been identified for seven new sidings between Temple Mills Junction and Coppermill North Junction on the west side of the railway to provide additional stabling facilities • finally, existing infrastructure away from London cannot accommodate turnback arrangements for a 28tph service. Additional infrastructure has therefore been assumed as described below. The above constraints have been assessed in detail and this option is considered operationally viable, subject to the new infrastructure being provided.
Infrastructure required	**Figure 7.4** illustrates the changes in the Bow Junction/Stratford area. This work would have significant synergies with Crossrail construction works in this area, so implementation is likely to be best undertaken before 2018. The concept is based on upgrading the existing Up & Down Temple Mills lines for passenger use, together with providing two new and one upgraded crossover between tracks in the Bow Junction area. This would provide two independent peak direction main line routes between Stratford and London Liverpool Street (shown in blue). Additional changes would be needed for improved country end turnbacks. Chelmsford and Wickford have been assumed in the analysis but other alternatives exist. Additional berthing capacity in the vicinity of Orient Way depot would be required for the extra trains.
Passenger impact	By the early 2020s a 26tph peak direction service would provide significant frequency benefits to many stations, and additional peak capacity at a level broadly sufficient to resolve the gap at that stage. Increasing peak frequencies further to 28tph by 2031 would provide sufficient capacity to the end of the RUS period.
Freight impact	None identified, as the additional trains would operate at peak times only. The existing route between the North London Line and the Great Eastern Main Line would remain unaffected by the above track layout changes.

Financial and economic analysis

The capital cost of this scheme comprises the following:

- Bow Junction changes (£16.62m)
- High Meads new sidings (£15.86m)
- turnback infrastructure at Chelmsford East (£3.87m)
- turnback infrastructure at Wickford (£0.83m)

TOTAL £37.2 million in 2011 prices.

The operational costs to run 9 additional trains over the peak 3 hours, in the morning and evening peaks are included. It is assumed that 3 additional 12-car trains are leased.

The following table outlines the appraisal results, based on implementation of the infrastructure by 2019, with services increased to 26tph in 2024. Any improvements to train performance arising from the increased flexibility on the approaches to London Liverpool Street have not been included.

35-year appraisal	**Present value £m**
Costs (present value)	
Investment cost	41.9
Operating cost	71.2
Revenue	-33.7
Total costs	**79.5**
Benefits (present value)	
Rail users benefits	140.1
Non users benefits	22.9
Other Government impacts	-6.6
Total quantified benefits	**156.3**
NPV	**76.9**
Quantified BCR	**2.0**

Note: All figures are presented in 2002 market prices

This option represents high value for money.

Link to other options

This option does not appear to be compatible with **Option C4**, given the need for Empty Coaching Stock (ECS) moves away from London Liverpool Street to Orient Way depot. This would not be possible with an 8tph Lea Valley to Stratford service using both Platforms 11 and 12 at Stratford and in operation in the vicinity of Orient Way.

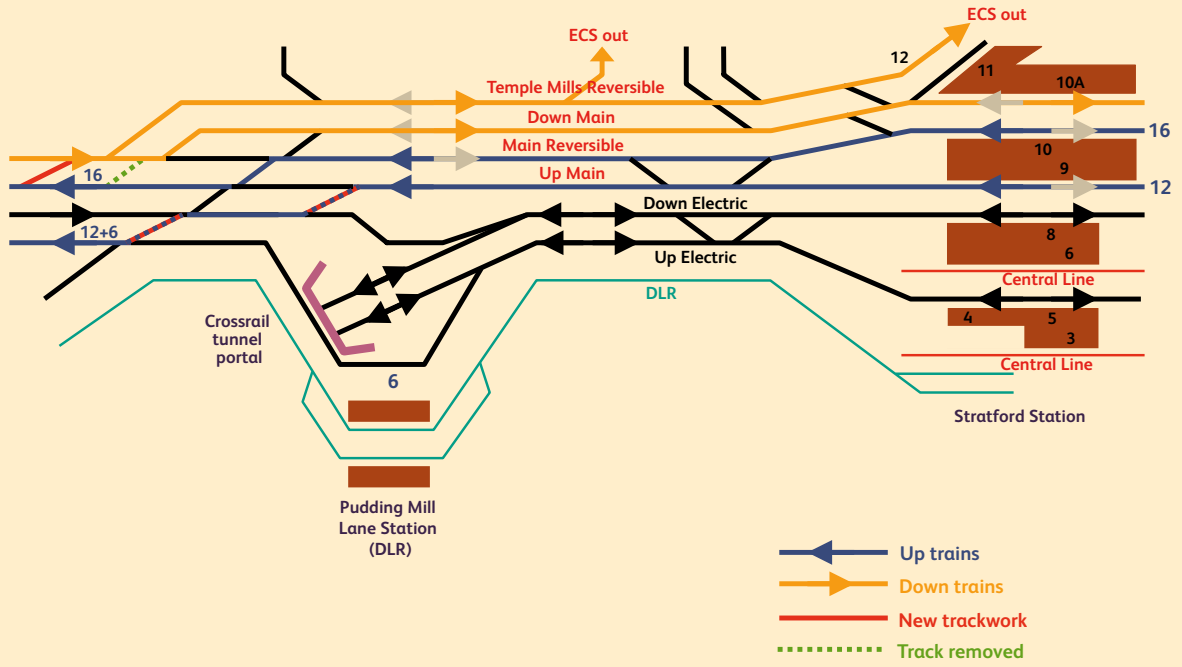
For the same reason, it is not compatible with a combination of **Option C3** and **Option C5**, since that would also be an 8tph service.

There would still be interaction with a 6tph service to Stratford, but this is considered achievable, subject to the ECS strategy being optimised with new sidings as described above. A 6tph West Anglia service is potentially deliverable using solely Platform 11 at Stratford (so ECS could use Platform 12) and fewer trains overall would be in operation in the vicinity of Orient Way.

Conclusion

This option is recommended.

Figure 7.4 – Bow Junction Proposed Infrastructure: Morning Peak Usage



7.7.4 From the above the principal recommendation for GEML capacity is a remodelling scheme in the Bow Junction area to enable additional trains to run, with 28 main line services operating in the busiest hours by 2031. This would build on increasing 12-car operations and rolling stock replacement on the route. Various ancillary works are required, principally turnback infrastructure and depot capacity.

7.7.5 Following the RUS Network Rail anticipates seeking funding for the Bow Junction remodelling scheme and associated works in CP5.

7.8 Gap E: Brighton Main Line and suburban area

7.8.1 **Table 7.2** forecasts crowding on Brighton Main Line (BML) services, even following completion of the Thameslink Programme and implementation of all other previous RUS recommendations. Standing on the BML at present occurs over long distances, for example Haywards Heath to London, a journey time well over the 20 minutes normally considered appropriate by industry planning rules, so the RUS has sought to identify an economically viable way of fully addressing this.

7.8.2 Many stakeholders expressed concern that the Draft for Consultation had not recommended a scheme to fully resolve BML crowding in the short or medium term. Further analysis has therefore taken place focusing on identifying the size of the BML gap which can be expected to remain following committed schemes and other previous recommendations. The forecast busiest hour gap in 2031 is some 3,000 shortfall in capacity to London Victoria.

7.8.3 The RUS emphasises that the Thameslink Programme in particular will provide additional BML on-train capacity, with the design of the new-build Thameslink rolling stock being more spacious than vehicles currently in use. Thameslink will also significantly improve journey opportunities from the BML into central London, with BML to Thameslink trains no longer needing to use the slow route through Herne Hill at peak times. The number of peak trains running into/via London Bridge in the busiest hour from East Croydon is expected to increase from today's 11 to 18. Development work on the post-Thameslink timetable is also seeking to improve services to London Victoria, for example increasing peak services from the Redhill line to this terminal from today's three to four trains in the busiest hour.

7.8.4 Additionally in the short term the RUS emphasises the importance of achieving all practical train lengthening on the BML and branches to provide significant extra capacity in comparison to today. **Table 7.2** indicates schemes to enable all Sussex outer trains to run at full length.

Table 7.2 – Sussex route train lengthening (previous recommendations)	
Brighton Main Line to Thameslink route services	Platform lengthening to 12-car currently in progress at London Blackfriars, Farringdon and on the Midland Main Line. Once these works are complete 12-car operations will be possible.
Uckfield line	Train lengthening previously recommended by the Sussex RUS, based on 10-car 23m diesel vehicles (or 12-car 20m electric vehicles if an electrification scheme were to be implemented, though neither electrification nor additional double track sections are required to facilitate train lengthening alone).
East Grinstead line	Platform lengthening to 12-car currently in progress
Caterham/Tattenham Corner lines (joining at Purley)	12-car previously recommended by the Sussex RUS (interim stage in CP5 likely to be based on 10-car)

7.8.5 The RUS considers that the above strategy will provide significant levels of further capacity for the route and represents a robust way forward. This approach will build on the relatively recent implementation of the Brighton Main Line RUS in the December 2008 timetable which has resulted in significant reductions in standing. Beyond existing strategy the only further option considered as a potentially viable means of providing further capacity over the longer term in the Draft for Consultation was **Option E3**, which would involve a new tunnel from outer London to alleviate the critical section of the BML through East Croydon. This option remains a potential eventual requirement for the long term, though it is not considered necessary within the RUS period to 2031. The other BML options presented in the Draft for Consultation have been withdrawn, as have other options such as double-deck trains or trains longer than 12-car (for reasons similar to those discussed under Gap F below).

7.8.6 Finally the Draft for Consultation carried forward the previous recommendation from the Sussex RUS for calling certain morning peak Brighton/Gatwick Express services at Clapham Junction. Aviation stakeholders expressed concern with this recommendation during the consultation period, however it was widely supported by other groups, and such a service change would remove the 114 minute gap in direct Brighton to Clapham Junction journey opportunities which currently exists and benefit the many passengers who are seeking to make such trips. The RUS also notes that further timetable interventions may become appropriate in future to better balance services with demand.

7.8.7 In the inner suburban area further train lengthening from 10-car to 12-car, as recommended by the South London RUS, could at some stage be required to alleviate crowding on the Sydenham route (on which the future gap is uncertain, and sensitive to the modelling assumption) and possibly routes via Balham. In the short term implementing robust 10-car operations on these is an immediate priority and will provide significant crowding relief. **Option I4** later provides a further means of tackling issues on the Sydenham route.

7.9 Gap F: South West Main Line

7.9.1 **Table 7.2** forecasts significant peak crowding on South West Main Line (SWML) outer trains, with a capacity shortfall of over 6,100 passengers in the high-peak hour even if every main line train is at maximum length.

7.9.2 The RUS has not automatically carried forward the recommendation from the SWML RUS for 12-car inner suburban operations, given that this scheme is now considered to be very high capital cost and the modelled gap is on fast trains rather than inner suburban stopping services. Stakeholders expressed concern with this conclusion during the consultation, so the RUS restates that 12-car remains the appropriate solution in a high growth scenario, but it cannot be recommended at present. The priority for Network Rail's CP4 is therefore the committed implementation of 10-car operations, which includes passive provision for 12-car where practical. **Option F1** restates the potential 12-car scheme for the longer term.

Assessment of Option F1 – implement 12-car SWML inner suburban operations	
Concept	This option would involve 12-car trains, generally with extended platforms, moving beyond the 10-car lengthening planned in CP4.
Operational analysis	12-car trains may involve longer turnarounds at terminal stations and increased junction margin times. Increased turnaround times may increase the number of platforms required for suburban services at London Waterloo, with a likely impact on main line platform arrangements.
Infrastructure required	Platform extensions from 10-car to 12-car would be required throughout the SWML suburban network. However selective door operation may be utilised at certain difficult sites. London Waterloo station would need to be completely rebuilt, due to physical obstructions preventing lengthening of Platforms 1-4 beyond 10-car. This would be an extremely complex, disruptive and expensive scheme and could only be contemplated at the time of signalling renewal.
Passenger impact	Significant capacity for extra passengers would be provided in the high-peak on inner services, further alleviating crowding and accommodating growth beyond the committed 10-car scheme. However no extra capacity would be provided for outer suburban passengers which is where the forecast gap lies.
Freight impact	None anticipated.
Financial and economic analysis	Not undertaken. However given the envisaged high cost and the modelling not currently forecasting a gap this is likely to be poor value for money.
Link to other options	None identified.
Conclusion	Not recommended at present since the forecast capacity gap is on outer services which is a problem which would not be solved by this scheme. However this conclusion should be kept under review.

7.9.3 The RUS analysis indicates that lengthening all fast and semi-fast services will be a priority once the 10-car scheme for stopping trains is implemented. **Table 7.3** indicates schemes to enable all SWML fast line trains to run at full length. These are considered as priorities by the RUS but the magnitude of the reduced gap remains such that further interventions will still be required.

Table 7.3 – South West Main Line train lengthening (previous recommendations)	
Guildford via Cobham line (semi-fast services)	Train lengthening to 12-car equivalent previously recommended by the SWML RUS
Salisbury line	Train lengthening previously recommended by the SWML RUS, based on lengthening of more trains to 10-car 23m diesel trains (or 12-car electric vehicles if an electrification scheme proceeded, though neither electrification nor additional double track sections are required to facilitate train lengthening alone).

7.9.4 As a result of the significant gap forecast to remain even if the above are implemented the RUS has now considered five larger scale options in detail. This has been influenced by stakeholder feedback received as a result of the consultation, with concerns expressed that the Draft for Consultation did not identify a viable way forward for capacity on the route.

7.9.5 **Option F2** involves double-deck trains and further work has identified that this is potentially achievable at high cost for a small number of services, but such an approach would result in significant operational complexities and is not capable of providing sufficient additional capacity.

Assessment of Option F2 – run double-deck trains on SWML outer services	
Concept	This option would involve running double-deck trains on Southampton/Portsmouth to London Waterloo routes.
Operational analysis	This would create the need for a dedicated sub-fleet for the services concerned, which would be a new operational constraint. Double-deck trains will require increased station dwell times. Only services making a relatively small number of station calls are therefore considered suitable for double-deck operations, to avoid impacting on route capacity.
Infrastructure required	Extensive gauging works would be required, including through all the tunnels on the route.
Passenger impact	The RUS anticipates that an extra 2,100 peak hour seats would be possible on a total of 11 identified main line services into London Waterloo. This would reduce standing to a certain degree. Careful design would be needed in the design of any double-deck unit to avoid disbenefits. This would include factors such as access for the disabled and personal security issues, given the reduced sightlines through the train.
Freight impact	Gauging works for double-deck vehicles are likely to have synergies with enabling higher and wider freight containers to operate.
Financial and economic analysis	No appraisal has been carried out.
Link to other options	None.
Conclusion	This option is not capable of providing enough additional capacity to come close to resolving the forecast gap. Due to the anticipated high cost and failure to address the gap this option is not recommended.

7.9.6 **Option F3** involves running significantly longer domestic trains than those in operation anywhere else on the UK network into the former International Platforms at Waterloo. However, again this also involves major operational restrictions in where such trains could commence from and call at, it requires complex grade separation works in the Clapham Junction area for the SWML to pass over or under the Windsor lines approaches to London Waterloo and is also not capable of providing sufficient additional capacity.

Assessment of Option F3 – run 16-car trains on SWML outer suburban services into London Waterloo International	
Concept	This option would involve running 16-car trains into London Waterloo International from SWML destinations.
Operational analysis	A flat crossing move into London Waterloo International would be impractical from the SWML, since the 16-car platforms are only readily accessible from the Windsor lines. The option therefore requires additional grade separation. Trains would most likely run as two eight-car trains joining at a location such as Woking or Basingstoke from separate origin points. Such splitting and joining would significantly increase operational complexity. Junction margins would increase at locations throughout the route, due to the low speeds and the length of a 16-car train, which would be a new operational constraint.
Infrastructure required	This would require a new two-track flyover in the Clapham Junction area to take the SWML tracks across to the north side of the railway corridor. Major remodelling at Queenstown Road would also be required. In addition 16-car platforms would be required at a location such as Woking or Basingstoke. This would involve extensive signalling and track layout changes.
Passenger impact	The RUS anticipates that an extra 2,600 peak hour seats would be possible on a total of 11 identified main line services into London Waterloo. This would reduce standing to a certain degree. However there would be significant disbenefits during the major construction works on the London Waterloo approaches and with the timetable changes which would be necessary (for example additional journey times due to the splitting and joining of trains on route).
Freight impact	Dependent on infrastructure solution.
Financial and economic analysis	No appraisal has been carried out.
Link to other options	None.
Conclusion	This option is not capable of providing enough additional capacity to come close to resolving the forecast gap. Due to the anticipated high cost and failure to address the gap this option is not recommended.

7.9.7 **Option F4** would involve increased peak service frequency through an additional four trains per hour from a location such as Basingstoke. The option tested would involve significantly increasing the intensity of services on the London Waterloo station approaches and potentially requires the grade separation of Woking Junction.

Assessment of Option F4 – run 28tph on the South West Main Line into London Waterloo with infrastructure enhancements at key pinchpoints	
Concept	This option would involve running additional trains in the high peak into London Waterloo, increasing the SWML peak service from 24tph to 28tph on the existing fast lines from Surbiton inwards.
Operational analysis	This level of service can theoretically be accommodated within existing signal headways on the SWML, but key constraints such as London Waterloo (station approaches and platform lengths), Woking Junction and Basingstoke may require enhancement, though this depends on the specific service specification. In addition Queenstown Road constrains the removal of mainline empty stock from London Waterloo during the morning peak and may require remodelling. Even if all the above were resolved stakeholders have indicated during the consultation that operating this level of service on the SWML would have a severely detrimental effect on train performance, since it is reliant on removing existing 'firebreak paths' in the timetable. These are unused timetable slots, designed to avoid a late running train from delaying large numbers of other services behind them. The critical issue relates to the need for a 28tph service over the Up Main Line between Surbiton and London Waterloo. Future signalling systems could potentially allow this level of service if the key pinchpoints were resolved, but significant further development would be required to confirm this.
Infrastructure required	The following infrastructure may assist with this option: • use of enhanced signalling technology to allow trains to operate closer together • remodelling of London Waterloo station throat and approaches, increasing the number of parallel movements and 12-car capable platforms • grade separation of Woking Junction • additional infrastructure to allow further services to start at Basingstoke • alterations to the layout at Queenstown Road and re-introduction of Platform 1 (if not already delivered by **Option G2** beforehand) In addition as mitigation for the removal of the existing firebreak paths from the timetable, the lines from Clapham Junction to London Waterloo could be reconfigured to allow for a reversible Main Fast line in addition to the two current main fast lines, improving the robustness of Waterloo operations.
Passenger impact	Approximately 3,200 extra seats would be provided. This would only provide approximately 50 per cent of the capacity required to resolve the gap.
Freight impact	No impact identified.
Financial and economic analysis	No appraisal has been undertaken as the option has not been shown to be operationally viable.
Link to other options	The alterations to Queenstown Road required for this option will also be required for **Option G2** (increasing the service level on the Windsor lines to 18tph).
Conclusion	This option has not at present been shown to be operationally viable and it would not fully address the gap to 2031 in any event. However the infrastructure it considers would provide a significant interim step, including more robust operations until such a time that further additional capacity could be provided, therefore it could be implemented progressively as renewals, included new signalling technologies, become due.

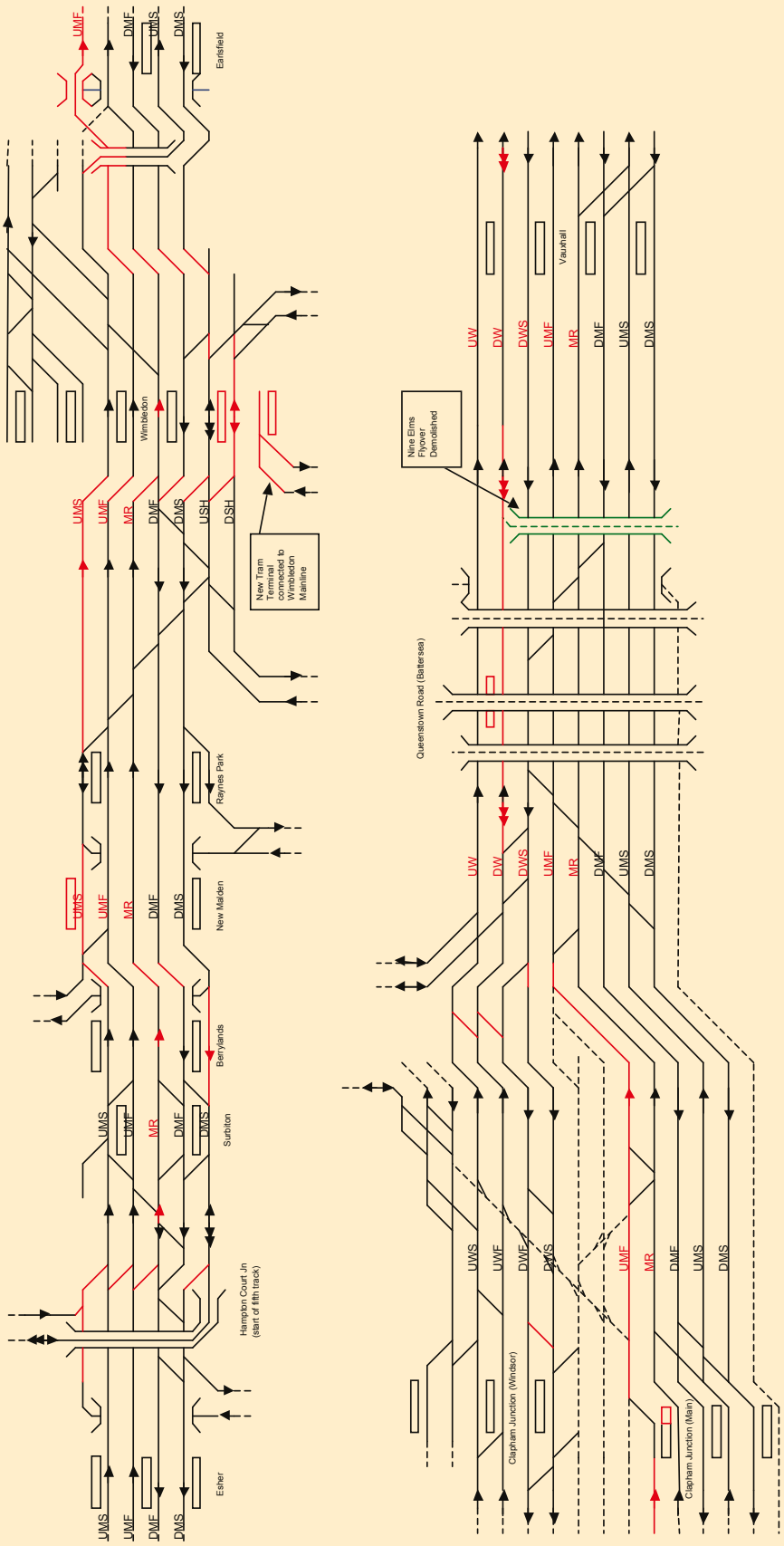
7.9.8 **Option F4** has not been confirmed to be operationally viable for the 28 trains in the busiest hour as tested, partly given current uncertainties with respect to new signalling technologies. In addition in the long term it would not provide enough additional infrastructure to enable the number of extra trains on the route as a whole needed to fully resolve the forecast gap. It would, however, be a significant interim step. Further consideration of this partial solution for SWML route capacity is recommended as part of future resignalling schemes on the route.

7.9.9 The key to fully solving SWML route capacity is creating an ability to run more fast trains between Woking and London Waterloo. One way of doing this would be for trains currently

crossing from the slow to the fast lines at Surbiton to remain on a separate track, enabling additional trains from beyond Woking to take their place. **Option F5** further develops the infrastructure from **Option F4** to facilitate removal of such crossing moves by providing an additional main line track from Surbiton into London Waterloo. This would enable a significantly increased level of service to operate over the critical London approaches. Such a proposal involves major work, but is considered to be potentially possible in the future mostly within the existing railway boundary as outlined below.

Assessment of Option F5 – run 32tph or more on the South West Main Line into London Waterloo with infrastructure enhancements at key pinchpoints and provision of five tracks between Hampton Court Junction and Clapham Junction	
Concept	This option would involve running additional trains in the high peak into London Waterloo, increasing the SWML peak service from 24tph to 32tph or more on two separate peak direction fast lines from Surbiton inwards.
Operational analysis	This option would remove the capacity constraints at London Waterloo (station approaches and platform lengths), Waterloo – Surbiton (numbers of trains using the existing fast lines), Woking Junction, Queenstown Road and Basingstoke. As a result a significant increase in train operations on the SWML is likely to be viable.
Infrastructure required	The following infrastructure would be required: • an additional track from Surbiton to Clapham Junction • reconfiguration of Clapham Junction to London Waterloo to provide a reversible main fast line (achieved by conversion of one of the Windsor line tracks) • remodelling of London Waterloo station throat and approaches, increasing the number of parallel movements and 12-car capable platforms, with all existing platforms being needed • grade separation of Woking Junction • additional infrastructure to allow further services to start at Basingstoke • alterations to the layout at Queenstown Road and reintroduction of Platform 1 (if not already delivered by Option G2 beforehand). This is shown in **Figure 7.5**
Passenger impact	Assuming an extra eight trains are operated then an extra 6,400 seats would be provided in the busiest peak hour, which is sufficient capacity to address the gap. The track layout changes arising from this option may allow certain trains to call at Clapham Junction at peak times, though further consideration is required. There could be journey time savings for off-peak passengers as up direction trains calling at Clapham Junction would no longer be slowed by approach-controlled signalling.
Freight impact	No impact anticipated as freight does not generally run in the peak.
Financial and economic analysis	The cost of this option is estimated at £1.0 billion at 2011 prices. No economic appraisal has been undertaken at this stage.
Link to other options	None
Conclusion	This option potentially represents a physically viable way forward to address the gap. However significant work is required to confirm economic viability. Further development of this option is recommended. In the meantime protection from development of the land requirements along the route corridor and at London Waterloo station (where all platforms would be needed) is recommended.

Figure 7.5 – proposed track layout for Option F5



Notes:
Remodelling also required on the London Waterloo approaches.
Red indicates new infrastructure.

7.9.10 The RUS has also considered diverting some SWML demand onto the GWML. This has some synergy with **Option A5** as considered earlier. It is considered further under **Option F6** below.

Assessment of Option F6 – run peak services from Basingstoke into London Paddington via Reading	
Concept	This option would involve starting some of the 20tph peak main line service from Reading to London Paddington under **Option A5** as a new Basingstoke – Reading – London Paddington service.
Operational analysis	Subject to implementation of **Option A5**, Basingstoke is considered a viable origin point for some of the 20 main line paths in the busiest peak hour.
Infrastructure required	The Basingstoke to Reading line would need to be electrified.
Passenger impact	This option would enable **Option A5** to provide some capacity relief to the SWML as well as the GWML. However given the slightly increased journey times (when compared to using the SWML direct route from Basingstoke to London Waterloo) such trains may only be used by a relatively small proportion of passengers. The option has potential to reduce SWML loadings to a small degree, but would not resolve the 2031 capacity gap.
Freight impact	Southampton to Midlands/North traffic operates via the Reading – Basingstoke route, so electrification of this section for passenger services would move towards electrifying the main freight route between Southampton and the North.
Financial and economic analysis	No analysis undertaken.
Link to other options	This option requires implementation of **Option A5** and associated changes to Crossrail/ Heathrow Express.
Conclusion	The limited potential passenger demand, and likely cost of electrification, suggests that this option is unlikely to have a good standalone business case. However in the event that the route was electrified this would then be a tactical intervention which may postpone the need for major changes on the SWML itself by a small duration. Further developement is therefore recommended if done in conjuction with a future scheme to electrify the Basingstoke to Reading line for other reasons.

7.9.11 From the above analysis of **Options F1-F6** the RUS concludes that there is no simple solution to SWML route capacity, with major enhancements required over a 12 mile section approaching London, not just at key pinchpoints. The fifth track from Surbiton inwards is a potential long term solution, but it has not been robustly confirmed to be viable at this stage. An alternative approach is discussed in **Option F7** below, by providing a six track approach to London from at least as far out as Raynes Park by means of a new tunnelled alignment for stopping services, as a potential variant to the safeguarded Crossrail line 2 scheme. Such an approach would involve major infrastructure works and is unlikely to occur until the end of the RUS period at earliest.

Assessment of Option F7 – utilise Crossrail line 2 (Chelsea – Hackney Line) as a means of solving SWML capacity issues	
Concept	This option would effectively create a six-track SWML from Raynes Park/Surbiton, with two tracks for inner suburban services being in a new underground tunnel extending beyond Wimbledon.
Operational analysis	A six track approach to Central London would enable additional main line and suburban trains to run. Semi-fast trains currently switching from the slow to fast lines in the Surbiton area would remain on the existing slow lines and run semi-fast (probably calling at Wimbledon and Clapham Junction only). This would in turn enable additional fast line trains to run using the capacity freed up on those tracks. Some suburban services would use the new route to Central London via Victoria, potentially at increased frequency.
Infrastructure required	The safeguarded tunnel under Central London, extended out to at least beyond Wimbledon via Clapham Junction would be needed. Once on the surface further additional tracks, potentially to Surbiton would be needed. Further details are provided in **Chapter 8**.
Passenger impact	Significant new journey opportunities would be provided and congestion on the route would be extensively reduced.
Freight impact	None identified.
Financial and economic analysis	The Crossrail line 2 project would be a multi-billion pound scheme. Analysis of the strategic business case for the project is ongoing, led by TfL.
Link to other options	None identified.
Conclusion	Further development work is recommended in the medium term.

7.9.12 The high cost of fully resolving the capacity gap (by whatever means) suggests the SWML should be a priority in exploring the extent to which demand management techniques, such as the use of smartcard ticketing and differential pricing of season tickets, could reduce demand in the high peak. A detailed review will then be required regarding whether the full solution of providing additional tracks is appropriate, given the high capital costs involved.

7.9.13 The **Option F7** approach of utilising the Crossrail line 2 alignment to alleviate the SWML is discussed further in **Section 8.4**.

7.10 Gap G: Windsor lines

7.10.1 **Table 7.2** identified a small peak capacity on the Windsor lines. This includes the additional train planned under the High Level Output Specification (increasing from today's 15 to 16 trains in the busiest hour upon reopening of the former international platforms at Waterloo), and further 10-car operations throughout the route to Reading. However modelling suggests that this additional capacity would primarily alleviate existing suppressed demand, with the extra capacity likely to fill up quickly, so further interventions may also be justifiable.

7.10.2 Significant further development work has taken place since publication of the Draft for Consultation, with two different options now developed for a timetable recast to achieve 18 trains in the busiest peak hour. The principal differences are that **Option G1** would be a peak increment only whilst **Option G2** would be an all day increase of two trains per hour, this being linked to a potential new service to Heathrow Airport as considered under **Option J1**. However shortly after the Draft for Consultation was published it was announced that the Transport and Works Act (TWA) application for the BAA Heathrow Airtrack scheme is not now proceeding in the near future, so no further work is anticipated on the latter option at present.

7.10.3 In both cases the additional peak trains would be routed via the Hounslow loop to free up capacity via Richmond and in response to stakeholder concerns regarding increasing level crossing downtimes on that corridor. Detailed analysis is presented below.

Assessment of Option G1 – increase service levels to 18tph at peak times on the Windsor lines	
Concept	This option tests increasing service frequencies with an 18tph service on the Windsor Lines at peak times. No off-peak increase would be provided.
Operational analysis	Timetable development work has identified that this increase is viable, following the reopening of the former International Platforms at London Waterloo. The additional terminal capacity would enable SWML main line trains to be held at London Waterloo until after the peak, before proceeding to Clapham Yard (these currently make this move via the Windsor lines in the main part of the peak). This therefore facilitates a peak time service increase on the Windsor lines. The additional services would run via the Hounslow Loop. Detailed timetable development has been undertaken and this option is considered viable.
Infrastructure required	This requires the disused international platforms at London Waterloo to be recommissioned, as planned in CP4. No further infrastructure requirements have been identified.
Passenger impact	This option would provide additional capacity and improved journey opportunities throughout the route.
Freight impact	Freight does not generally run in the peak so there would be no impact.
Financial and economic analysis	No analysis undertaken at this stage.
Link to other options	None.
Conclusion	This option will be operationally viable (upon completion of works to bring the disused platforms at Waterloo back into use), so further consideration of train service options is recommended.

Assessment of Option G2 – increase service levels to 18tph at peak times, with a 2tph all day additional service to Staines/Heathrow Airport	
Concept	This option tests increasing service frequencies with an 18tph service on the Windsor Lines at peak times. Off-peak services would be increased by 2tph.
Operational analysis	Timetable development work had identified that this increase was viable, following the reopening of the former international platforms at London Waterloo. However additional infrastructure at Queenstown Road is required. This is because SWML main line trains would no longer be able to be held at London Waterloo until after the peak before proceeding to Clapham Yard, due to the increased off-peak quantum of trains on the Windsor lines. The additional services would run via the Hounslow Loop at peak times. Detailed timetable development has been undertaken and this option is considered viable.
Infrastructure required	• This requires the disused international platforms at London Waterloo to be recommissioned, as planned in CP4. • Platform 1 at Queenstown Road would need to be reopened, together with various track layout changes in the area to allow two peak direction tracks at Queenstown Road in both the morning and evening peaks.
Passenger impact	This option would provide additional capacity and improved journey opportunities throughout the route. The increased off-peak service would allow a 2tph service to Heathrow Terminal 5 if a new connection were provided from the Windsor Lines to the airport.
Freight impact	Whilst freight does not generally run in the peak additional trains at off-peak times would reduce opportunities for freight paths, including those from Kent to the route via Acton Central (principally those destined for the Midland Main Line and to/from the SWML).
Financial and economic analysis	No analysis undertaking at this stage.
Link to other options	This option would build further on **Option G1**.
Conclusion	No further work is anticipated, given that the BAA Heathrow Airtrack scheme is not proceeding.

7.10.4 **Option G1** above is forecast to provide sufficient capacity to respond to the gap. However, in a high demand scenario **Option G3** would provide further capacity through 12-car capability on the route.

Assessment of Option G3 – implement 12-car operations on the Windsor lines	
Concept	This option would involve running 12-car trains, generally with extended platforms, moving beyond the 10-car lengthening mostly planned in CP4.
Operational analysis	12-car trains may involve longer turnarounds at terminal stations, increased junction margin times and could increase the times that certain level crossings are closed to road traffic. Kingston loop trains could not be extended beyond 10-car due to platform lengths on the Wimbledon corridor, unless **Option F1** was also implemented.
Infrastructure required	Platform extensions from 10-car to 12-car would be required throughout the route, which would be a major undertaking. However, Selective Door Operation could potentially be utilised at a small number of difficult sites.
Passenger impact	Capacity for 20 per cent extra passengers would be provided on the lengthened trains, alleviating crowding.
Freight impact	None anticipated.
Financial and economic analysis	No analysis undertaken at present, given that **Option G1** would resolve the forecast gap.
Link to other options	None.
Conclusion	This option does not appear to be required to bridge the gap under current forecasts, but this conclusion should be kept under review.

7.10.5 The conclusion from the above is that additional peak trains on the Windsor Lines are viable following the reopening of the former International Platforms at Waterloo, with a service increment from 15 to 18 trains possible in the busiest hour. This would resolve the forecast peak capacity gap, subject to fully implementing 10-car operations throughout the route. This has not been subject to an economic appraisal at this stage, so further work will be needed to confirm a value-for-money business case.

7.10.6 Stakeholders have indicated that 12-car operations are potentially needed in a high growth scenario in the longer term, for which passive provision is recommended. Off-peak service increments are not anticipated at a strategically significant level, given that the BAA Heathrow Airtrack scheme is not now proceeding in the near future.

7.10.7 **Option G4** in the Draft for Consultation considered reconfiguring the London Waterloo – Barnes Junction section to provide two tracks via Richmond and two tracks via Hounslow on the Waterloo approaches, rather than mostly two up and two down tracks at present (except through Queenstown Road). This specific variant was not favoured by industry stakeholders during the consultation so has not been considered further in detail, but the RUS advises that a future Waterloo resignalling scheme may give the opportunity for four fully bidirectional tracks over this route section, significantly improving operational flexibility and maintenance access.

7.10.8 **Option J3** in **Chapter 8** provides an alternative means of improving access between Heathrow Airport and the Windsor Lines, by means of a Crossrail extension to Staines.

7.11 Gap H: Elephant & Castle corridor

7.11.1 **Table 7.2** identified that there will be standing in crowded conditions on the Elephant & Castle corridor, principally on services running via Herne Hill.

7.11.2 The following option seeks to bridge this gap.

Assessment of Option H1 – implement 9, 10 or 12-car operations on the Wimbledon Loop	
Concept	Following completion of the Thameslink Programme the RUS anticipates the following service: • 4tph via Tulse Hill to the Blackfriars bay platforms • 8tph via Tulse Hill to London Bridge. This service pattern reflects the operational constraints identified in the South London RUS, with crossing moves from the Herne Hill lines to the Thameslink tracks in the Elephant & Castle area not considered viable. This option would involve lengthening these trains to provide additional capacity.
Operational analysis	Limited impact identified although longer trains may involve longer turnarounds at terminal stations and increased junction margin times.
Infrastructure required	Platform extensions across the route would be required. The principal difficulties include the need for major works at Tulse Hill, Herne Hill and Elephant & Castle. Whilst in theory Selective Door Operation could be utilised, it is unlikely to be operationally practical to implement this approach at all of these, given the train loadings so close to Central London. This scheme therefore requires complex additional infrastructure.
Passenger impact	Significant extra capacity would be provided in response to the gap.
Freight impact	No impact identified.
Financial and economic analysis	No economic analysis undertaken, however given the envisaged high cost and other ways of responding to the gap this is likely to be poor value for money.
Link to other options	None.
Conclusion	This option cannot be recommended at present due to the significant complexity (and therefore cost) involved in extending platforms beyond eight-car. However this conclusion should be kept under review.

7.11.3 The conclusion from the above is that the Elephant & Castle corridor would need a complex infrastructure scheme to provide additional seats on trains using the route. However, such a scheme would be disruptive to implement and it is unlikely at present that it would have a viable business case.

7.11.4 As an alternative the use of higher density rolling stock, similar to the Class 378 vehicles used by London Overground, may be more appropriate on this route given the relatively short duration of journeys involved. The RUS recommends further consideration in the future should loadings on this route dictate.

7.12 Gap I: Orbital routes

7.12.1 **Table 7.2** identified that, without further interventions, there would continue to be a significant and increasing peak capacity gap on orbital routes. The capacity gap applies to many routes avoiding Central London, though the Draft for Consultation focused primarily on the West London Line (WLL).

7.12.2 One of the more immediate capacity challenges at present appears to be the service between the WCML and WLL in the morning peak, given that this generally hourly service forms the only link between the Watford Junction and Kensington Olympia corridors. **Option I1** considers medium term timetable changes in response to this issue, investigated in more detail during the consultation period.

Assessment of Option I1 – increase West London Line – Watford Junction (or beyond) peak service to 2tph	
Concept	This option would increase the present service from the Watford Junction route to the WLL to a train every 30 minutes.
Operational analysis	The main consideration is the compatibility between timings on the WCML and those on the WLL, with further issues including the operational viability of turnbacks at Watford Junction and/or Milton Keynes Central. Further analysis has now identified that a 2tph peak service between the two routes is likely to be viable, but that this requires additional dual-voltage rolling stock and a recast of either route, most likely the WLL. As a result this service is not deliverable at the present time, but can be expected to be achievable following the completion of work on the Thameslink Programme, when additional dual voltage vehicles will be freed up and a recast of all services south of London (including through workings onto the WLL) will become necessary in any case.
Infrastructure required	None required.
Passenger impact	The Watford Junction – Kensington Olympia route suffers from a morning peak gap in frequency at present, e.g. at Wembley Central (for example) between 07:49 and 09:05 which leads to severe overcrowding. This option would reduce the gap to 30 minutes which would significantly reduce crowding.
Freight impact	No impact identified.
Financial and economic analysis	No economic analysis has been undertaken at this stage. However, given the current levels of crowding, and suppressed demand thought to exist at present the RUS considers that there is likely to be good case for this service in the event of the rolling stock being available.
Link to other options	None identified.
Conclusion	The RUS recommends detailed investigation of this option as sufficient dual voltage rolling stock becomes available upon the completion of work on the Thameslink Programme.

7.12.3 The above option would add a single 4-car service per peak hour to the north end of the WLL route, providing major connectivity improvements for passengers from north of Willesden Junction. However it would only marginally add to capacity overall and would not resolve the significant crowding issues at the Clapham Junction end of the route. **Option I2** therefore considers a complementary step.

Assessment of Option I2 – lengthen Southern WLL services to 8-car		
Concept	This option would length Southern services on the WLL from four-car to eight-car. These services operate Croydon/Clapham Junction – Shepherd's Bush/Milton Keynes Central.	
Operational analysis	No impact identified south of London or on the WLL itself. On the WCML the bay platform (2A) at Milton Keynes Central is only four-car in length. Certain WLL services in the evening utilise this platform and cannot readily be replatformed due to London Midland services using Platform 2. If lengthened to 8-car these services will need to be turned at Bletchley instead.	
Infrastructure required	Platform extensions at Clapham Junction, Imperial Wharf, West Brompton and Shepherds Bush.	
Passenger impact	Additional capacity through lengthened services would be provided. A small number of direct links between Milton Keynes Central and the WLL may potentially be lost, though this is subject to detailed timetable development.	
Freight impact	No impact anticipated.	
Financial and economic analysis	The following table outlines the appraisal results.	
	60-year appraisal	**Present value £m**
	Costs (present value)	
	Investment cost	22.4
	Operating cost	72.1
	Revenue	-26.2
	Total costs	**68.3**
	Benefits (present value)	
	Rail users benefits	105.7
	Non users benefits	50.7
	Other Government impacts	-5.2
	Total quantified benefits	**151.2**
	NPV	**82.8**
	Quantified BCR	**2.2**
	Note: All figures are presented in 2002 prices This option represents high value for money.	
	The analysis above does not include implementation of **Option I1**. However given the significant demand growth on orbital flows (and **Option I1** not addressing loadings at the Clapham Junction end) the RUS considers that there will be a demand case for both options.	
Link to other options	Given the need for dual voltage rolling stock (except for Clapham Junction – Shepherds Bush workings) full implementation is likely to be linked to the introduction of new Thameslink vehicles and the associated rolling stock cascade.	
Conclusion	This option is recommended as soon as the rolling stock becomes available.	

7.12.4 The conclusion from the above is that the principal recommendation for CP5 is for eight-car Southern operations on the WLL. This would provide a step-change in capacity and respond to demand generators such as the anticipated redevelopment of the Earls Court area. This scheme would also help with one-off peak loadings on the route, for example Christmas shopping at the Westfield shopping centre and Chelsea football matches, though additional shuttles for such events are also a possibility. Also anticipated in the medium term are timetable changes to provide a 30 minute peak frequency from the WCML to the WLL as detailed on **Option I1**, though further work is required on the timetable recast necessary to achieve this.

7.12.5 On orbital routes generally the RUS notes significant ongoing demand growth over recent years and this can be expected to continue. Given that increasing service frequencies is unlikely to be operationally viable on these lines, which are also heavily used for freight, further train lengthening is therefore likely to be required, as considered further under **Option I3**, **Option I4** and **Option I5**.

Assessment of Option I3 – lengthen London Overground services (West and North London Line routes) to six-car		
Concept	This option would lengthen Class 378 London Overground services on the West and North London Lines from 4-car to 6-car.	
Operational analysis	No impact identified.	
Infrastructure required	Significant platform lengthening works would be required on the NLL, building on the recent implementation of 4-car operations. Extensions would be required at most stations, including associated works such as bridgeworks at certain locations. The most complex sites are at Gospel Oak, Kentish Town West and Camden Road (where there is a significant interaction and synergy with works for the proposed HS1 – HS2 link). On the WLL this option requires infrastructure from **Option I2**, plus additional work in Platform 1 at Clapham Junction.	
Passenger impact	This scheme would provide a 50 per cent capacity increase, alleviating crowding.	
Freight impact	No impact identified.	
Financial and economic analysis	Analysis has shown a high value for money case for a package comprising this option, together with additional services on the WLL, as shown below.	
	60-year appraisal	**Present value £m**
	Costs (present value)	
	Investment cost	90
	Operating cost	423
	Revenue	-112
	Total costs	**401**
	Benefits (present value)	
	Rail users benefits	1,251
	Non users benefits	825
	Other Government impacts	-42
	Total quantified benefits	**2,034**
	NPV	**1,633**
	Quantified BCR	**5.1**
	Note: All figures are presented in 2002 prices. The package including this option represents high value for money.	
Link to other options	Platform extensions to eight-car on the WLL would also be provided by **Option I2**.	
Conclusion	Recommended, subject to confirmation of the business case for this option as a standalone intervention.	

Assessment of Option I4 – lengthen London Overground services (East London Line route) to five-car		
Concept	This option would lengthen Class 378 London Overground services on the East London Line from 4-car to 5-car. It seeks to respond to the crowding gap on the Sydenham line, either as an alternative to, or as well as, 12-car inner suburban operations into London Bridge.	
Operational analysis	This option is still considered significantly easier to implement than other ways of responding to the Sydenham line gap, which would require 12-car operations or more trains on the route.	
Infrastructure required	Minor works would be required at certain stations. Selective Door Operation (SDO) would be required at Canada Water, given that platform extensions at this underground location are impractical.	
Passenger impact	This scheme would provide a 25 per cent capacity increase, alleviating crowding.	
Freight impact	No impact.	
Financial and economic analysis	Analysis has shown a value for money case a package consisting of this option together with some additional services on the ELL.	
	60-year appraisal	**Present value £m**
	Costs (present value)	
	Investment cost	58
	Operating cost	225
	Revenue	-34
	Total costs	**249**
	Benefits (present value)	
	Rail users benefits	661
	Non users benefits	254
	Other Government impacts	-11
	Total quantified benefits	**904**
	NPV	**655**
	Quantified BCR	**3.6**
	Note: All figures are presented in 2002 prices. The package including this option represents high value for money.	
Link to other options	This option is considered to be complementary to the alternative approach of implementing 12-car operations on the Sydenham to London Bridge route. However in a high demand scenario it is possible that there may be a case for both options.	
Conclusion	Recommended, subject to confirmation of the business case for this option as a standalone intervention and confirmation of viability of SDO at Canada Water.	

7.12.6 On the Sydenham line **Option I4** represents an alternative, and potentially simpler, means of resolving the forecast gap from **Table 7.2** without implementing 12-car operations. On this route the RUS also notes that a London Overground service increment of two additional trains per hour over the Crystal Palace – Dalston Junction section might possibly be operationally viable at some stage in the future. However, given the significant interaction between such services and the post-Thameslink timetable structure of all services via Sydenham, on which significant development work is still in progress, this cannot be confirmed at present so no further analysis has been undertaken.

Assessment of Option I5 – lengthen London Overground services (Gospel Oak – Barking line) to three-car or four-car	
Concept	This option would involve longer trains on the Gospel Oak – Barking line. This could potentially involve Class 378 trains following electrification, but longer diesel trains would also provide similar additional capacity.
Operational analysis	No impact identified.
Infrastructure required	Relatively minor modifications to platform equipment would be required. The only significant works would be at South Tottenham station, where track layout changes would be required to facilitate the platform lengthening.
Passenger impact	This scheme would provide a 50 or 100 per cent capacity increase, alleviating crowding.
Freight impact	No impact identified.
Financial and economic analysis	Analysis shows significant benefits from crowding relief and generated revenue, indicating a high value for money case for train lengthening. Given that costs of diesel and electric multiple units vary, and that electrification brings wider benefits, the strength of the economic case will depend on the wider strategy for this route.
Link to other options	The rolling stock type to implement this option would depend on whether the route was electrified. From a passenger capacity perspective, either diesel or electric vehicles could be utilised. Electrification of the route was recommended by the Network RUS: Electrification Strategy.
Conclusion	Recommended for further development, either as a standalone lengthening scheme or in conjunction with electrification.

7.12.7 The above options for lengthening of London Overground's orbital routes are recommended by the RUS (subject to confirmation of the business cases for the options as standalone interventions).

7.12.8 In the longer term it is likely that a new interchange station being provided to the HS2 route and Crossrail in the Old Oak Common area would lead to significant demand from both the North and West London Lines to this area. Demand on orbital routes in the Willesden Junction/Old Oak Common area therefore needs to be considered in the context of a major interchange station, similar to that now experienced at Stratford to the east. The RUS therefore recommends further analysis, focusing on improving access from existing corridors to Old Oak Common in general as discussed in **Chapter 8**.

7.13 Summary

7.13.1 This chapter has developed a strategy for providing sufficient peak capacity for each of the main lines, at a route corridor level, up to 2031, into and around London. Based on current demand forecasts it has identified that the forecast gaps are capable of being broadly resolved on this basis, though the RUS has not considered individual train loadings. Given that some stakeholders have suggested that the growth forecasts may be conservative, the RUS notes that in a high demand scenario the same interventions would apply, though they would be required earlier than outlined herein.

7.13.2 The strategy includes the following stages:

- implementing currently committed schemes. This includes the Thameslink and Crossrail Programmes, a significant train lengthening programme in the London suburbs, the Intercity Express Programme and a small number of additional services. Many of these schemes indirectly affect other routes, for example Thameslink facilitates service improvements on routes such as the Hertford Loop and frees up EMUs for use in the Thames Valley
- implementing uncommitted recommendations from previous RUSs. This primarily involves further train lengthening, for example on Kent routes via London Bridge. Additional rolling stock, beyond current commitments, is likely to be required to implement all such interventions. In addition, some tactical-level interventions from previous RUSs have also not yet been implemented, for example inserting Clapham Junction calls in some morning peak Gatwick Express services
- construction of a new High Speed 'Y' network, resolving the north-south capacity gaps on the WCML, ECML and MML

- new interventions from this London and South East RUS. This includes the following:
  - extending services from the Crossrail tunnels to Reading, together with other GWML service changes which appear likely to become necessary due to the forecast commuter growth from the Thames Valley. Subject to further analysis this would include running extra peak Reading/outer Thames Valley trains to London Paddington (20 main line arrivals via Reading in the 08:00 – 08:59 period) and running all Heathrow Airport services through the Crossrail tunnels (10 Crossrail trains per hour to Heathrow Airport, rather than 4 Crossrail and 4 Heathrow Express as currently planned)
  - West Anglia service changes, with the principal aim of running a Lea Valley local service every fifteen minutes to Stratford at an affordable capital cost but in a manner consistent with improvements in journey times to the West Anglia Main Line
  - Great Eastern service changes: running approximately four extra outer suburban to London Liverpool Street trains in each peak hour, using the capacity freed up following Crossrail, a proposed Bow Junction remodelling scheme and other infrastructure work
  - additional trains on the Windsor Lines, building on the reopening of the international platforms at London Waterloo with a 18tph peak service should demand dictate
  - longer trains on all orbital routes.
- a significantly more complex scheme to resolve the key remaining strategic level peak capacity gap beyond the above, which is forecast by this RUS to be on the SWML. The emerging approach to fully resolve the gap in the long term is either through tunnelling or for a 5-tracking scheme from the Surbiton area to Clapham Junction, with major remodelling all the way into to London Waterloo. Alternatively advanced signalling technologies might enable a partial capacity solution on this route, in conjunction with more affordable incremental infrastructure upgrades at key locations. Given the high cost of fully resolving the gap, the SWML should be a priority in exploring the extent to which high peak demand could be reduced by demand management measures, for example through utilising smartcard ticketing technology to allow regular commuters to benefit from lower fares if travelling on less busy trains or less than five days per week.

7.13.3 **Chapter 10** provides indicative timings with respect to the above.

8. Potential new lines

8.1 Introduction

8.1.1 **Chapter 7** developed a strategy for alleviating future crowding on the existing rail network, by providing additional on-train capacity for Central London commuters in the morning and evening weekday peak periods. On the majority of routes this approach would be sufficient to resolve the forecast capacity gap, subject to demand not growing at a rate exceeding that anticipated by this Route Utilisation Strategy (RUS).

8.1.2 However the conclusion of this RUS and previous studies is that on certain key main lines the existing rail network cannot realistically be developed through additional rolling stock, timetable changes and/or enhanced infrastructure in a manner sufficient to keep up with the forecast growth in demand. This primarily relates to north south capacity, which Government strategy for a new High Speed Rail network is now designed to address. The RUS also concludes that capacity on the South West Main Line is a long term strategic concern, for which new routes may offer a potential solution if the five track proposal between Surbiton and Waterloo from **Option F5** detailed in **Chapter 7** cannot be implemented. There are also major more local capacity issues in many parts of the capital on both the National Rail and London Underground systems, for which a multi-modal considered solution is required.

8.1.3 This chapter moves beyond responding to the demand being forecast on the existing network, by looking at strategic level connectivity gaps to key locations which are the major drivers of demand for travel. The RUS has not sought to identify or consider all potential schemes in this category, but focuses on key themes such as improving access to Heathrow Airport, future development of the Crossrail network and updating the understanding of other schemes already covered by existing Department for Transport (DfT) or Mayor of London strategies.

8.2 Gap J – access to Heathrow Airport

8.2.1 The first gap identified, for which new lines might be appropriate, has been access by rail to the UK's busiest airport at Heathrow. Based on the existing network and committed schemes only, the airport will be accessible directly by rail by means of the following:

- four trains per hour Heathrow Express non-stop service from London Paddington
- four trains per hour Crossrail stopping service via Central London by 2018
- London Underground Piccadilly Line service via Central London.

8.2.2 In addition to the above there are extensive bus services from Heathrow Airport. Many of these are local in nature but several are of strategic importance to rail passengers. The main ones of relevance to this RUS are:

- RailAir coach link from Reading, providing connections to Great Western Main Line (GWML) services
- RailAir coach link from Woking, providing connections to South West Main Line (SWML) services
- local bus to stations served by stopping trains on the GWML, including Maidenhead, Slough and Hayes & Harlington
- bus links from Watford, providing connections to West Coast Main Line (WCML) services, though few long distance trains currently call at this location
- local buses from Feltham, providing connections to services via Richmond and providing an alternative to travel via Central London from much of South London
- bus links from High Wycombe, providing connections to the Chiltern route.

8.2.3 For longer distance passengers there is currently an extensive coach network between Heathrow Airport and towns and cities throughout the country. The extensive nature of this network is almost certainly at least in part due to the difficulty in accessing the airport by rail from certain directions.

8.2.4 However it is recognised that buses are low capacity and relatively unpopular with passengers to and from airports, especially where they form part of a journey principally made by rail. For this reason the RUS considers the following to be strategic level connectivity gaps, from directions other than Central London, at Heathrow Airport:

- lack of rail connectivity between Heathrow Airport and the SWML from Woking and beyond
- lack of rail connectivity between Heathrow Airport and the GWML from the West, principally at Reading but also including stations such as Slough and Maidenhead
- lack of rail connectivity between Heathrow Airport and the Windsor lines, especially from the Richmond/Clapham Junction direction
- lack of rail connectivity between Heathrow Airport and cities in the Midlands, northern England and Scotland.

8.2.5 **Table 8.1** summarises new line options to Heathrow Airport responding to the above:

Table 8.1 – potential new lines to Heathrow Airport

Option	Scheme	Service and demand issues	Status
J1	BAA Heathrow Airtrack scheme	Would allow direct services from Heathrow to Reading via Ascot, Guildford via Woking and Waterloo via Staines.	Transport and Works Act not currently proceeding. No further work therefore anticipated in the near future.
J2	Heathrow Airport Western connection (north)	Would enable up to 4tph Crossrail services to be extended to Reading via Slough.	Recommended for detailed consideration.
J3	Heathrow Airport Western connection (south)	Would enable up to 4tph Crossrail services to be extended to Staines.	Recommended for detailed consideration, as an alternative to **Option J1**.
J4	New High Speed Rail station complex serving Heathrow Airport directly	Would link Heathrow Airport to the proposed High Speed Rail network.	The Government's proposed High Speed Rail strategy includes a new station at Heathrow Airport, to be provided when the High Speed Rail network extends to Manchester and Leeds.

8.2.6 **Options J1** and **J2** represent long-standing opportunities to improve local connectivity to Heathrow Airport, with the principal aim of increasing the public transport modal share to the airport and decongesting local roads. However, no further work is anticipated in the immediate future on **Option J1** as the BAA Heathrow Airtrack Transport and Works Act application has now been withdrawn. **Option J3** is therefore presented as a potential incremental step in improving airport connectivity to South West London. This option also has the benefit of avoiding the need for passengers to have to change trains at Heathrow Terminal 5 and it would also effectively create a Staines branch of the GWML which would be operable entirely separately to the Windsor Lines.

8.2.7 The combination of **Option J2** and **J3** would enable all the eight trains per hour at Heathrow Terminal 5 (arising from **Option A5** in **Chapter 7**) to be extended westwards, greatly improving connectivity to the airport and making this a through station. The RUS strongly supports this concept and recommends further development of the detailed business case for a Heathrow western connection, with routes to both the GWML and Windsor lines. This further analysis will need to be undertaken jointly between the DfT, the railway industry, BAA and local stakeholders in this area.

8.2.8 The RUS is aware that **Option J4** has significant stakeholder support, but detailed analysis suggests that, if included from the outset, it would substantially increase the costs and reduce the benefits of the initial London – Birmingham phase of the High Speed Rail scheme. Government strategy is therefore that the station at Heathrow Airport should be built when the High Speed Rail network is extended to Manchester and Leeds.

8.2.9 Lack of rail connectivity to Central London is also a strategic gap, particularly from certain Heathrow terminals. The Piccadilly Line does not provide a high quality travel experience in the way that is more achievable with main line vehicles and only four Crossrail trains per hour are currently planned to Heathrow, in addition to four Heathrow Express trains. **Option A5** is therefore also of relevance to the connectivity gap, since as well as responding to the GWML peak capacity gap this option would also result in all terminals at Heathrow Airport being served by Crossrail, rather than a choice needing to be made between the Terminal 4 and Terminal 5 routes. In addition Heathrow Airport would be served by ten trains per hour from Crossrail Central London stations rather than the currently planned four. At peak times all of these would run skip-stop from Paddington station, with the increased frequency significantly reducing typical journey times for a passenger turning up at a central London Crossrail station – though this would not be the case for those travelling from around the Paddington station area. In addition both eastern branches of Crossrail would see direct trains to Heathrow Airport, enabling both Canary Wharf and Stratford to see such trains rather than a choice needing to be made between these two as alternatives.

8.2.10 Finally **Option K1** below is also relevant to this gap, providing improved connections to Heathrow Airport from the WCML.

8.2.11 Implementation of all the above would provide significantly improved connectivity to Heathrow Airport relative to current plans. This would initially be from large parts of Central London through the 10 trains per hour Crossrail service under **Option A5**, with western connections via Slough and Staines under **Options J2** and **J3** respectively, to create a through station at Heathrow Terminal 5. **Option K1** could additionally link in with High Speed 2 (HS2), as described below, and would also provide an alternative to the M25 motorway for Heathrow Airport travellers from Hertfordshire, Buckinghamshire and beyond. In the longer term **Option J4** would eventually link Heathrow Airport to a new national High Speed Rail network.

8.3 Gap K – maximising the benefits of the central London Crossrail tunnels

8.3.1 The Crossrail Programme will provide a major increment to connectivity across London on an east west axis, with a high frequency service across Central London at peak times. New travel opportunities will be created and journey times reduced. As indicated in **Chapter 5** this level of service is forecast to provide sufficient capacity on this corridor.

8.3.2 However, as stated in the Draft for Consultation the London and South East RUS scoping document noted the following as a potential gap for this RUS: Mismatch between a) the presently planned Crossrail capacity, service patterns and routeings at both western and eastern ends and b) the predicted future demand; and the associated impact on non-Crossrail services.

8.3.3 The primary issue is associated with the western end of Crossrail, since in the base position over half of services running westbound through the central London tunnel will not carry passengers beyond Paddington station. The trains turning in sidings at Westbourne Park as a result will be:

- 14 of 24 trains per hour in the peak
- eight of 16 trains per hour in the off-peak.

The RUS does not consider this consistent with maximising the economic benefits of the Crossrail tunnels in the longer term. This approach was widely supported during the consultation, with stakeholders agreeing that all 24 trains should ideally be extended to appropriate destinations in the West.

8.3.4 With respect to the above quantum it is noted that the following factors from this RUS now apply:

- **Option A1** in **Chapter 7** recommended relief line services running from Reading through the new central London tunnels from 2018. The specific variant of this option appraised would reduce the trains turning in the Westbourne Park sidings to 12 per peak hour, ie alternate trains.
- beyond this **Option A5** in **Chapter 7** outlined a likely future requirement for a 16 trains per peak hour GWML relief lines to Crossrail tunnels operation, with the four further Crossrail route trains per hour on the GWML resulting from incorporation of all Heathrow Airport services into such operations. This would then further reduce the trains turning at Westbourne Park to eight per peak hour.

8.3.5 As a result of the above the RUS works on the basis that eight Crossrail paths from Central London per peak hour will be available for extension westwards. The starting position is that all of these would be extended to serve Old Oak Common, consistent with Government policy for a High Speed Rail station at that location.

8.3.6 The Draft for Consultation described various options for an additional Crossrail western branch, with initial analysis favouring an extension to the slow lines of the WCML. This option received a large amount of stakeholder support during the consultation. Many stakeholders, while agreeing with the option, also noted the potential synergy between this scheme and HS2. The potential extension, **Option K1**, has now therefore been subject to an initial economic appraisal by the RUS.

8.3.7 Two versions of the economic analysis were produced:

- a standalone version assuming implementation in conjunction with only the committed changes to the WCML timetable and infrastructure
- a version assuming implementation together with the proposed HS2 scheme.

8.3.8 The standalone scheme would improve journey times to and from Central London for most passengers currently using the affected WCML services and reduce crowding on the public transport network feeding the Euston area, particularly the Underground.

8.3.9 Implementation of the scheme in conjunction with HS2 would also generate these benefits, at a higher level than the standalone scheme. The business case analysis does not include any temporary benefits associated with HS2 engineering works in the Euston station area.

Assessment of Option K1 – extend Crossrail services onto the WCML slow lines	
Concept	This option would extend Crossrail services via a new chord through the Old Oak Common area onto the WCML. Assuming implementation of **Option A1** and **Option A5** this would result in a western destination beyond Paddington for all 24 Crossrail trains, with none needing to terminate in the Inner London suburbs. The resulting 8tph via Watford Junction to Crossrail would replace most slow line services to London Euston.
Operational analysis	This option is considered likely to be operationally viable if the infrastructure below is provided, but significant timetable development work would be required to confirm this. Additionally, removal of 8tph from London Euston station could simplify the reconstruction of this location for High Speed Rail, if **Option K1** were implemented in advance of HS2. There would be interactions between Crossrail and London Midland/freight services in the Wembley area, which further analysis would need to resolve.
Infrastructure required	A new chord would be required to connect the GWML slow lines with the WCML slow lines in the Old Oak Common area. A number of potential route alignments for such a connection exist through the Old Oak Common site. These would pass through, or interact significantly with, the proposed new HS2 station site. Therefore a robust infrastructure solution is only likely to be achievable if the design of this link is considered in conjunction with planning for the proposed HS2 station at this location. Work will also be required away from the immediate Old Oak Common station site, for example to the Dudding Hill route and its junction with the WCML which is likely to need to be reconfigured to a double track connection. Some modifications to junctions in the Wembley Central area may also be required. Other elements such as a new Crossrail depot strategy and possible additional turnback infrastructure on the WCML would depend on the specific train service proposal adopted. If HS2 goes ahead this link would potentially reduce the amount of work required to the London Underground network in the Euston area to accommodate HS2 passengers.
Passenger impact	Analysis suggests that over 75 per cent of existing passengers on the affected services would benefit from significant time savings to their existing destination or origin in London, with this option providing direct new routes from WCML stations to the West End, the City of London and the Docklands. Fewer than 15 per cent of existing passengers would face increased journey times. This time penalty, which would largely affect passengers travelling to and from the Euston station area itself, would be relatively small. Moreover, if HS2 goes ahead, other changes to WCML services may provide additional calls at, or faster journeys from, outer suburban stations at the south end of the WCML, thereby removing this impact. Passengers using the feeder public transport network in the Euston station area would benefit from reduced crowding. This benefit would manifest itself through lower wait times and less crowded tube trains and buses. Post HS2, The Old Oak Common area would be further enhanced as a strategic transport hub, with an additional new route available via Watford Junction. The diversion of most slow line services via Crossrail would facilitate many new connection opportunities from stations at the south end of the WCML. This would include access to Heathrow Airport (with a single change at Paddington or Old Oak Common, post HS2) and access to the Thameslink network (with a single change at Farringdon).
Freight impact	There would be interaction between Crossrail and freight services in the Wembley area and potentially on the Dudding Hill line, which further analysis would be needed to resolve.

Assessment of Option K1 – extend Crossrail services onto the WCML slow lines

Financial and economic analysis

The following table outlines the appraisal results, as a standalone scheme.

60-year appraisal	**Present value £m**
Costs (present value)	
Investment cost	195 – 248 range
Operating cost	192
Revenue	49
Total Costs	**436 – 489 range**
Benefits (present value)	
Rail users benefits	833
Non users benefits	-21
Other Government impacts	-11
Total quantified benefits	**800**
NPV	**364 – 311**
Quantified BCR	**1.8 – 1.6**

Note: All figures are presented in 2002 market prices

It should be noted that the apparent reduction in industry revenue, and negative non-user benefits, shown in this table are due to limitations in the modelling of this option. In practice a scheme with such strong user benefits would generate additional revenue and non-user benefits. The RUS therefore expects that the BCR for this option would increase significantly with more detailed analysis.

The appraisal in a post – HS2 scenario shows greater rail user benefits and additional revenue, such that the BCR range is 2.6 – 2.2. The scheme is therefore high value for money. Due to the early stage of development of this option further details are not presented.

The standalone version represents at least medium value for money (indicated by a BCR between 1.5 and 1.99) and possibly high value for money (a BCR in excess of 2.0) if the modelling issues are addressed. The version in conjunction with HS2 represents high value for money.

Link to other options

This option has significant synergy with High Speed Rail proposals for the Old Oak Common area and London Euston.

Conclusion

Under the rules that govern RUSs, schemes which involve infrastructure costs can be recommended for implementation if they can be demonstrated to represent high value for money. This option in conjunction with HS2 meets this criteria; in the absence of HS2 it is not yet clear whether this is the case.

However, given the complexity of the key issues and the need for further information regarding certain elements, the scheme is recommended for detailed development with a view to implementation if HS2 goes ahead. Further design work should be linked to the ongoing planning for the HS2 station at Old Oak Common.

In the event that this option is not implemented the RUS recommends that passive provision for it is made in any planning with respect to the Old Oak Common area.

8.3.10 It is recommended by this RUS that further work is undertaken on the details and merits of a Crossrail to WCML extension, initially with the aim of identifying a route alignment in the Old Oak Common area for safeguarding from development. This work would need to interface significantly with the HS2 design process. Further work is also required on the train planning elements, including the performance implications of the option.

8.3.11 Detailed consideration is also needed with respect to the outermost limit of a potential WCML Crossrail network, with some stakeholders suggesting that Crossrail journeys from locations such as Milton Keynes Central are unlikely to be consistent with Crossrail rolling stock design. More detailed analysis is required, focussing on which combination of Watford Junction, Tring, Bletchley and Milton Keynes would be appropriate for slow line turnback under **Option K1**. There is significant synergy in this respect with High Speed Rail, since following HS2 it can be expected that Central London demand at key stations such as Milton Keynes Central, and north thereof, would be provided for on the fast lines with significantly increased frequencies relative to today, so Crossrail route trains would generally only be used for shorter distance flows at the south end of the WCML.

8.3.12 The RUS also notes the following potential additional Crossrail western extensions, as described earlier under **Gap J** in **section 8.2**, assuming the implementation of **Option A5** as detailed in **Chapter 7**:

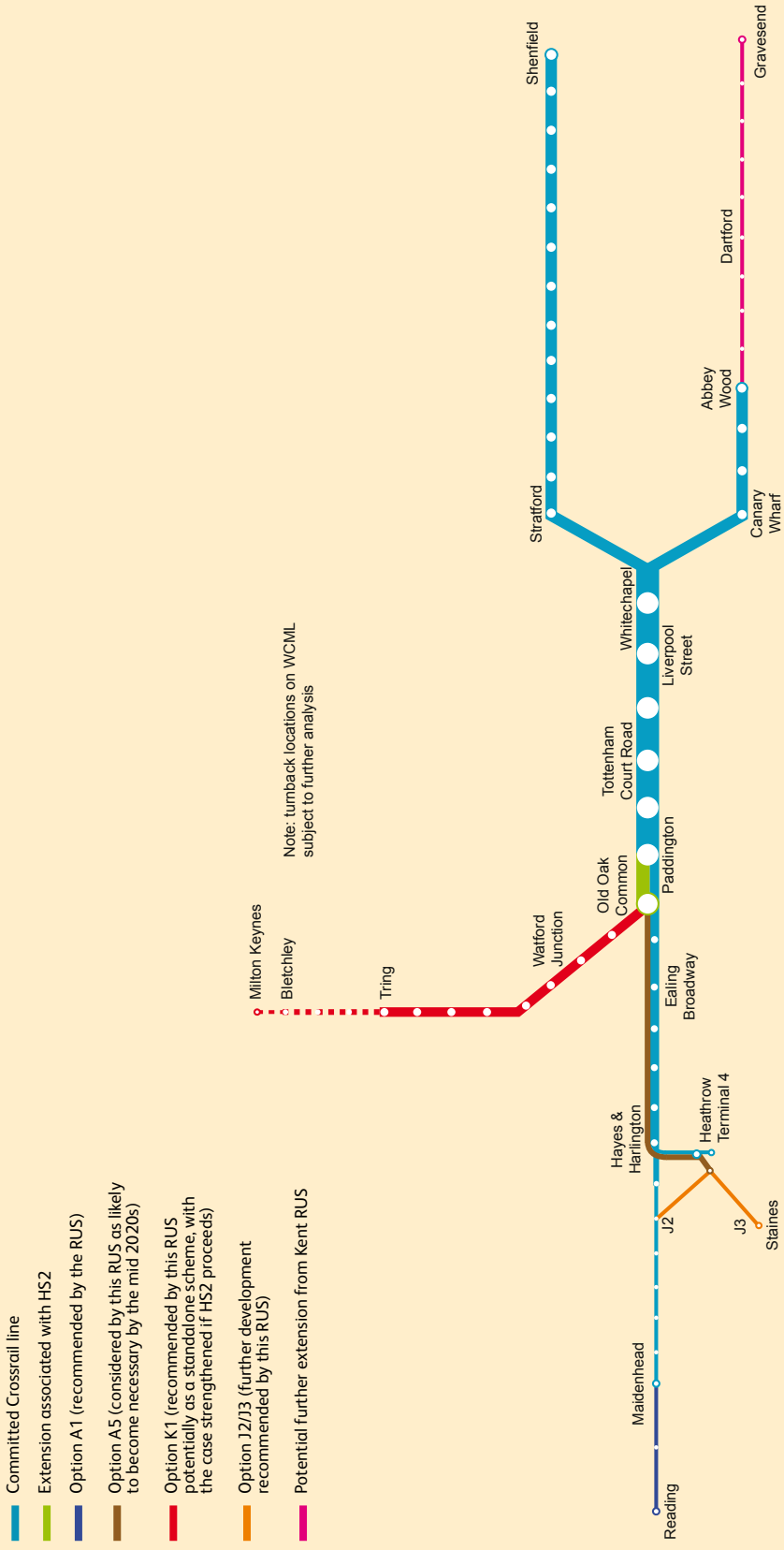
- beyond Heathrow Terminal 5 to Reading via Maidenhead, as recommended for further development under **Option J2.** If this option were implemented it is possible that some relief line services via West Drayton might then be curtailed at a location east of Reading, since there is unlikely to be a case at Reading itself for high frequency stopping services to London on two separate routes
- beyond Heathrow Terminal 5 to Staines, as recommended for further development under **Option J3**.

8.3.13 Finally with respect to Crossrail extensions the RUS restates for the longer term, subject to a business case, the potential future Crossrail extension to Gravesend, as highlighted in the Kent RUS. This route is currently safeguarded and passive provision is now made in the design of works at Abbey Wood for the necessary infrastructure to be provided in the future. This is likely to involve two new crossovers between the Crossrail and North Kent Line tracks at Abbey Wood, plus additional turnback infrastructure in the Slade Green/Crayford/Barnehurst area to avoid increasing the overall quantum of trains though Dartford.

8.3.14 The RUS also recognises stakeholder aspirations emerging from the consultation for a new Crossrail station at Kensal Rise. However, given that this would be located in close proximity to the proposed HS2 interchange at Old Oak Common, such a station is not considered consistent with the overall GWML strategy presented in this document, including minimising of journey times on the relief lines to locations such as Heathrow Airport.

8.3.15 **Figure 8.1** illustrates the potential future Crossrail extensions recommended for further consideration. The RUS does not hold a view on possible operators of such extensions, franchised or otherwise.

Figure 8.1 – possible future Crossrail extensions



8.4 Gap L – future Crossrail line 2 (Chelsea – Hackney Line)

8.4.1 The RUS restates the currently safeguarded alignment of a new cross-London rail tunnel. This would greatly improve connectivity on a south west to north east axis and alleviate London Underground congestion, consistent with the Mayor's Transport Strategy.

8.4.2 The safeguarded London Crossrail line 2 corridor would provide the following benefits:

- direct journeys from additional areas in the London suburbs to Central London, avoiding the need to change onto the London Underground network
- reduced journey times across Central London
- reduced demand on some of the most congested sections of the Underground, including the Victoria, Piccadilly and Northern lines
- reduced demand on certain intensively operated bus corridors
- regeneration of several parts of the capital.

8.4.3 The RUS notes that a number of potential modifications to the safeguarding may be appropriate:

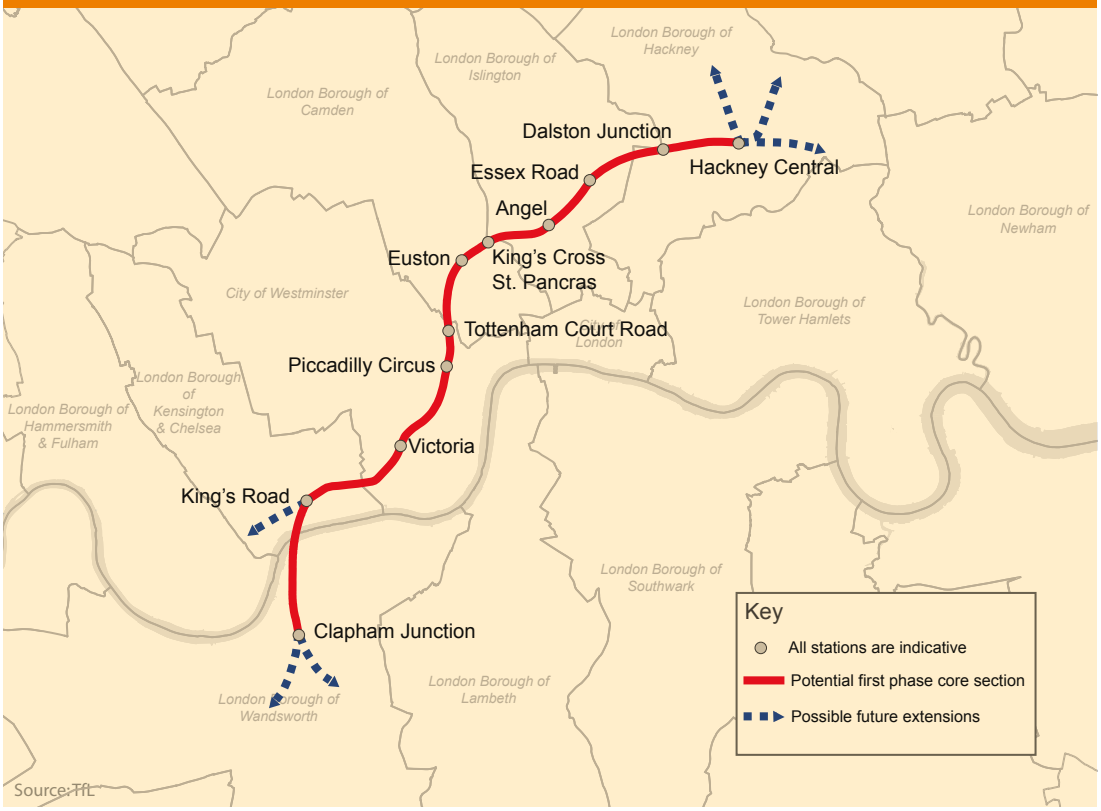
- firstly, the alignment has the potential to provide significant additional dispersal capacity from the High Speed Rail network at London Euston, as well as at London St Pancras International. This would significantly alleviate severe crowding on the Victoria line at Euston Underground station, so further consideration of including a Euston stop in any Crossrail line 2 scheme is recommended by this RUS
- beyond this the RUS also considers that Crossrail line 2 may have potential to alleviate the SWML peak capacity gap, as identified earlier under **Option F7** in **Chapter 7**. This may prove significant for the longer term, given that the favoured approach for the SWML as outlined in **Option F5** in **Chapter 7** has not been robustly demonstrated to be physically or economically viable at this time. However, given the need for a tunnel out beyond Wimbledon, at least, to alleviate SWML capacity, this approach would significantly increase the cost of the Crossrail line 2 project itself
- it is also noted that connections to south central routes towards Croydon are possible, though as with the SWML any new tunnel would need to extend south of Croydon itself to provide meaningful congestion relief to the Brighton Main Line in such a scenario. Modelling indicates however that this option would provide fewer benefits than a scheme incorporating the SWML
- either of the above would appear to require an alignment via Clapham Junction, an area which is a significant driver of demand in its own right. This approach is considered by the RUS to have greatest potential as a means of jointly alleviating London Underground and National Rail capacity issues, or potentially providing new journey opportunities by connecting to suburban routes, than the currently safeguarded alignment to Wimbledon via the Southfields route. Further development of a Crossrail line 2 alignment via Clapham Junction is therefore recommended
- finally the RUS notes that the West Anglia corridor may provide an eventual destination for trains using such a cross-London tunnel. This is because such a tunnel would relieve the London terminal capacity constraint on the West Anglia route, into which a connection appears realistic. Four-tracking of the West Anglia route should therefore, in the longer term, be reviewed as part of the development of such a scheme. Such an approach appears to offer more potential strategic options than the previously assumed destination of the north eastern end of the London Underground Central Line.

8.4.4 The RUS recommends further development of Crossrail line 2 for the longer term, to alleviate both London Underground and main line congestion on trains, provide new journey opportunities and reduce journey times.

8.4.5 The RUS recognises that the scheme is not affordable at present but recommends that consideration should be given as to whether it, or a variation, will become necessary once current major projects in the London area (principally the Thameslink Programme, Crossrail 1 and London Underground upgrades) have been completed.

8.4.6 **Figure 8.2** illustrates the potential future Crossrail line 2 alignment and possible extensions to it.

Figure 8.2 – possible future Crossrail line 2 (Chelsea – Hackney line)



8.5 Gap M – High Speed 2 (issues in the London area)

8.5.1 This London and South East RUS strategy is based on a post-HS2 scenario. This is because it would not be possible for the rail industry to resolve the future capacity gap on the south end of the WCML effectively in any other way, given the forecast demand growth. Capacity upgrades to the WCML and other routes would require additional tracks, with significant associated land acquisition, and such an approach is considered more costly and disruptive than building an entirely new route, whilst delivering a much lower level of benefit.

8.5.2 High Speed Rail will provide a step-change in north – south travel opportunities. Capacity will be created on HS2 itself for travel between major cities, whilst existing capacity on the WCML, the Midland Main Line (MML) and East Coast Main Line (ECML) routes will be reallocated for improved commuter services on shorter distance flows, better long distance services between the smaller towns and cities (many of which are not well served or connected at present) and for the anticipated growth in freight traffic.

8.5.3 With respect to the London area the RUS notes that the opening of HS2 will be a significant driver for wider changes to local travel patterns in central and western parts of the capital. In particular the following would apply:

- demand for travel from across London and the wider South East to and from London Euston station would increase markedly
- significant new demand would materialise from across London and the wider south east to and from the new station at Old Oak Common.

8.5.4 The above appears to have the most significant implications for the following issues away from HS2 itself:

- Euston Underground station capacity and the Victoria and Northern Lines (both branches), which serve it **Option K1**, as discussed earlier, would potentially alleviate capacity at this location by diverting outer suburban passengers to the Crossrail route
- operations on the GWML, which would have a new station at Old Oak Common, to be served by Crossrail services. The RUS does not consider it likely that Great Western long distance services would generally call, given the time penalty this would impose on London – West Country/South Wales journey times. Further work is therefore recommended regarding which, if any, longer distance GWML trains should call

- operations on the North London Line (NLL), which passes close by the proposed HS2 station at Old Oak Common. There are potential opportunities for links from nearby Willesden Junction, or alternatively, to reroute the NLL through Old Oak Common station (though the RUS emphasises that **Gap I** in **Chapter 7** identified capacity concerns on the NLL even without HS2 passengers using this route)
- operations on the West London Line (WLL), which also passes close by the proposed HS2 station. The RUS notes that there could be potential options for extending WLL services currently terminating at Shepherds Bush to Old Oak Common (by means of a new short spur diverting WLL services into the new station) or by pedestrian links from Willesden Junction as above
- the resulting service mix on the WCML, since this would change substantially following HS2

8.5.5 The RUS advises that further development of the strategy for accommodating HS2-related local flows between London, the wider South East and both London Euston and Old Oak Common stations is required. Planning for Euston will need to focus on capacity and constructability whilst works at Old Oak Common will be influenced by the need to provide new transport connections to one of the largest brownfield sites in London. It is noted that implementation of **Option A5** in **Chapter 7** would result in all Heathrow Airport services being on the GWML slow/relief lines at this point, so this would need considering in the Old Oak Common station layout design.

8.5.6 In addition the Government's High Speed Rail plans include a direct link between HS1 and HS2. This link would run in a tunnel from Old Oak Common to the NLL in the Primrose Hill area from where it proposes to make use of existing infrastructure to connect to the HS1 line north of London St Pancras International. This link will facilitate direct trains over a reversible single line route between HS1 and HS2. The RUS notes this would require that international trains operate over a constrained two-track section of the existing NLL, interacting with both London Overground and freight services, including an important existing recessing point for the latter. The RUS therefore considers that additional infrastructure enhancements will be required in the Primrose Hill/ Camden Road area, to either minimise or completely avoid interaction with the NLL. A number of options are presently being assessed, including revised options on the NLL itself that would require three tracks over Camden West Junction.

1 This would also allow trains between HS1 and a potential future station at Heathrow Airport.

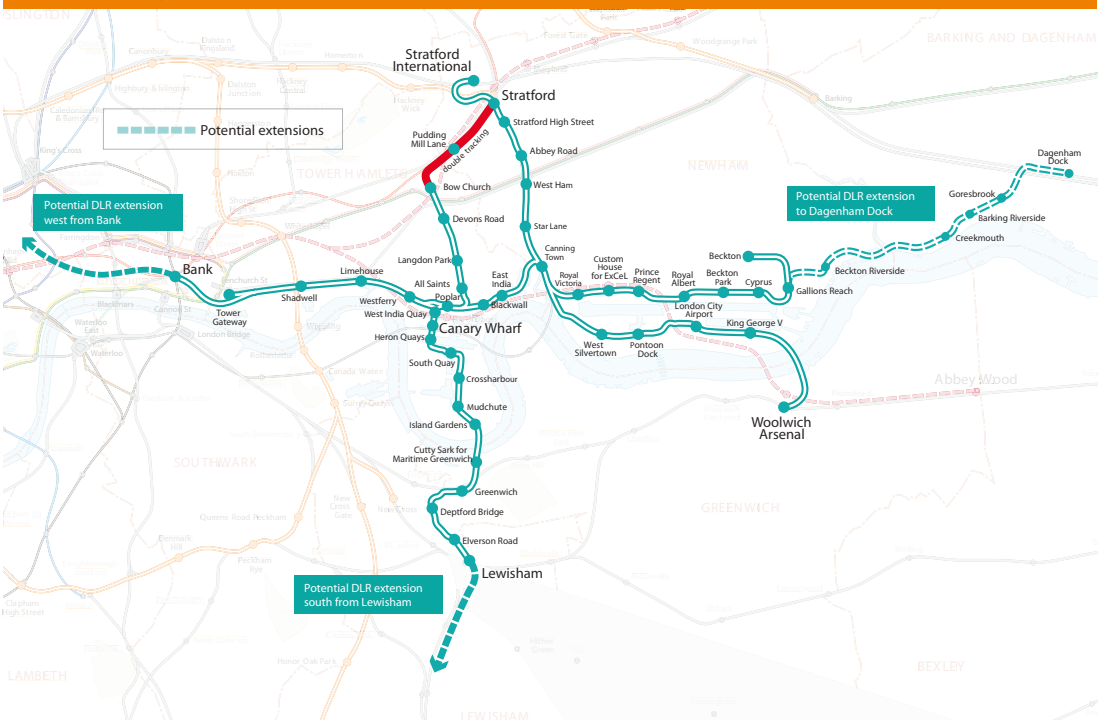
8.6 Gap N – Bakerloo Line Southern Extension

8.6.1 The established Kent RUS identified that a potential scheme to convert the Hayes branch for use by London Underground services could alleviate main line and suburban routes via London Bridge, with services on this line rerouted via a southern extension to the London Underground Bakerloo Line. Such a line would also provide additional capacity in inner South London, greatly improving travel opportunities for areas such as Denmark Hill and Camberwell. There may also be capacity relief to the Elephant & Castle corridor to Blackfriars, depending on the specific route chosen.

8.6.2 Further detailed analysis has since been undertaken, led by Transport for London (TfL). **Figure 8.3** illustrates the potential future Bakerloo Line southern extension.

Figure 8.3 – possible future LUL Bakerloo Line southern extension

Figure 8.4 – possible Docklands Light Railway extensions



8.7 Gap O – Docklands Light Railway Extensions

8.7.1 Following publication of the Draft for Consultation TfL has carried out initial work in connection with potential extensions to the Docklands Light Railway (DLR) system. Of these an extension west of Bank via City Thameslink, continuing further west via either Charing Cross (using the little-used former Jubilee Line platforms) to Victoria or via Euston (for HS2) would involve significant interaction with National Rail so is of most relevance to this RUS. The other potential extensions could include links further into East and South London.

8.8 Gap P – East West Rail

8.8.1 The potential East – West Rail (EWR) scheme would, if implemented, have synergy with service improvements to major growth areas such as Milton Keynes. The scheme would involve reopening a currently disused rail route southwest of Bletchley, providing direct links on the Oxford/Aylesbury – Milton Keynes Central/Bedford axis. In the longer term it could potentially be extended towards Cambridge, though this would be significantly more complex.

8.8.2 Whilst any passenger gap is outside the geographic scope of this RUS the EWR scheme is potentially useful for rail freight, as discussed in **Chapter 9**. In the longer term the scheme may enable certain traffic from Southampton to access locations via the WCML without the need to travel via London, Coventry or the Birmingham suburbs, all of which are forecast to become increasingly congested areas. Traffic for Daventry would particularly benefit in the short term, as such traffic currently requires a routeing via London. The route may also offer opportunities for HS2 construction traffic.

8.8.3 The RUS therefore recognises that this scheme, which is being developed by a consortium of local authorities, might provide additional freight routeing opportunities, in addition to those used at present, upon its completion.

8.8.4 The consortium has undertaken a business case assessment which indicates that there is a good economic case for implementation of EWR.

8.9 Gap Q – Croxley Link

8.9.1 A further connectivity scheme is the Croxley Link, as promoted by TfL and Hertfordshire County Council, which would enable passengers to access Watford Junction from the London Underground Metropolitan Line. Following publication of the Draft for Consultation the Croxley Link has advanced into the DfT's 'Development Pool' of local major transport schemes. Further work is now ongoing on the business case.

8.9.2 The Croxley Link has synergy with HS2, since it can be expected that increased main line trains to the north would call at Watford Junction following a WCML service recast upon completion of HS2.

8.10 Gap Q – Tramlink extensions

8.10.1 Another potential scheme involving interaction between the National Rail network and other transport modes is the extension of the London Tramlink system to Crystal Palace. This would involve removing all heavy rail services currently running via Birkbeck to Beckenham Junction, so the RUS restates previous analysis which anticipated that a new turnback facility would be required in Platform 6 or 7 at Norwood Junction to allow the necessary level of service on the Gipsy Hill route to be retained.

8.10.2 Other potential Tramlink extensions may also be considered in the future, as indicated in the Mayor's Transport Strategy. Most of these are unlikely to involve any heavy rail interaction but the RUS notes that the Bromley North branch is potentially suitable for conversion to light rail.

8.11 Other new routes or re-openings

8.11.1 The RUS recognises that various other potential rail, light rail and bus based schemes exist in addition to the above, many of which are promoted by local stakeholders. The promoters of each scheme will need to demonstrate that it is value for money, affordable and deliverable and represents the best way to meet wider transport and economic objectives.

8.12 Summary

8.12.1 This chapter has considered potential new routes or extensions, both as a means of increasing rail network capacity where no other options exist and of resolving connectivity gaps to key demand drivers. This has included the high level of demand for surface access to Heathrow Airport which is only partially provided for by the railway network at present, options for the potential future development of the Crossrail 1 network, thinking ahead towards Crossrail line 2 and the implications of HS2 on the London area. Other schemes listed include a southern extension to the London Underground Bakerloo line, DLR extensions, the East – West Rail scheme, the Croxley Link and a possible Tramlink extension to Crystal Palace. It has also been noted that there are many other smaller-scale schemes being promoted at a more local level which are not described herein.

8.12.2 Given the early stage of development of many of the schemes in this category limited economic appraisal has been carried out at this stage. Further detailed development is therefore recommended by this RUS.

9. Freight in South East England

9.1 Introduction

9.1.1 This chapter develops a strategy to provide sufficient capacity and route capability across South East England to allow for the future development of rail freight, consistent with current forecasts. The requirement to provide capacity, capability and economic attractiveness to freight operators in South East England is emphasised as necessary to support the economic development and environmental needs of the country as a whole.

9.1.2 The analysis follows on from the national Freight Route Utilisation Strategy (RUS), established in 2007. This section develops this further, taking into account the emerging view from the industry's Strategic Freight Network (SFN) workstream. The RUS builds upon this with respect to the South East England area, especially in respect of the key future growth area of containerised flows to and from ports.

9.1.3 The RUS do-minimum baseline includes several recently completed, ongoing or otherwise committed freight upgrade schemes, as part of the SFN. Some of the key schemes of most relevance to this RUS, many of which are physically located outside of the South East of England, are:

- loading gauge clearance to W10 between Felixstowe and the West Midlands via Bury St Edmunds, with completion achieved in April 2011
- the Nuneaton North Chord, a capacity scheme to enable trains from Felixstowe via Bury St Edmunds to access the West Coast Main Line (WCML) without crossing all tracks at Nuneaton on the flat, for which completion is planned by 2013
- the Ipswich North Curve, enabling trains from Felixstowe to access the Bury St Edmunds route without a reversal being required at Ipswich
- the recently completed loading gauge clearance scheme to W10 between Southampton and the West Midlands via Basingstoke and Oxford, together with ongoing work on diversionary routes
- capacity and capability schemes on the southern end of the East Coast Main Line (ECML) and between Peterborough and Doncaster
- capacity schemes in the West Midlands
- trials of 30-wagon (approximately 640m length) intermodal trains operating to/from both Felixstowe and Southampton.

9.1.4 The remainder of this chapter considers the overall allocation of capacity, focusing on how best to manage the interaction between freight and passenger services at a time of rising demand for both.

9.2 Future gaps

9.2.1 Freight demand forecasts were developed nationally to 2015 by the Freight RUS and then to 2019 and 2030 for the SFN. The forecasts were developed using the Great Britain Freight Model (GBFM), which is designed to forecast key freight trends, including major flows of relevance to this RUS such as to and from the South East ports and the Channel Tunnel. The model covers all transport modes and produces a matrix of all future freight flows. For certain commodities, the GBFM forecasts were modified to reflect operators' understanding of developments in their markets. The final forecasts, while subject to a large range of uncertainty and scenario selection in a similar manner to those for passenger traffic, aim to represent an industry consensus of a plausible level of freight traffic on which to base ongoing investment in the railway.

9.2.2 These traffic forecasts indicate that the most relevant rail freight issue affecting South East England will be an ongoing increase in international shipping imports into the UK from the rest of the world. The key issue this creates for the rail freight industry is the need to move increased numbers of intermodal freight containers between the South East ports and inland terminals, which are generally located in the Midlands, northern England and Scotland. The anticipated rail freight increase arises from a combination of both the increased shipping levels and a greater rail modal share for this traffic in the future.

9.2.3 The current traffic levels and SFN growth forecasts for the key freight flows to 2030 to/from the principal import locations in the South East England area are shown in **Table 9.1**. It can be seen that, even assuming significant train lengthening and a move to six-days per week operations, there are very significant increases in freight paths needed for all these key growth areas, each of which interacts at present with other railway operations in and around London

Table 9.1 – key freight growth origin points of relevance to this RUS

	2010 average daily trains	2030 average daily train paths with maximum utilisation[1]	2030 average daily train paths required with 5-day operation for inter modal trains[2]
Southampton	20	51	60
Channel Tunnel	6	35	42
Felixstowe/Bathside Bay	28	58	69
Essex Thameside (London Gateway etc)	8	50	58
Kent Thameside (Isle of Grain, Medway etc)	9	24	24

Notes:
1 Based on trains operating six days per week and 640-metre length intermodal trains, except for Channel Tunnel traffic for which 775-metre length is assumed.
2 The 5-day figures are likely to be overstated as they include the additional demand induced by 6-day operation. Currently, services tend to operate 51/2 days a week on many corridors. Bulk trains continue to operate 6-days a week.
Paths shown apply in both directions.
Paths shown are for all freight traffic not just intermodal traffic.

9.2.4 From **Table 9.1** it can be seen that if the objectives of operating freight six days a week (Monday – Saturday) are not achieved, then the requirement for paths per day, based on the projected demand, increases still further and places considerable strain on capacity and in some cases demand for paths is likely to outstrip supply. Likewise, if longer train lengths are not achieved, this will also mean that additional paths would be needed. Therefore, it will be essential to continue to work towards longer train lengths and six day working before other more expensive infrastructure solutions are considered. The needs of six day operation and longer trains are likely to require interventions (including infrastructure) in their own right on some routes and at terminals, but these will also stimulate the modal shift away from road haulage through improved rail efficiency and competitiveness. Full operations on Sundays have not been assumed as there will continue to be a need for maintenance and renewals work, both on the railway network and at terminals.

9.2.5 The RUS notes that growth forecasts from ports in **Table 9.1** are predicated upon their owners' and operators' plans to increase capacity – for both quayside activity and rail handling. The inland terminals for these freight flows are likely to remain distribution centres in the Midlands, Northern England and Scotland, though the RUS notes that a degree of flexibility is needed rather than constraining operations around specific locations.

9.2.6 In order to meet the key growth requirements in **Table 9.1** for certain types of freight, additional flows could be accommodated by running trains in existing but unused freight opportunities in the working timetable. This particularly applies to Channel Tunnel traffic, where the 35 paths required are currently protected by international agreement, and also from the Kent Thameside area, where standard hour timetable opportunities exist to increase traffic if this becomes necessary as forecast. However, this approach is far less practical with respect to the key intermodal traffic flows from the major container ports, to/from which at present there is a very low level of unused freight paths. In some instances where capacity is severely constrained, consideration may need to be given to whether the allocation of capacity to freight services should be weighed against the use of that capacity by lightly-loaded passenger services.

9.2.7 It can be concluded that significant additional freight paths will be required in future from the key ports of Southampton, Felixstowe/Bathside Bay and the London Gateway area in particular if the forecasts in **Table 9.1** are broadly correct. This leads to the need for the RUS to focus on how to increase rail freight capacity, capability and operational flexibility over the most appropriate routes between these areas and the markets they serve.

9.2.8 Due to the locations of the major distribution centres only relatively small volumes of intermodal rail freight are forecast to serve the London area direct from the ports, though a large proportion of the final market for the goods associated with such traffic is clearly in and around the Capital. Moving traffic by rail from the national distribution centres to the next stage in the supply chain is dependent on customers having rail-connected facilities and with limited such opportunities at present onward journeys from distribution centres therefore generally need to be made by road. Environmental considerations, fuel costs and road congestion, together with the increasing efficiency of the rail freight industry are likely to lead to an increasing

trend for this later stage in the distribution chain to be made by rail in the future. As a result, in addition to strategic issue of growth from ports covered by **Table 9.1,** there is also significant potential for high levels of growth in domestic container movements by rail in South East England. However overall volumes and specific flows in this area will be highly sensitive to the development of suitable terminal sites, so are more uncertain when planning at RUS level.

9.2.9 It is also emphasised that, to remain competitive with road haulage and to improve modal share, freight trains in future will need to be longer, have quicker end-to-end journey times and need to be able to carry 9'6" international shipping containers on standard wagons from the busier ports. The SFN workstream expands on this with the core trunk network requirements as shown in **Table 9.2**. These features have particular importance when considering routeing options as described later.

Table 9.2 – Strategic Freight Network – future core trunk network requirements
Sufficient capacity for growth.
Limited conflicts between passenger and freight traffic (e.g. by utilising/avoiding lines, grade separation).
Minimise freight movements via London if a better alternative route can be made available (unless the ultimate origin or destination of the freight is in London).
Provide for longer trains.
Provide for appropriate axle loads.
Appropriate loading gauge for the traffic that needs to use it.
Include defined diversionary routes for each core route to ensure availability whenever operators wish to use the network.
Reduced journey times to compete with road transport.

9.2.10 The various loading gauges for rail freight are shown in **Figure 9.1**.

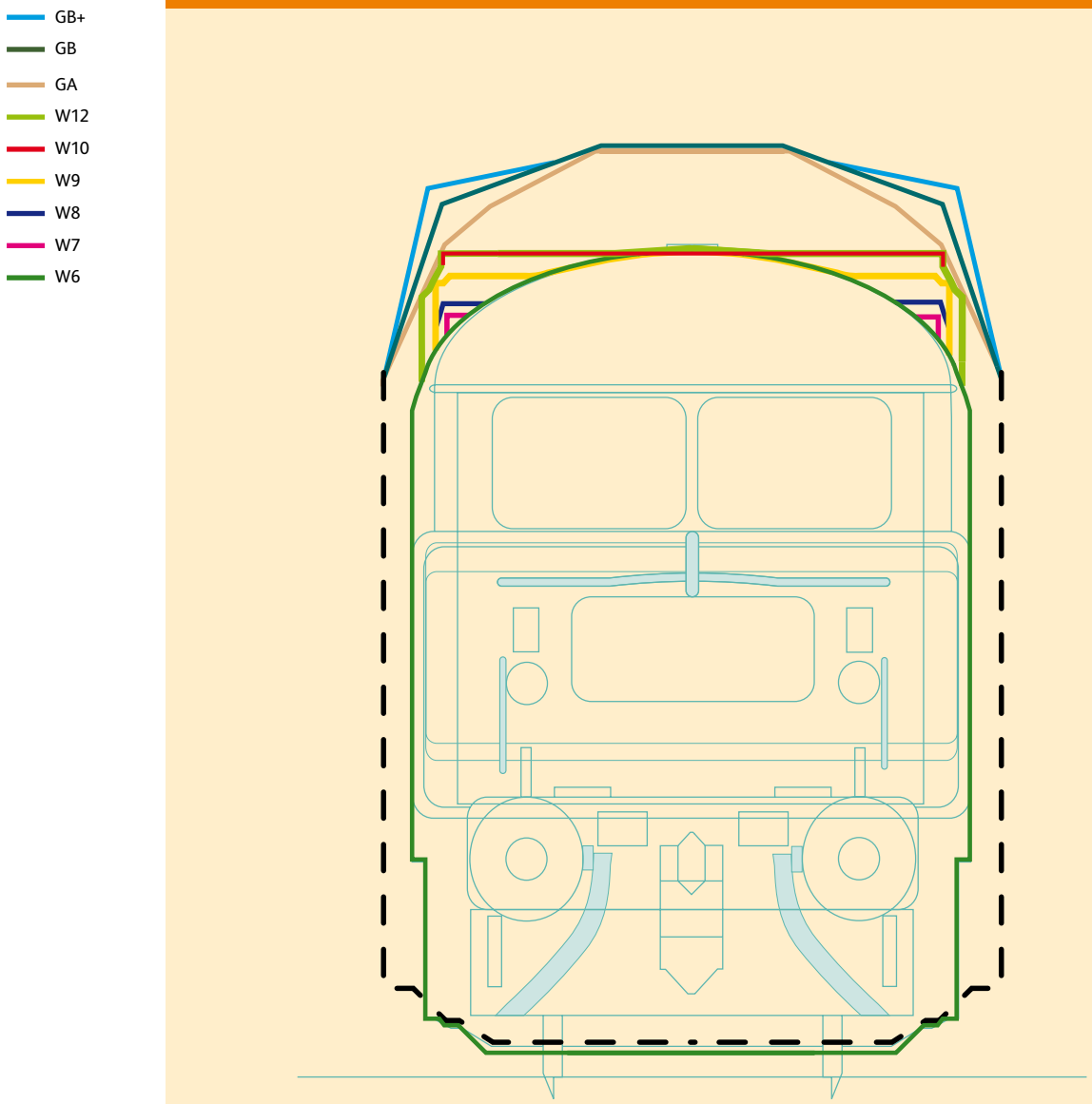
9.3 Routeing recommendations

9.3.1 Given the increased demand for both passenger and freight it is important to consider optimum routeing options. Whilst most passenger trains are serving the busiest sections of the rail network such as the London area, and cannot therefore be routed away, there may be some opportunities to provide new routes for some existing or new freight services, as long as this does not result in uncompetitive increases in operational costs or journey times. However for many of the alternative routeing options potentially available this would require capital investment, as some of these routes may need to be upgraded beyond currently committed schemes to ensure they have sufficient capacity and capability to accommodate the trains concerned.

9.3.2 The RUS emphasises that such route upgrades should in general be an opportunity to increase overall freight capacity and capability, as well as improving journey times, rather than merely used to reroute freight away from the capital. It was particularly emphasised by the rail freight industry during the consultation that any alternative routeings to those in use today must not impose uncompetitive operating costs or any other inefficiencies on the freight operators.

9.3.3 The following sections consider various routeing options to accommodate the forecast freight growth, assisting rail to compete with road transport. The RUS has sought to identify a preferred routeing option for normal traffic in the first instance, followed by a view regarding diversionary routes which will become necessary (and therefore should have similar capability), for use during maintenance work for example.

Figure 9.1 – loading gauge envelopes and container sizes



9.4 Port of Southampton traffic

9.4.1 Growth from the major international shipping facility in the Solent is anticipated, possibly with new terminals, due to the combined effect of increasing imports of container-based goods and the increasing rail modal share forecast for moving such imports. **Table 9.3** shows the 51 forecast paths in 2030 per day from Southampton split by inland origin/destination region.

9.4.2 It can be seen from **Table 9.3** that whilst approximately 10 per cent of Southampton traffic will need to serve London directly the majority of this container traffic will be destined for the major distribution centres in the Midlands or north of England. The rail route of first choice to these destinations is therefore the most direct route, running via Basingstoke, Reading and Oxford as shown in **Figure 9.2** later.

9.4.3 At present a particular problem in growing freight volumes using this route is the need to cross the main lines to the west of the Reading station area – a major capacity constraint involving interaction with fast passenger trains to and from London Paddington. However this issue will be removed in Control Period 5 (CP5) following the completion of the ongoing Reading remodelling scheme, during which a grade-separated connection will be provided.

9.4.4 A problem until recently was that the Southampton freight route was not W10 loading gauge cleared, so 9'6" international shipping containers were unable to be carried on standard wagons. However this issue has now been resolved through a major loading gauge clearance scheme on the main route between Southampton and the West Midlands (and the WCML at Nuneaton) via Winchester, Reading and Oxford. Further planned works cover the partial diversionary route to Basingstoke via Andover (i.e. avoiding Winchester).

Table 9.3 – Southampton 2030 average freight trains per day

	Paths based on 640m intermodal trains operating 6-days per week	Paths based on 640m intermodal trains operating 5-days per week[1]
Yorkshire	7.5	9.0
North West	12.8	15.3
Scotland	3.5	4.3
West Midlands (inc Daventry)	6.9	8.1
East Midlands	6.0	7.3
West	0.7	0.8
London	5.1	6.0
North East	1.1	1.3
Other	7.3	7.7
Total	**51.0**	**59.8**

Notes:
1 The 5-day figures are likely to be overstated as they include the additional demand induced by 6-day operation. Bulk trains continue to operate 6-days a week.
Paths shown apply in both directions.
Paths shown are for all freight traffic not just intermodal traffic.

9.4.5 Whilst the Reading remodelling scheme will alleviate the main north south capacity constraint the following other limitations south of Oxford will still be relevant following its completion. This list is not necessarily exhaustive.

- capacity in the Eastleigh to Southampton area, and elsewhere in the Solent as described in **Chapter 11**
- capacity at Basingstoke, where southbound freight services need to cross the entire layout on the flat to reach the South West Main Line (SWML) down lines. There are potential opportunities for a passing loop in the station area, though this would primarily improve timetabling opportunities for northbound traffic
- capacity over the 10-mile, two-track Didcot to Oxford section, which is shared between freight and six passenger trains (four of which are fast) in each standard hour
- the absence of a further W10 loading gauge diversionary route avoiding the sections of this line north of Basingstoke.

At present, the timetable permits two standard freight paths per hour in the off-peak between Southampton and the Midlands via Winchester. Whilst part of the rationale for gauge-clearing the diversionary route via Andover was also to provide additional capacity for W10 gauge traffic, the projected level of growth from Southampton may require further interventions to facilitate a four freight paths per hour service pattern.

9.4.6 None of the above is felt to be an insurmountable barrier to future freight growth on the section south of Oxford. However further development of a W10 loading gauge diversionary and capacity enhancing strategy is recommended, focusing on:

- the Southampton – Basingstoke – Didcot corridor, possibly routeing via Melksham (as an alternative to the Andover route)
- the Reading/Didcot – Oxford – West Midlands corridor, routeing either via Kew and the WCML, or via Reading, Acton and the WCML. As an alternative to these a further option would be to avoid all major line closures on the Didcot – Oxford corridor, to enable six day working at all times, possibly requiring additional infrastructure when the Oxford area is resignalled.

The RUS recognises that operators have some concerns regarding the additional mileage which some of the diversionary options incur. As part of the SFN workstream, diversionary options for W10 traffic from Southampton are currently being assessed in detail. **Figure 9.2** later should therefore be taken as indicative in this respect.

9.4.7 Beyond Oxford freight services currently all continue northwards via Leamington Spa, with West Midlands services then running via Solihull towards the Birmingham Freightliner terminal and the freight facilities at Washwood Heath. From this point routeings exist via Water Orton towards Derby for Yorkshire and North East England. Any other routeing from Central Birmingham would be via Birmingham New Street station and other parts of the busy West Midlands passenger rail network, severely limiting opportunities for use of such routes by freight.

9.4.8 In addition to the above, the main freight route to the WCML for North West England leaves the Oxford route at Leamington Spa and runs via Coventry, joining the WCML at Nuneaton. This route is capacity constrained by single track sections between Coventry and Leamington Spa as well as a flat crossing move through Coventry station. For southbound freight traffic towards Southampton there is also a flat crossing move across the WCML at Nuneaton. Whilst this existing route is heavily used such constraints make it potentially unsuitable for accommodating significant levels of future growth at busy times without infrastructure enhancements, especially as there are local aspirations for more passenger services. Partial redoubling, between Milverton Junction and Kenilworth, is currently under investigation as described in the West Midlands & Chilterns RUS and would assist, but the Coventry station area and Nuneaton area (in the southbound direction) represent significant future capacity challenges on this corridor.

9.4.9 Capacity over the Nuneaton – Leamington Spa corridor therefore appears to be a potential barrier to future freight growth from Southampton, especially due to the crossing move at Nuneaton in the southbound direction. Interventions to address this issue may therefore be required in the future, as noted under Gap 8 of the Freight RUS.

9.4.10 One way discounted as a response to the constraints in **9.4.9** was for some Southampton traffic to run via London in normal operating circumstances, then onwards to the north via the WCML, Midland Main Line (MML) or East Coast Main Line (ECML). This would increase congestion on busy routes in and around the capital so has not been considered further, except for diversionary purposes (which would tend to take place at night or weekends when capacity for freight is significantly improved). It would also conflict with freight demand growth from other origins using the southern end of the WCML. The RUS therefore seeks an option which enables Southampton growth whilst both avoiding London (for traffic not serving that area) and the Coventry/Nuneaton/ West Midlands constraints (for traffic not serving such areas).

9.4.11 One potential approach would be to reopen the currently closed route from Bletchley towards Bicester (at Claydon Junction), as part of the third-party promoted East-West Rail (EWR) scheme. Reopening of this line could potentially enable new routeing options for Southampton freight flows to the north, linking in to forecast demand (from **Table 9.3**) especially to Daventry in the West Midlands or the North West via the WCML. The most immediate new routeing options would be:

- Southampton – Oxford – Bletchley – WCML (for the Northwest)
- Southampton – Oxford – Bletchley – Daventry (for the Daventry International Rail Freight Terminal).

Other routeing options could potentially be available by proceeding beyond Bletchley, towards the MML at Bedford. In all cases the London area, the Birmingham area and the Leamington – Nuneaton route would be capable of being avoided (for traffic not needing to be on these routes). However, this approach received mixed views in feedback received in response to the Draft for Consultation, with freight operators generally preferring more direct routes via Banbury where practical.

9.4.12 The following tables show the mileages and indicative unconstrained journey times of the various routeing options from Southampton to the WCML at Nuneaton (**Table 9.4**) and to Daventry (**Table 9.5**). The RUS considers that, since there is a potential reduction of around 15 minutes for Southampton to Nuneaton (i.e. WCML North) flows and a potential reduction of at least 30 minutes for Southampton to Daventry flows, there may be potential to develop the EWR scheme in a manner that assists freight growth.

Table 9.4 – comparative distances and journey times on the major existing and potential future routeings between Southampton and the WCML at Nuneaton

Route	Route	Distance (miles)	Time (mins)
Preferred route	Winchester, Oxford and Coventry	137	166
Other existing routes	Andover, Oxford and Coventry	160	197
	Winchester, SWML and Kew	177	228
	Winchester, Reading, Acton and Willesden	175	216
	Melksham, Oxford and Coventry	175	227
Routes via East-West Rail	Winchester, Oxford and East-West Rail	149	150
	Melksham, Oxford and East-West Rail	187	211

Table 9.5 – comparative distances and journey times on the major existing and potential future routeings between Southampton and Daventry International Railfreight terminal

Route	Route	Distance (miles)	Time (mins)
Preferred route	Winchester, SWML and Kew	158	213
Other existing routes	Winchester, Reading, Acton and Willesden	155	201
Routes via East-West Rail	Winchester, Oxford and East-West Rail	129	172
	Melksham, Oxford and East-West Rail	167	233

Notes
1 Journey times are calculated on the basis of a typical Class 4 train, with clean end-to-end paths.
2 Oxford to Bletchley journey time assumed as 40 minutes.

9.4.13 With regard to any MML routeing from Southampton this was not generally favoured during the Consultation. However it is noted that loading gauge clearance to W10 or W12 of the MML north of Bedford could have potential synergies with any structural works required for future electrification, and that freight growth north of Bedford might be easier to achieve than south thereof, albeit still potentially with a need for some capacity works. As a result the RUS recommends that MML capacity north of Bedford for possible south coast freight traffic should be kept under review, especially during any future electrification scheme.

9.4.14 **Table 9.6** summarises some of the key issues associated with each of the main potential future routeing options north of Oxford.

Table 9.6 – routeing options north of Oxford for Southampton traffic

Route	Major operational constraints	Principal freight terminals likely to use the route
Oxford – Leamington Spa – Solihull – Birmingham freightliner terminal or Washwood Heath	N/A	Terminals in central Birmingham
Oxford – Leamington Spa – Solihull – Washwood Heath – Water Orton – Derby – MML North	N/A	Terminals in Yorkshire and North East England.
Oxford – Leamington Spa – Coventry – Nuneaton – WCML North	Capacity on the Leamington Spa – Coventry route and at Coventry station. Southbound flat crossing move across WCML at Nuneaton.	Terminals in North West England and Scotland.
Oxford – Leamington Spa – Solihull – Birmingham New Street station – Walsall/ Wolverhampton	Requires operation via Birmingham New Street station.	N/A
Oxford – Leamington Spa – Coventry – Aston –Walsall/Wolverhampton	Requires operation on congested Coventry to Birmingham New Street route.	N/A
Oxford – Bletchley (via East-West Rail) – Rugby – WCML North	Oxford – Bletchley route not currently operational Claydon – Bletchley. Limited capacity at south end of WCML.	Daventry. Terminals in North West England and Scotland.
Oxford – Bletchley (via East-West Rail) – Bedford – MML North (ie MML North via EWR)	Oxford – Bletchley route not currently operational Claydon – Bletchley. Requires operation over MML North.	Terminals in Yorkshire and North East England.

9.4.15 The following high level conclusions can be drawn from **Table 9.6**:

- based on current infrastructure, future growth in container traffic from Southampton will potentially be impacted by capacity constraints over the Nuneaton – Coventry – Leamington Spa route, especially in the southbound direction
- resolving the above is not considered a simple solution and would require significant infrastructure enhancements (including further grade separation at Nuneaton) as described in Gap 8 of the Freight RUS
- an alternative solution could potentially involve reopening of the Oxford – Bletchley route, as currently promoted by a consortium of local authorities. This would assist Southampton traffic growth with a new route to destinations in North West England and Scotland, subject to path availability on the WCML, without needing to travel via the constrained Nuneaton – Leamington Spa route. A more direct route between Southampton and Daventry would be provided, together with possibly routeing options between Southampton and the East Midlands via Bedford.

9.4.16 Further development of the core and diversionary routeing options for Southampton freight remains ongoing.

9.4.17 In addition, there may well be a case for infill electrification on routes from Southampton to the north in Control Period 6 (CP6), consistent with the strategy outlined in the Network RUS: Electrification Strategy, as part of a rolling programme of electrification schemes, especially if it tips the balance in favour of the use of more environmentally-friendly electric traction in future by both freight and passenger services. This would require electrification north of Oxford and over the Basingstoke – Reading route (also linking to **Option F6** in **Chapter 9**).

9.4.18 The key recommendations are summarised in the box below.

Freight growth from Southampton Docks – key recommendations

1. Continue the move towards traffic operating six-days per week with 640m length trains, which will require additional funding beyond current commitments.
2. The preferred route for normal operations to the WCML will be via Winchester and Oxford thence as follows:
   - traffic for the WCML North via the Leamington Spa – Coventry – Nuneaton route, on which additional double track sections would be beneficial
   - traffic for West Midlands terminals via Solihull.
3. Further consideration is supported of use of the potential East-West Rail corridor, to provide a faster route between Southampton and Daventry International Rail Freight Terminal (avoiding London) and to avoid southbound flat crossing moves for traffic from the WCML at Nuneaton.
4. Development of diversionary routes of equivalent capability (especially loading gauge and train length) to the main route is required for the entire length of key flows.
5. Further investigation is required regarding long term freight paths in the Southampton area, focussing both on routeing options via Winchester and Salisbury.

9.5 Essex Thameside (London Gateway) traffic

9.5.1 This area includes the existing Tilbury terminal and the development currently under construction at London Gateway port. Rail freight growth from the area is forecast due to the new port development (with its associated logistics and distribution industry), together with increasing imports from international shipping and the increasing rail modal share in moving such imports. **Table 9.7** shows the 50 forecast paths in 2030 from Essex Thamesside per day split by inland origin/ destination region.

Table 9.7 – Essex Thameside 2030 average freight trains per day

	Paths based on 640m intermodal trains operating 6-days per week	Paths based on 640m intermodal trains operating 5-days per week[1]
Yorkshire	8.6	10.3
North West	5.4	6.5
Scotland	3.2	3.8
West Midlands (inc Daventry)	9.0	10.8
East Midlands	8.0	9.6
West	7.2	7.8
London	6.9	6.9
North East	0.0	0.0
Other	1.8	2.1
Total	**50.0**	**57.8**

Notes:
1 The 5-day figures are likely to be overstated as they include the additional demand induced by 6-day operation. Bulk trains continue to operate 6-days a week.
Paths shown apply in both directions.
Paths shown are for all freight traffic not just intermodal traffic.

9.5.2 Since the new facilities at London Gateway are located on the outskirts of the capital itself only a very small proportion of the rail freight concerned is forecast (in **Table 9.7**) to need to serve other parts of the capital by rail, since such short distance traffic would generally be carried by road and those flows that do exist by rail are unlikely to be intermodal traffic. For the remaining flows it is clearly impractical to avoid the Capital entirely, given the port's location and the current rail network geography. Freight trains from London Gateway heading for the Midlands, the north of England and the West Country will therefore need to travel on busy routes around East and North London at the start/end of their journey.

9.5.3 As a result the RUS emphasises that capacity issues in North and East London will heavily influence the choice of main line routeing beyond London for these trains. It is also noted that resolving infrastructure constraints in the London area is likely to be highly constrained by the availability of physical space for additional tracks etc, a factor much less likely to apply once radial routes away from London are reached.

9.5.4 **Table 9.8** summarises the principal issues associated with each of the main potential future routeing options for London Gateway traffic.

Table 9.8 – routeing options north of London for London Gateway traffic

Route to North	Route Across London	Major operational constraints
ECML via Stratford and North London Line (NLL)	Dagenham – Barking – Forest Gate – Stratford – Dalston – Drayton Park – Hertford North – Peterborough.	Need for flat crossing moves across Great Eastern Main Line (GEML)/Crossrail tracks at Forest Gate/Stratford. Interaction with increasing passenger services over part of the NNL (Stratford – Highbury & Islington). Interaction with increasing passenger services over the Finsbury Park – Hertford route. Requires operation over 2/3 track section of ECML between Huntingdon and Peterborough. For most traffic an ECML routeing would involve extra distance to the principal inland distribution centres.
ECML via Gospel Oak – Barking (GOB) and West Anglia	Dagenham – Barking – Leytonstone High Road – Seven Sisters – Cheshunt – Ely – Peterborough.	Interaction between fast and slow trains over the Cheshunt – Cambridge route. Restrictions on loading gauge. GOB and Ely to Peterborough not electrified, although both schemes are listed as candidates in the Network RUS: Electrification Strategy. Capacity on the Ely to Peterborough line, until addressed by potential future enhancements. For most traffic an ECML routeing would involve extra distance to the principal inland distribution centres.
ECML via Stratford and West Anglia	Dagenham – Barking – Forest Gate – Stratford – Seven Sisters or Tottenham Hale – Cheshunt – Ely – Peterborough.	Need for flat crossing move across GEML/Crossrail tracks at Forest Gate/Stratford. Interaction between fast and slow trains over the Lea Valley line and route to Cambridge. Restrictions on loading gauge. Ely to Peterborough not electrified, although this scheme is listed as a candidate in the Network RUS: Electrification Strategy. Capacity on the Ely to Peterborough line until addressed by proposed future enhancements. Involves extra distance to principal markets.
WCML via GOB	Dagenham – Barking – Leytonstone High Road – Upper Holloway – Gospel Oak – Hampstead Heath – Willesden Junction.	Interaction with increasing passenger services over part of the NLL (Gospel Oak – Willesden Junction). GOB not electrified although this scheme is listed as a candidate in the Network RUS: Electrification Strategy.
WCML via Stratford, NLL and Primrose Hill	Dagenham – Barking – Forest Gate – Stratford – Dalston – Primrose Hill.	Need for flat crossing move across GEML/Crossrail at Stratford. Interaction with increasing passenger services over part of the NLL (Stratford – Camden Road).
WCML via Stratford, NLL and Hampstead Heath	Dagenham – Barking – Forest Gate – Stratford – Dalston – Gospel Oak – Hampstead Heath – Willesden Junction.	Need for flat crossing move across GEML/Crossrail at Stratford. Interaction with increasing passenger services over the whole of the NLL (Stratford – Willesden Junction).
MML via GOB	Dagenham – Barking – Leytonstone High Road – Upper Holloway – Carlton Road Junction.	Interaction with intensive Thameslink service in the Carlton Road junction area on MML. Restrictions on loading gauge. GOB and north of Bedford not electrified although both schemes are listed as candidates in the Network RUS: Electrification Strategy.

Table 9.8 – routeing options north of London for London Gateway traffic		
Route to North	**Route Across London**	**Major operational constraints**
MML via Stratford and GOB	Dagenham – Barking – Forest Gate – Stratford – Upper Holloway – Carlton Road Junction.	Need for flat crossing move across GEML/Crossrail at Stratford. Interaction with intensive Thameslink service in the Carlton Road junction area on MML. Restrictions on loading gauge. North of Bedford not electrified although this scheme is listed as a candidate in the Network RUS: Electrification Strategy.
MML via WCML	As WCML options then Bletchley – Bedford.	As WCML options plus: Not electrified Bletchley – Bedford. Restrictions on loading gauge.
MML via ECML	As ECML options then Peterborough – Leicester.	As ECML options plus: Not electrified from Peterborough although this scheme is listed as a candidate in the Network RUS: Electrification Strategy.
WCML via ECML	As ECML options then Peterborough – Leicester – Nuneaton.	As ECML options plus: Not electrified Peterborough – Nuneaton although this scheme is listed as a candidate in the Network RUS: Electrification Strategy.
WCML via MML	As MML options then Leicester – Nuneaton.	As MML options.

9.5.5 It can be seen from items highlighted in orange in **Table 9.8** that many cross-London routeing options, including all those involving the North London Line via Dalston, require flat crossing moves across the Great Eastern Main Line (GEML)/ Crossrail tracks at Forest Gate and Stratford. The RUS has sought to avoid this where possible, given that it is a major operational constraint. Hence routeings utilising the Gospel Oak – Barking line, which crosses above the GEML near Forest Gate on a flyover, are preferred. This approach was widely supported in feedback received in response to the Draft for Consultation.

9.5.6 As a result the conclusion from **Table 9.8** is that the main initial routeing options away from the Capital for London Gateway traffic are as below:

- operating via the significant flat junction constraints across Crossrail traffic at Forest Gate/ Stratford to the North London Line and onwards to the ECML
- operating via the Gospel Oak – Barking line and West Anglia to the ECML at Peterborough, though this involves extra distance and significant interaction with passenger traffic north of Cheshunt
- operating via the Gospel Oak – Barking line and the MML, involving significant interaction with the intensive Thameslink service in the Carlton Road Junction area
- operating via the Gospel Oak – Barking line and the WCML, joining at Willesden.

9.5.7 Of the above only the WCML option avoids major issues in terms of interaction with passenger services in the London area, so this route is recommended as the preferred routeing choice for most London Gateway traffic to the north.

9.5.8 In addition to the cross-London route towards the WCML being less capacity constrained than the limited other cross-London alternatives an important further factor to consider is that only the WCML is currently W10 loading gauge cleared. Use of the southern end of an alternative route would involve significant infrastructure enhancement costs to enable efficient carrying of 9'6" international shipping containers on conventional wagons.

9.5.9 Finally whilst it is recognised that freight paths on some parts of the WCML are currently scarce, construction of High Speed 2 (HS2) can be expected to alleviate this issue, with passenger demand from locations such as Northampton and Milton Keynes Central generally then being catered for on the fast lines, in turn freeing up slow line paths for freight traffic.

9.5.10 The conclusion from the above is therefore that the most effective option for future growth in freight traffic from London Gateway will be, in general, via the Gospel Oak – Barking line and the south end of the WCML. The Gospel Oak – Barking line and associated connections are currently unelectrified, but the recommendation of the Network RUS: Electrification Strategy for electrification to be provided on this line is re-emphasised here. Between Gospel Oak and Willesden Junction there is a need to accommodate passenger growth in addition, so the capacity strategy for passenger traffic is designed around train lengthening (as discussed in **Option I5** in **Chapter 7**) rather than additional trains.

9.5.11 Once on the WCML any London Gateway traffic heading to terminals in the West Midlands will generally need to leave the WCML at Nuneaton, running via Water Orton. This avoids the congested Birmingham – Coventry corridor and provides access to West Midlands rail terminals.

9.5.12 Notwithstanding the general strategy of using the WCML some opportunities for using the MML South section (Carlton Road Junction – Bedford) will continue to be available following the completion of the Thameslink Programme, with two trains per hour freight paths anticipated by the RUS in each off-peak standard hour. However many of these paths are likely to be taken by existing domestic traffic (for example aggregates), so options for London Gateway growth would be extremely limited, even if this were the preferred routeing to the North. The RUS particularly emphasises that the Carlton Road Junction/Kentish Town area is severely constrained due to being located in a narrow deep cutting with tunnels at each end. Given the densely built-up nature of this part of inner London and the amount of property demolition which would be necessary for grade separation the RUS is of the view that such a scheme could only be considered if it were the only option available. Whilst there are potentially smaller scale opportunities to provide additional or higher speed crossovers to reduce to a limited degree the interaction between MML freight and Thameslink services this is not sufficient to change the conclusion that an alternative routeing strategy, generally involving the WCML, is preferred.

9.5.13 It can be seen from **Table 9.7** that some flows from London Gateway are likely to be suited to the ECML and a flat crossing move across the Great Eastern Main Line (GEML)/Crossrail tracks at Stratford/Forest Gate is therefore an unavoidable feature of such flows. Following concerns raised during the consultation the RUS has now undertaken detailed timetable analysis to determine the maximum extent of services compatible with the post-Crossrail timetable structure at this location. As described in more detail below this work has confirmed off-peak capacity for future freight services needing to operate in this area, but has confirmed that this should not be a preferred routeing where better alternatives exist.

9.5.14 The RUS has also reviewed the implications of removing such conflicts at Stratford/Forest Gate by means of an infrastructure scheme, creating a grade separated route from Barking towards Hackney that does not interact with the GEML/ Crossrail. However given the densely built-up nature of this part of inner London and the amount of property acquisition which would be necessary the RUS is of the view that such a scheme could only be considered if it were the only option available. The RUS therefore recommends that this particular major conflict is avoided via an alternative routeing where possible.

9.5.15 With respect to the ECML traffic examination of **Table 9.7** suggests that approximately 9 of the 50 trains per day from Essex Thameside would be more appropriately routed to their destination via the ECML. As described above use of the Gospel Oak – Barking line presents difficulties in this respect since it has no direct connection onto the ECML. The only connection available from this route is via Seven Sisters and Bishops Stortford to the ECML at Peterborough, a longer distance and involving interaction with fast passenger trains such as Stansted Express, aspirations from other operators to increase services to Stansted Airport and the need to increase capacity of the Ely – Peterborough route for Felixstowe traffic as described in **section 9.6** below. One way considered to avoid this issue would be to improve the run-round facility at Upper Holloway to enable trains to access the ECML more directly, but this would only assist northbound traffic given that there is no connection from the ECML to the Gospel Oak – Barking line in the southbound direction. A further solution would be to continue to Wembley then reverse via Primrose Hill and Camden Road for the ECML, but this involves extra mileage and increases the interaction with passenger traffic so is not favoured by the RUS.

9.5.16 For London Gateway – ECML traffic the only direct connection onto the ECML is from the North London Line (NLL) rather than the Gospel Oak – Barking line, so requiring the flat crossing moves over the Crossrail route at Forest Gate and Stratford. Whilst this crossing move is a major constraint as outlined earlier (and avoiding it is a key reason why the RUS recommends that as much London Gateway traffic as possible is routed via the Gospel Oak – Barking line), freight industry stakeholders expressed concern during the consultation that a viable way forward had not been identified in the Draft for Consultation for freight between London Gateway and the ECML. Further timetable development has now been undertaken to confirm whether the crossing moves at Forest Gate/Stratford can be accommodated, or if providing capacity for these flows represents a strategic gap for this RUS.

9.5.17 This detailed analysis has identified future daytime off-peak paths across the junction constraints at Forest Gate/Stratford for the following freight traffic:

- 11 trains each way between Felixstowe/Bathside Bay and London/the West/Daventry. This assumes rerouteing of all other daytime freight traffic via Bury St Edmunds as recommended in **Section 9.6** below
- five trains each way between Essex Thameside and the ECML.

9.5.18 All of the above fit into the standard off-peak passenger timetable (six trains per hour per direction) on the North London Line, with most having a short pathing stop in either the Angel Lane or Channelsea freight loops, depending on direction. The paths are based on the post-Crossrail timetable and are consistent with the Great Eastern Main Line infrastructure and peak timetable enhancements recommended in **Option D2** in **Chapter 7**.

9.5.19 With approximately nine paths per day required between London Gateway and the ECML a split of five daytime paths and approximately four trains running each night is considered realistic, so capacity between ECML and London Gateway is not considered a RUS gap.

9.5.20 These key recommendations are summarised in the box below.

Freight growth from Essex Thameside – key recommendations

1. Traffic to operate six-days per week with 640m length trains, which will require additional funding beyond current commitments.
2. Preferred route for most traffic will be via the Gospel Oak – Barking line to the WCML, on which paths for freight traffic need protecting.
3. Electrification of the Gospel Oak – Barking line was recommended by the Network RUS : Electrification Strategy and this strategy is re-emphasised as appropriate. This also links to **Option I5** in **Chapter 7** which could involve replacing existing diesel rolling stock on this route with 4-car electric Class 378 trains.
4. Some paths are required to the East Coast Main Line for which capacity exists in the Forest Gate/Stratford area and should be protected in future timetable recasts.

9.6 Haven Ports (Felixstowe and Bathside Bay) traffic

9.6.1 High levels of growth are forecast from the existing major international shipping facility of Felixstowe, and at Bathside Bay near Harwich once this planned new port is built. Collectively these ports are known as the 'Haven Ports'. The forecast growth comes from increasing imports of intermodal traffic and increasing rail modal share in moving such imports. **Figure 9.9** shows the 58 forecast paths in 2030 per day split by inland origin/destination region from this area. The figure also shows that if six-day a week operation is not achieved, more paths will be required. The same is true if trains are not lengthened to 640m.

9.6.2 Growth in train paths to and from Felixstowe is based on a key assumption that the port will proceed with phase 2 of its Felixstowe South development. This will then trigger its Section 106 planning commitments for rail network enhancement, notably partial doubling of the Felixstowe branch line. If the branch line doubling is delayed or does not proceed this is likely to impact significantly on the figures shown.

9.6.3 **Table 9.9** indicates that, whilst a small proportion of this traffic will be serving London directly, most of the rail freight from the Haven Ports will be heading to distribution centres located in the Midlands and north of England. The most direct rail route to such locations is therefore via Bury St Edmunds, Peterborough (for the ECML), Leicester (for the MML) and Nuneaton (for the West Midlands and the WCML). However as this cross-country route has limited capacity and is not electrified the majority of traffic currently operates via London (utilising the GEML and NLL, joining the WCML at Camden Junction).

9.6.4 Ongoing enhancement schemes (capacity, train length and loading gauge) will enable an increasing proportion of this traffic to operate via the cross-country route rather than via London. This includes the Ipswich North Curve and Nuneaton North Curve schemes, the former of which will allow longer freight trains to operate than can be accommodated with a reversal in Ipswich Yard. Such schemes are consistent with the RUS strategy of freight not serving London being routed to avoid the capital and received significant support during the consultation.

9.6.5 However even when the schemes currently committed are completed there will still be some significant barriers to using the cross-country route for all traffic to the Midlands or north. The principal ones are:

- capacity restrictions in the Leicester area, through which significant north south and east west passenger movements are also necessary with limited tracks available
- capacity constraints at Ely
- the Ely – Soham single line
- Haughley Junction, near Ipswich, which is a single-lead junction at present
- the cross-country route being non-electrified
- the cross-country route having sections of low capacity absolute block signalling.

Table 9.9 – Felixstowe/Bathside Bay 2030 average freight trains per day

	Paths based on 640m intermodal trains operating 6-days per week	Paths based on 640m intermodal trains operating 5-days per week[1]
Yorkshire	6.9	8.2
North West	14.2	17.0
Scotland	2.9	3.5
West Midlands (inc Daventry)	10.6	12.7
East Midlands	10.4	12.4
West	5.6	6.7
London	5.6	6.8
North East	1.1	1.3
Other	0.6	0.6
Total	**58.0**	**69.2**

Notes:
1 The 5-day figures are likely to be overstated as they include the additional demand induced by 6-day operation. Bulk trains continue to operate 6-days a week under this scenario.
Paths shown apply in both directions.
Paths shown are for all freight traffic not just intermodal traffic.

9.6.6 Based on the above it is recommended that further development of the Felixstowe – Nuneaton cross-country route is likely to be required in the future, focusing on further infrastructure upgrade schemes to eliminate key capacity constraints and improve capability on this route. This work is now being taken forward with funding from the SFN CP5 Development fund. In addition, there may well be a case for electrifying this route in CP6, consistent with the strategy outlined in the Network RUS: Electrification Strategy, as part of a rolling programme of electrification schemes, especially if it tips the balance in favour of the use of more environmentally-friendly electric traction in future by both freight and passenger services.

9.6.7 It is emphasised that any freight paths freed up on the GEML in the Stratford area (by diverting existing Haven Ports traffic to the cross-country route) could potentially be available for London Gateway – ECML traffic, which would be required to achieve the solution for such traffic outlined in **9.5.17**.

9.6.8 Even when the capacity restrictions and economic issues associated with the cross-country route are resolved a W10 loading gauge-cleared diversionary route via the GEML and London will still be required. However such traffic diversions would generally be overnight or at weekends when passenger numbers are lower. Other growing flows such as freight between Felixstowe and the West Country will continue to need to run via London as their preferred route.

9.6.9 These key recommendations are summarised in the box below.

Freight growth from Haven Ports – key recommendations

1. Continue the move towards traffic operating six-days per week with 640m length trains, which will require additional funding beyond current commitments.
2. Preferred route for most traffic will be via the cross-country route via Bury St Edmunds.
3. Existing schemes (eg Ipswich North Curve, Nuneaton North Curve) will provide additional capacity on the cross-country route but significant further works will be required, for example in the Leicester area.
4. Routes via London will be necessary, both for diversionary purposes and for traffic not suited to a cross-country routeing.

9.7 Channel Tunnel/Kent Thameside traffic

9.7.1 To the south east of London rail freight growth is forecast from the Channel Tunnel in particular, leading to the eventual take up of all 35 paths at present protected by international agreement. High levels of growth are also forecast from the Kent side of the Thames Gateway.

9.7.2 **Table 9.10** shows the 35 forecast Channel Tunnel and 24 forecast Kent Gateway paths in 2030 per day split by inland origin/destination regions from these areas. The figures presented below are based on the assumption of intermodal trains operating six days a week, and with longer formations. If either of these is not deliverable, then more paths per day are required.

Table 9.10 – Channel Tunnel/Thames Gateway 2030 average freight trains per day

	Channel Tunnel[1]	Kent Thamesside (Isle of Grain, Medway etc)[2]
Yorkshire	2.6	0.6
North West	3.9	0.8
Scotland	2.0	0.1
West Midlands (inc Daventry)	7.2	0.9
East Midlands	9.0	1.3
West	3.4	2.5
London	7.2	16.0
North East	0.1	0.0
Other	0.0	1.3
Total	**35.0**	**24.0**

Notes:
Paths shown apply in both directions, with trains operating six days per week.
1 Paths shown assume 775-metre trains.
2 Paths shown assume 640-metre trains.
Paths shown are for all freight traffic not just intermodal traffic.

9.7.3 As with the shipping ports only a small proportion of Channel Tunnel traffic is forecast as serving the London area directly. The following three main potential future routes are available for Channel Tunnel traffic travelling beyond the capital:

- via the existing route (generally Maidstone East and Catford), then operating via the West London Line to join the WCML at Willesden
- via High Speed 1 (HS1) to the Dagenham area, with traffic heading further north then having the same routeing options (and gauge restrictions) as traffic from London Gateway
- via Tonbridge, Redhill, Guildford, Reading and Oxford, then utilising routes as per traffic from Southampton
- In addition there are also various diversionary routes associated with the classic network options.

9.7.4 The potential for Channel Tunnel traffic growth is accepted in this RUS. However, the history of the business and current provision for growth are of note. From its opening, the Channel Tunnel attracted new business which reached a peak of 3.2 million tonnes p.a. around 10 years ago. Services were suspended in 2001/02 as a result of the actions of would-be illegal migrants in France. Recovery has been slow – a little over one million tonnes of traffic per annum is passing currently – equivalent to five to six trains per day. Set against this level of actual demand, a minimum of 35 specified paths/day in each direction between the Channel Tunnel and Wembley Freight Operating Centre have been protected by Network Rail for the duration of the Channel Tunnel/Railways Usage Contract up to 2052.

9.7.5 The RUS notes that the use of HS1 for freight is unlikely to be a direct replacement for existing flows on the classic network. HS1 provides opportunities for time-sensitive goods and/or those requiring European loading gauge operation, which represent new markets for the UK rail industry. The key issue is that such freight will require terminals in the London Riverside area serving HS1; the Mayor for London's policy documents support this.

9.7.6 Beyond the London Riverside area, opportunities for HS1 freight are much more limited, given that a circuitous journey around north London would still be required (with relatively minor gains over the existing West London Line route) and the

higher costs likely to be involved. It is therefore likely that HS1 will be principally utilised for new freight flows from Europe serving the London area directly as above, rather than for rerouteing existing traffic from the Channel Tunnel to the north. However, when HS2 is constructed, with a direct European gauge connection to/from HS1, then potential opportunities for conveying such traffic to points further north might conceivably present themselves overnight.

9.7.7 The RUS has also considered the potential of developing the Tonbridge – Redhill – Reading route for freight traffic. However this route suffers from the following major problems:

- the majority of Channel Tunnel freight trains are expected to be destined for the Midlands and North of England, rather than the West Country or Wales. A routeing via Reading therefore involves significant additional mileage
- extremely expensive infrastructure enhancements would be required, including a potential grade separation and avoiding line south of Redhill and new tunnels in the Guildford area
- large sections of the route are not electrified
- it would add to traffic over the capacity-constrained Reading – Oxford route, which was identified in **section 9.4** as the route for accommodating future Southampton traffic growth.

For the above reasons the RUS recommends that this option is not pursued.

9.7.8 Based on the above the RUS recommends that the existing freight routes to the north from the Channel Tunnel remain the main routeing for such traffic in the future. The post-Thameslink Programme timetable structure currently under development includes two freight paths via the Catford Loop and Maidstone East in each off-peak standard hour, and these will need to remain for the foreseeable future. The Ashford International – Tonbridge – Redhill – Clapham Junction line will remain a diversionary route, with investigations ongoing at present into enabling electric haulage on this line when the preferred Maidstone East line is closed.

9.7.9 The West London Line (WLL) is a particular constraint associated with the current routeings. The key issues are:

- passenger services on this route have increased significantly in recent years and **Chapter 7** forecast a capacity gap associated with future passenger demand growth
- there is only limited capability for southbound trains to be held whilst awaiting a path through Kent or northbound trains to be held whilst awaiting a path on the WCML. Freight trains must in general therefore be kept moving to avoid delaying the following passenger traffic (and vice versa). The planned commencement of London Overground services via the South London Line to Clapham Junction can be expected to increase this existing issue, given that these passenger trains will use sections of currently freight-only line
- the West London Line only has a direct connection onto the WCML for services for the north of London. Freight for the MML must use the Kew and Dudding Hill route, interacting significantly with South West Trains' passenger services via Barnes. Freight for the ECML must run via a large section of the North London Line
- whilst the Barnes/Kew route is a diversionary route for the WLL, parts of this are not electrified.

9.7.10 Capacity issues on the WCML identified in the WCML RUS for other traffic are equally relevant to Channel Tunnel flows.

9.7.11 Traffic from Kent Thameside is forecast to have significantly lower growth levels, but is also generally routed via the West London Line so has many issues in common with Channel Tunnel traffic as above.

9.7.12 These key recommendations are summarised in the box below.

Channel Tunnel freight growth – key recommendations

1. Channel Tunnel freight has significant potential to grow strongly, up to the 35 daily paths protected by international agreement.
2. Continue the move towards traffic operating six days per week with 775m length trains.
3. Preferred route for most traffic will be via Maidstone East, Catford and Kensington Olympia to the WCML.
4. Development of specialist flows via HS1 is anticipated, subject to suitable freight terminals in east London.

9.8 Domestic freight growth

9.8.1 In addition to growth from ports significant levels of domestic traffic are also forecast, including around the Capital. **Tables 9.11** and **9.12** show the 2030 average freight trains per day forecast with respect to such traffic.

Table 9.11 – 2030 average freight trains per day between UK terminals to/from London (including domestic intermodal)

	Paths based on 640m intermodal trains and 6-day operation	Paths based on 640m intermodal trains and 5-day operation[1]
Yorkshire	5.5	6.3
North West	9.0	10.8
Scotland	9.0	10.8
West Midlands (inc Daventry)	4.0	4.8
East Midlands	9.3	9.5
West	14.5	14.5
North East	4.0	4.8
Other	1.8	1.8

Notes: Paths shown are in both directions
1 The 5-day figures are likely to be overstated as they include the additional demand induced by 6-day operation. Bulk trains continue to operate 6-days a week.
Paths shown are for all freight traffic not just intermodal traffic.

Table 9.12 – 2030 average freight trains per day between non-London terminals where the shortest route is via London

	Paths based on 640m intermodal trains	Paths based on 640m intermodal trains and 5-day operation[1]
Bristol – Peterborough	2.0	2.4
Northern England – Kent/Essex	0.6	0.6
East Midlands – Berkshire	1.0	1.0
Mendips – Sussex/Kent/Essex	4.7	4.7

Notes:
1 The 5-day figures are likely to be overstated as they include the additional demand induced by 6-day operation
Paths shown are in both directions, with trains operating six days per week.
Paths shown are for all freight traffic not just intermodal traffic.

9.8.2 With respect to the London area most of the growth in domestic traffic is expected to be in trains to and from strategic rail freight interchanges – that is, terminals with modern intermodal rail facilities serving significant concentrations of distribution and logistics industries.

9.8.3 The overall contribution of the domestic intermodal sector to freight growth is expected to be considerable over time and it will be important for network planning purposes to continue to track its development. However, current appraisal of the prospective strategic rail freight interchanges developments in the South East suggests that they do not appear to affect significantly the conclusions emerging up this point with respect to traffic from the ports.

9.8.4 **Table 9.13** indicates the rail freight interchange developments in the South East which the RUS is aware of.

Table 9.13 – potential rail freight interchanges in South East England

Location	Developer/ promoter	Progress with development	Implications for RUS
Alconbury	Urban and Civic	Renewal of planning permission being sought.	Train services likely to fit within appraised options for Haven Ports and Channel Tunnel demand.
London Riverside (Barking area)	Transport for London (TfL)	Mayoral policy supports freight terminals serving HS1 and TfL is working to safeguard suitable sites.	Enables HS1 freight to serve a London destination. Also enables domestic intermodal freight from this area.
Borough Green	Cemex	Early stage of plan development.	Pending developer's view of train numbers/ flows.
Cricklewood	Hammerson	Master plan being progressed.	Rail Freight Interchange (RFI) size expected to be below 'strategic' level.
Howbury Park	Prologis	Planning permission granted.	Requires paths through the congested South London area and interacts with Slade Green depot. 2tph standard off-peak paths to locations in Kent Thameside planned in post-Thameslink timetable which should be sufficient for demand at this site.
Kemsley Fields	Gazeley	Initial proposals being developed with Kilbride, Morrisons and Knauf to assess scope to create new rail freight interchange nearby on former Knauf sidings.	RFI size expected to be below strategic level.
Kent International Gateway	DMI/Axa	Planning permission refused.	Not now expected to proceed.
Northfleet	The former South East England Development Agency	Initial proposals being developed with Gravesham Borough Council, Lafarge, Crossrail and Kimberly-Clark for multimodal industrial/ distribution development.	Requires paths through the congested South London area. 2tph standard off-peak paths to locations in Kent Thameside planned in post-Thameslink timetable which should be sufficient to cater for demand at this site. Could be used in short term to receive up to five spoil trains per day from Crossrail project, other third-party prospects unlikely to exceed two – four trains per day.
Kings Dyke (Peterborough)	Gazeley	Detailed planning application in preparation.	Located on the Felixstowe – Nuneaton cross-country freight route, which is the preferred route for future freight growth.
Radlett	Helioslough	Judicial Review of the Secretary of State's refusal to grant planning consent found in favour of the developer (June 2011). Legal planning process ongoing.	Pending outcome of legal/planning processes.
SIFE (Colnbrook)	Goodman	Planning permission being sought.	Strategic Rail Freight Interchange will be close to existing Channel Tunnel/ WCML routes. No significant additional routeing issues.
Sundon (Luton)	Prologis	Early stage of development.	Pending developer's view of train numbers/ flows.
London Gateway	DP World	Planning permission granted and construction under way.	Significant train paths anticipated once terminal opens, as described in **Section 9.5** earlier. Potential domestic intermodal flows in addition.

9.9 Summary

9.9.1 This chapter has considered the key growth challenges impacting on freight in Southeast England in the future, based on the latest SFN demand forecasts. This work has been developed in close collaboration between the SFN Steering Group, the London and South East RUS Stakeholder Management Group and its freight working group.

9.9.2 The principal conclusions from this chapter are as follows:

- the majority of strategic level capacity issues will arise from intermodal container traffic entering the UK from ports at Southampton, London Gateway, the Haven Ports (Felixstowe and Bathside Bay, Harwich) and via the Channel Tunnel
- a key priority at present is increasing train lengths and implementing six-day operations for key flows. This will require additional currently unfunded infrastructure in some areas but would both increase efficiency and stimulate demand in the short term, and would avoid a lack of capacity in the longer term
- wherever acceptable, new routes for freight traffic not serving London should be developed, to avoid the Capital in response to the above. However this must not impact on the competitive position of rail freight in relation to road haulage. Where not practical to avoid London (notably in the cases of the London Gateway port and for Channel Tunnel traffic) the routeings should be based on avoiding key infrastructure constraints, unless such constraints are realistically resolvable
- the preferred route for most Southampton traffic should be via Oxford. North thereof WCML North traffic runs via the Leamington Spa – Nuneaton route, whilst traffic for terminals in central Birmingham runs via Solihull. A possible new route option to improve flexibility would be the third-party promoted East-West Rail scheme, potentially avoiding the need for southbound at-grade crossing moves at Nuneaton. This is subject to development of the East-West Rail scheme by a third party
- the preferred route for London Gateway traffic should in general be via the Gospel Oak – Barking line and the WCML, since this avoids conflicts with the GEML, represents the most direct route to the majority of terminals and is W10 loading gauge cleared. Electrification of this route was recommended by the Network RUS : Electrification Strategy. The relatively small proportion of traffic requiring an ECML routeing can mostly be accommodated at Forest Gate/ Stratford in the daytime off-peak, with the remainder overnight. Further consideration may be required for these flows, should more traffic materialise than presently forecast, given the criticality of crossing the GEML
- the preferred route for Felixstowe and Bathside Bay (Haven Ports) traffic should be the cross-country route via Bury St Edmunds. However, additional infrastructure enhancements beyond current commitments would be needed to allow all such freight to run this way. The RUS also considers that potential electrification of this route as part of a rolling electrification programme in CP6 would be beneficial, subject to business case
- the preferred route for Channel Tunnel traffic should be on existing routes to the WCML, though use of HS1 for new flows serving London is also likely, possibly with direct trains to HS2 in the longer term
- suitable diversionary routes for all of the above are needed, principally for use overnight and at weekends
- increasing domestic intermodal traffic in the London area is anticipated. This is consistent with the RUS strategy and would be assisted by freight not serving London having alternative routeings. However this requires development of appropriate additional terminal locations in South East England
- freight paths on the WCML will become increasingly scarce as freight traffic builds. This could be alleviated to some extent if all Southampton and Haven Ports traffic were to avoid the London area (except those trains serving the Capital directly). However the longer term solution would be through the construction of HS2
- analysis remains ongoing to determine fully the relevant infrastructure enhancements for inclusion in this strategy.

9.9.3 **Figure 9.2** illustrates graphically the routeings described above.

9.9.4 Further development of the infrastructure required to deliver this strategy will now occur, focussing initially on developing plans for CP5. Further analysis continues by the rail freight industry through the SFN workstream.

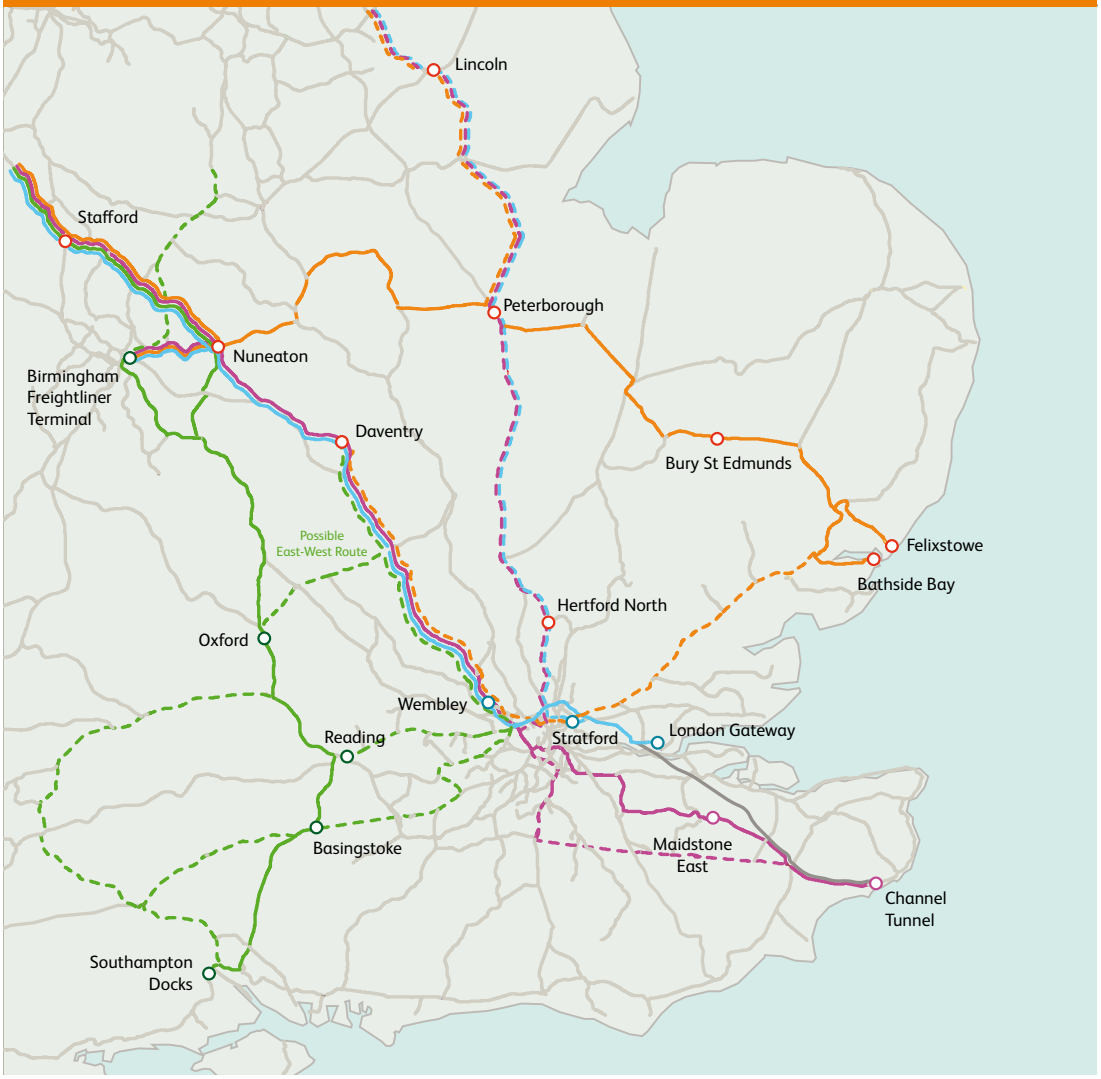
Figure 9.2 – 2031 recommendations for main and alternative freight routeings from South East ports to Midlands, North and Scotland

Felixstowe/Bathside Bay
- Main route
- Alternative route

Southampton Docks
- Main route
- Alternative route

Channel Tunnel
- Main route
- Alternative route

London Gateway
- Main route
- Alternative route



Note that further capacity and capability enhancements will be required on most of these routes to meet the demand objectives

10. Strategy to 2031

10.1 Overview

10.1.1 This Chapter outlines a potential methodology for implementation of this Route Utilisation Strategy (RUS), consistent with its demand forecasts and the assumptions it has made regarding future affordability.

10.1.2 The sections below split the interventions described in this strategy, many of which have been carried forward from previous established RUSs, into potential timings for future implementation. This will be subject to further review, but represents an emerging position.

10.1.3 The split shown is by Network Rail Control Periods, since funding for infrastructure interventions is generally determined utilising these 5-yearly review periods, via Government Statements of Funds Available (SOFAs) and High Level Output Specifications (HLOSs).

10.2 Control Period 4 (to March 2014)

10.2.1 The key elements of the ongoing and fully funded strategy for Control Period 4 (CP4) include infrastructure works, additional rolling stock and train service changes to improve the rail services on offer to passenger and freight users.

10.2.2 Network Rail's CP4 Delivery Plan includes an extensive set of infrastructure enhancement projects in and around London. This is regularly updated on Network Rail's website and includes the following elements, as described in **Chapter 5:**

- Key Output 1 of the Thameslink Programme, enabling 12-car trains to operate on the Bedford – Brighton line
- an extensive platform lengthening programme on London area routes, principally those currently operated by South West Trains (10-car suburban), Southern Railway (10-car suburban via Balham and Sydenham, 12-car on the East Grinstead line), Southeastern (12-car suburban), West Anglia (12-car Cambridge line) and c2c (12-car on the Tilbury Loop)
- power supply enhancement works in certain areas, to facilitate the train lengthening
- capacity for additional peak trains on certain routes, for example on the Chiltern Main Line (following the Evergreen 3 project – including provision of a new route to Oxford) and on the Windsor lines (utilising the disused former International Platforms at London Waterloo)
- infrastructure schemes targeting key bottlenecks on radial lines, for example Hitchin flyover and Alexandra Palace – Finsbury Park upgrade on the East Coast Main Line (ECML), major improvements in the Reading station area on the Great Western Main Line (GWML) and additional track layout capacity at Gatwick Airport on the Brighton Main Line
- completion of the London Overground network with a further extension to the East London Line to Clapham Junction via Denmark Hill
- freight capacity upgrade schemes such as the Nuneaton North Chord, enabling the growth element of traffic to/from the Haven Ports (Felixstowe and Bathside Bay) to be routed to the West Coast Main Line via Bury St Edmunds, and also upgrades to enable additional traffic to use the route via Lincoln
- freight capability upgrades, notably the recently completed W10 loading gauge clearance works on routes from Felixstowe and Southampton, enabling the carriage of 9'6" international shipping containers on standard wagons
- upgrading of the capacity and quality of key stations, including works at London King's Cross, London Blackfriars, Farringdon, London Cannon Street and East Croydon
- The early stages of work on the Crossrail Programme.

10.2.3 Rolling stock changes include provision of vehicles to allow some services to be lengthened as a result of the platform lengthening above. However the Department for Transport's (DfT) rolling stock strategy no longer specifically states additional vehicles to be procured by 2014, so it is now envisaged that these vehicles will be phased in progressively across the coming years.

10.2.4 Major timetable changes in CP4 include a new timetable on the Chiltern Main Line, the recently introduced new timetable on the East Coast Main Line, the full London Overground timetable, the recent extension of Southeastern highspeed services to Maidstone West and Deal, plus numerous smaller changes.

10.2.5 Further changes can be anticipated as passenger franchises are renewed.

10.2.6 This time period also includes ongoing consultation into plans for construction of High Speed 2 (HS2).

10.2.7 Consistent with Sir Roy McNulty's 'Value for Money' rail study, as outlined in **Chapter 2**, significant changes to industry working arrangements and the improved alignment of incentives across the many different organisations which make up the overall system are anticipated within the early years of this strategy. The affordability of the interventions recommended by this RUS for subsequent control periods is likely to be dependent on a successful outcome of this approach in CP4. Also in light of the McNulty report, the DfT now plans to conduct a review of fares policy, with changes potentially commencing within this timescale.

10.3 Control Period 5 (April 2014 to March 2019)

10.3.1 In order to fully utilise the network capacity which will be available in Control Period 5 (CP5) additional rolling stock, to provide further on-train space, is seen as a priority for this period. This is because the scope of committed CP4 platform lengthening would facilitate significantly more train lengthening than is committed at present.

10.3.2 The Crossrail and Thameslink Programme rolling stock orders will respond significantly to this issue, but the extent of any gap in rolling stock requirements in and around the Capital after them is dependent on the amount of rolling stock currently in use in South East England which is cascaded elsewhere. This is not fully known at present.

10.3.3 It is emphasised that many lines have specific requirements regarding rolling stock. For example additional diesel rolling stock would be required for the Uckfield line unless the route was electrified, whilst the West London Line requires dual voltage AC/DC compatible vehicles. Several routes require vehicles equipped with Selective Door Operation (SDO), which is not fitted to many older trains and is extremely difficult to retro fit. Any further expansion of high speed services in Kent would require additional Class 395 vehicles or similar.

10.3.4 Key infrastructure schemes during this period will include the completion of major projects ongoing at present and new projects already announced, together with other RUS recommendations. This is envisaged by this RUS as including:

- completion of the Crossrail Programme, providing a new high capacity cross-London route on an east west axis. This will free up some platform capacity at London Paddington and London Liverpool Street for other elements of this strategy

- major remodelling work, with numerous complex individual stages and lasting nearly the whole of CP5, in the London Bridge area under the Thameslink Programme. This will provide new cross-London capacity on a north south axis and some additional trains into London. Several routes (for example the Brighton Main Line) will benefit directly and others (eg the Hertford Loop) are expected to benefit indirectly as existing capacity is reallocated as explained in **Chapter 5**
- further platform lengthening on routes not funded in CP4, potentially including 10-car capability between Virginia Water and Reading, 12-car capability between Gravesend (to include Strood and Rochester), eight-car on the West London Line, 10-car on the Uckfield line (23m vehicles) and 10-car for services joining at Purley (from the Caterham and Tattenham Corner routes) and running to London Victoria
- further targeted capacity enhancements at key bottlenecks, including at Redhill on the Brighton Main Line, at Bow Junction on the Great Eastern Main Line and through the Medway Towns
- infrastructure to facilitate incremental service improvements on the West Anglia route, potentially starting with the Brimsdown turnback scheme to facilitate a four trains per hour service from the Lea Valley to Startford
- further freight upgrades, enabling additional traffic to run via Bury St Edmunds and work to enable an electrified Gospel Oak – Barking line to become a key route for freight
- work on loading gauge clearance for additional freight diversionary routes, especially from Southampton
- implementation of the Intercity Express Programme (IEP) on an electrified GWML and on the ECML
- further station upgrades, including locations not resolved in CP4 such as London Charing Cross and Clapham Junction
- detailed planning of a western connection to Heathrow Airport.

10.3.5 Towards the end of CP5 on certain routes the demand forecasts in this RUS do not indicate a peak capacity gap, so the emphasis will move away from providing additional peak capacity towards improving the journey experience in other ways. Once robust performance has been achieved the RUS notes that a key aspiration of many stakeholders has been to achieve a reduction in journey times. This particularly applies to those routes which are significantly slower than others a comparable distance from London, for example much of West Kent which has not directly benefitted from High Speed 1 (HS1). Previous RUS analysis has shown a strong case for investment in journey time reduction, whether by upgrading the infrastructure, changing the rolling stock or optimising the timetable pattern.

10.3.6 Development of detailed plans for High Speed 2 (HS2) is anticipated during CP5, including the start of enabling works at key sites. As described in this RUS detailed planning of the Old Oak Common area to become a strategic transport hub, with several routes linking to both HS2 and Crossrail services at this location, is recommended.

10.3.7 Other developments during this time are likely to include much more intensive use of HS1, with services anticipated from London St Pancras International to a range of European destinations, as part of a general trend in passengers switching from short-haul aviation to rail.

10.3.8 Additional peak trains into London Waterloo on the Windsor Lines would be operationally viable at this stage, in the event that demand requires.

10.3.9 As described above, the DfT now plans to conduct a review of fares policy, which will include addressing anomalies in the current system and the potential for much greater use of smart ticketing technology. For example, at present, there is a very inflexible system of season tickets and by CP5 options to address this can be expected. Currently when a commuter purchases a season ticket this is priced on the basis that they will travel in peak hours five days per week for most of the year. However, increasingly people now have opportunities for flexible working patterns which are not encouraged by this fixed-price approach. Smart ticketing technology has the potential to recognise people who have a pattern of work that allows them to occasionally work away from their main workplace and can therefore provide incentives to commuters to use the railway outside the busiest peak times.

10.3.10 The DfT will continue to specify smart ticketing requirements as rail franchises are renewed and this will progressively start to influence passenger demand at the busiest times.

10.4 Control Period 6 (April 2019 to March 2024)

10.4.1 Prior to Control Period 6 (CP6) the Crossrail and Thameslink Programmes will have been completed, so other major projects are more likely to be affordable.

10.4.2 Interventions in this time period are envisaged by the RUS as including:

- the commencement of major work on HS2
- the possible commencement of work on a Crossrail extension to the West Coast Main Line, interacting significantly with the above in the Old Oak Common area
- the development of other routes in and around the Old Oak Common area to provide synergy with HS2
- the potential provision of a western rail connection to Heathrow Airport (if not provided earlier), with routes towards Reading via Slough and to Staines
- possible implementation of a 10 trains per hour Crossrail service to Heathrow Airport, incorporating existing Heathrow Express operations
- implementation of additional fast trains from the outer Thames Valley to London Paddington at peak times, facilitated by the above
- platform lengthening on any routes not delivered in CP4 or CP5, for example on the North London Line
- further development of West Anglia routes, with either a new Chingford to Stratford service or additional infrastructure to enable more frequent Lea Valley to Stratford services
- extension of the IEP to cover an electrified Midland Main Line, with infill electrification schemes elsewhere
- resignalling on the approaches to London Waterloo, together with associated works such as the Woking flyover to potentially allow some additional trains to operate without requiring more tracks elsewhere (though this would be dependent on advanced signalling technologies to allow additional trains to operate robustly, and would not be a full solution to capacity on this route)
- route extension schemes to the existing Transport for London network, as outlined in **Chapter 8**, with the completion of smaller schemes and detailed planning work on major extensions to the London Underground Bakerloo Line and the Docklands Light Railway
- detailed planning for Crossrail line 2, which the RUS anticipates would be on an updated alignment to serve both London Euston (for HS2) and Clapham Junction.

10.4.3 In addition during this time period it is noted that new train control technologies will become available, based on the European Rail Traffic Management System. This has potential to simplify major infrastructure upgrade schemes and future maintenance, by removing much of the need for lineside signalling equipment.

10.4.4 Also in connection with new technologies the potential use of tram-train vehicles may enable a reconsideration of the business cases for some new or re-opened railway alignments by around this time period, principally in rural areas.

10.5 Control Period 7 (April 2024 to March 2029)

10.5.1 The key infrastructure interventions during this time period envisaged by the RUS could include:

- the completion of work on HS2 as far as Birmingham, with work commencing on expansion of the network towards Manchester and Leeds
- further development of the Old Oak Common area as a new strategic transport hub, potentially including new services to Europe via the HS1-HS2 link
- construction of the Crossrail line 2 route and other improvements to the Transport for London system
- potential construction of an additional track from Surbiton to London Waterloo, to allow additional services on the South West Main Line, subject to business case.

10.5.2 By the late 2020s passenger expectations will be significantly higher than today, with new technologies for passenger information and ticketing in particular greatly simplifying the journey experience. Robust train performance, safety and cost efficiency will remain key priorities.

11. Solent and South Hampshire

11.1 Introduction

The South West Main Line Route Utilisation Strategy (RUS) (Network Rail, March 2006) was the first RUS to be published since responsibility passed from the Strategic Rail Authority to Network Rail following the Government's White Paper in 2005. The RUS investigated future demand from Waterloo to Portsmouth, Southampton, Bournemouth, Weymouth, Salisbury, Exeter and Reading. In the light of changed service patterns and demand, the London and South East RUS Stakeholder Management Group (SMG) identified that a re-examination of services and potential gaps in the Solent and South Hampshire areas was warranted. This chapter describes the analysis and results of this study.

11.2 Dimensions

11.2.1 Geographical scope

The geographical scope, by lines of route, is defined as:

- South West Main Line (SWML): Basingstoke to Totton
- Netley line: Fareham to Southampton Central via Netley
- Botley line: Fareham to Eastleigh via Botley
- Test Valley line: Redbridge to Salisbury
- Marchwood branch: Totton to Fawley
- Chandler's Ford line: Eastleigh to Romsey
- Cosham line: Fareham to Portsmouth Harbour
- Bedhampton line: Havant to Hilsea
- Portsmouth Direct: Woking to Havant via Guildford[1]
- Alton line: Ash Vale to Alton[1].

The Solent and South Hampshire area is shown by line of route in **Figure 11.3**.

Key stations are Winchester, Eastleigh, Southampton Airport Parkway, Southampton Central, Fareham, Havant, Portsmouth & Southsea and Portsmouth Harbour.

Freight facilities and terminals are located at Eastleigh, Southampton (Eastern and Western Docks), Millbrook, Botley, Fareham, Marchwood, Fawley and Fratton.

11.2.2 Time horizon

This chapter examines in detail a time period of 20 years to 2031.

11.2.3 Planning context – Department for Transport

The Government's High Level Output Specification (HLOS) identifying requirements for the rail network in Control Period 4 (CP4) (2009–2014) was published in 2007, after the publication of the South West Main Line RUS. Alongside this, the Government also published its Statement of Funds Available (SOFA), identifying the funding which would be made available to the rail industry. This was followed by Network Rail's publication of its Strategic Business Plan (SBP) for CP4, in response to the above. The Office of Rail Regulation (ORR) reviewed the SBP and SOFA and allocated funds accordingly. Network Rail and its industry partners are in the early stages of preparing the Control Period 5 (CP5) (2014 – 2019) submissions.

The Department for Transport (DFT) published its Southern Regional Planning Assessment (RPA) in January 2007, which highlights some gaps and options within the Solent & South Hampshire area. A specific planning context for the railway is set by the DfT. The following are the DfT's most significant documents of relevance for the Solent and South Hampshire study area of the London and South East RUS:

- 'Delivering a Sustainable Railway', a White Paper published in 2007
- 'The Southern Regional Planning Assessment for the Railways', published in 2007
- 'The Eddington Transport Study', published in 2006.

Planning for the transport system needs to recognise that today's travel patterns will be influenced by demographic trends, employment opportunities, land use changes and many other factors affecting society as a whole. Transportation issues are therefore intrinsically linked to the wider planning process. The strategy recommended by this RUS seeks to be consistent with wider intentions of the relevant planning authorities for the area which it covers. However, it must also be consistent with government policies (as specified by the DfT) regarding transportation issues and funding.

1 These two lines of route technically fall outside the scope area but journey time improvements have been considered on these routes.

11.2.4 South East England Regional Assembly and South East England Development Agency

Although disbanded by the Coalition Government, the South East England Regional Assembly (SEERA) and South East England Development Agency (SEEDA) developed the South East Plan, published in May 2009, to set out a vision for the South East to 2026. Whilst there is uncertainty about the future role of the Plan, it is included here as many local authorities are continuing with the identified workstreams.

11.2.5 Planning context – Transport for South Hampshire

Hampshire County Council, Portsmouth City Council, Southampton City Council and local district councils have formed Transport for South Hampshire (TfSH). The TfSH Joint Committee meets regularly and works closely with Network Rail, South West Trains, Freightliner and other key business stakeholders, such as Associated British Ports, bus operators etc. on transport matters. TfSH is a strategic planning body and has no influence on everyday operational issues. TfSH is the Transport Advisor to the Partnership for Urban South Hampshire (PUSH) and is looking to play a similar role with the new Solent Local Enterprise Partnership (LEP).

TfSH is currently delivering a number of schemes including the South Hampshire Bus Rapid Transit system which is under construction. Originally planned as a light rail system, this has been transformed into a non-guided busway utilising the alignment of the former Fareham to Gosport railway line. This will interchange with National Rail at Fareham station. TfSH has a long-term aspiration to operate tram-train services on the St Denys – Fareham (Netley) line.

11.2.6 Planning context – local authorities

The local authorities (such as County Councils and District Councils) also prepare their own local transport plans, local development frameworks or local implementation plans. These can also be of relevance to the RUS. Many of these are currently being updated. Within the context provided by the national and regional planning authorities, other local authorities have produced/are producing spatial development and implementation plans which also cover transport issues. These authorities include counties, unitary authorities, districts and boroughs. The following local authorities are particularly relevant to the geographic scope of the Solent and South Hampshire section of this RUS:

- Basingstoke & Deane Borough Council
- Chichester District Council
- East Hampshire District Council
- Eastleigh Borough Council
- Fareham Borough Council
- Gosport Borough Council
- Guildford Borough Council
- Hampshire County Council
- Hart District Council
- Havant Borough Council
- New Forest District Council
- New Forest National Park Authority
- Portsmouth City Council
- Rushmoor Borough Council
- Southampton City Council
- Surrey County Council
- Test Valley Borough Council
- Waverley Borough Council
- West Sussex County Council
- Wiltshire Council
- Winchester City Council
- Woking Borough Council.

11.2.7 Local Enterprise Partnerships

LEPs have recently been established. The Solent & South Hampshire area is covered by two such groups:

- Solent LEP – PUSH area (South Hampshire, Southampton and Portsmouth)
- Enterprise M3 LEP – North Hampshire and West Surrey.

The role of the LEPs will be to support economic growth, regeneration and job creation within their areas. Both LEPs have identified congestion and transport infrastructure as priority areas to be tackled. Rail improvements are likely to feature heavily in the aspirations of both LEPs as this mode is recognised as being vital to improving connectivity and supporting low-carbon access to employment hubs such as Basingstoke, Southampton and Portsmouth, which are expected to be significant generators of new employment over the period of the RUS. As well as being informed by LEPs, current regional and local planning policies, the RUS will also inform future policy-making within its geographic scope. It can, for example, influence planning decisions regarding the location of major proposed developments, since most local policies require that these should be located in areas with adequate transport links.

11.2.8 Links to other RUSs

The Solent and South Hampshire section of the London and South East RUS builds on the findings of the South West Main Line RUS (Network Rail, March 2006) which developed a strategy for the years between 2007 and 2017 (the length of the current South Western franchise).

This section interfaces with other parts of the railway network through the following geographic RUSs:

- Sussex RUS (Network Rail, January 2010) which interfaces at Havant, with regard to the West Coastway route via Chichester to Brighton or Gatwick Airport and London Victoria
- Great Western RUS (Network Rail, March 2010) which interfaces at Salisbury for services to Portsmouth Harbour/Brighton from Cardiff and the West

and with various national elements of the RUS programme:

- the Freight RUS (Network Rail, March 2007), which made recommendations on the key strategic gaps for freight across the network as a whole and provided freight demand forecasts to 2014/15
- the Network RUS which is developing a number of workstreams at a national level:
  - Scenarios and Long Distance Forecasts (Network Rail, June 2009, established by the ORR)
  - Stations (Draft for Consultation published by Network Rail, May 2011)
  - Passenger Rolling Stock published as a Draft for Consultation by Network Rail, May 2011
  - Passenger Rolling Stock Depot Planning Guidance published as Draft for Consultation by Network Rail, June 2011
  - Electrification Strategy (Network Rail, October 2009, established by the ORR)
  - All RUS publications are available at **www.networkrail.co.uk**.

11.2.9 Assumptions about committed schemes

In preparing the base case (or do-minimum) demand forecasts for future years, it has been assumed that the scheme contained in Network Rail's March 2010 Route Plan (Route C) will be delivered:

- provision of W10 freight gauge between Southampton and the West Coast Main Line on the diversionary route via Andover in 2013.

11.2.10 Assumptions about future funding

The RUS assumes the scheme detailed in **11.2.9** is funded, or part funded, under the CP4 settlement. Any further recommendations made by this RUS for infrastructure schemes that could be implemented in CP4 are made with a stated caveat that they would have to be funded through the Network Rail Discretionary Fund (NRDF) and/or a third party source.

For schemes proposed beyond CP4, specific funding sources are not identified as it is envisaged these would be proposed by Network Rail for funding in CP5 or beyond. Further development of these schemes may in some cases take place through the CP5 development fund allocated by the ORR to Network Rail.

11.3. Current demand, capability and delivery

11.3.1 Introduction

This section considers the present day function and capability of the rail network in the Solent and South Hampshire area. Profiles are provided of passenger operations and freight movements, as well as information about current demand patterns, infrastructure, how the railway performs and how it is maintained.

11.3.2 Profile of the passenger market

Figure 11.1 shows that the Solent and South Hampshire area passenger market is dominated by journeys to and from London and within the area itself. This is closely followed by other medium distance journeys to and from the South East and South West regions. Most of the travel to the South West region is local journeys just over the border into Dorset or Wiltshire, with longer distance journeys to the rest of the country comprising only a small proportion of the demand from the passenger market.

The most significant flows are to Southampton and Portsmouth city centres, followed by flows to London. Significant numbers of passengers pass through the Solent & South Hampshire area or use trains to connect with flights at Southampton Airport and ferries at Southampton and Portsmouth to or from the Isle of Wight and the Continent.

Figure 11.2 shows robust growth in the decade to 2008 in journeys within the Solent and South Hampshire area in all segments of the passenger market, averaging about 4.7 per cent per annum.

There is significant competition for passengers on the parallel road networks between Southampton/ Portsmouth and Sussex, between Southampton, Winchester and destinations towards London and to Bournemouth, Poole and Dorset.

Figure 11.1 – rail demand by destination/origin

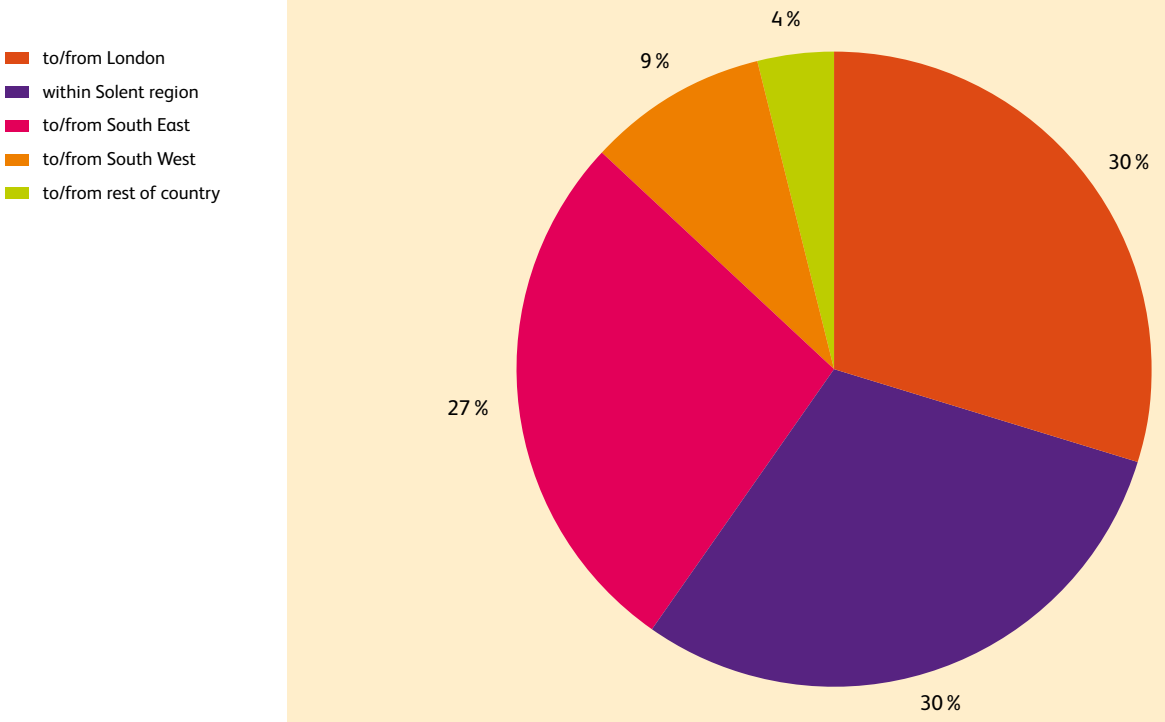
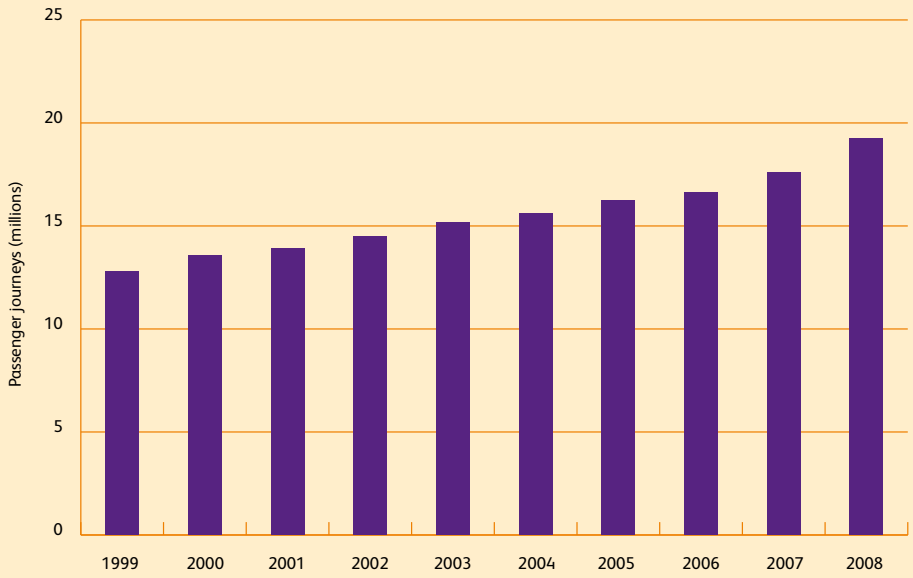


Figure 11.2 – growth in passenger journeys within the Solent and South Hampshire region



11.3.3 Passenger train services

At present, four franchised passenger train operating companies (TOCs) run scheduled services within the Solent and South Hampshire area:

- Stagecoach South Western Trains (trading as South West Trains), the largest operator within the area with trains on all passenger routes. Franchise dates: February 2007 – February 2017. This TOC will be referred to in this chapter as SWT
- New Southern Railway (trading as Southern) operates services from London Victoria and Brighton along the coast via Chichester to Portsmouth and Southampton. Franchise dates: September 2009 – September 2015. This TOC will be referred to in this chapter as Southern
- First Great Western (FGW) operates trains from Wales and the West Country to Portsmouth and Brighton. Also operates services from Reading to Redhill and Gatwick Airport via Guildford. Franchise dates: April 2006 – April 2016
- CrossCountry provides trains from Manchester to Bournemouth and Newcastle to Reading and Southampton. Franchise dates: November 2007 – April 2016.

There are currently no daily timetabled open access passenger train operators although charter trains such as the British Pullman and the Cruise Saver Express (Glasgow/Edinburgh to Southampton Docks), operated by Direct Rail Services (DRS), regularly operate in this area.

Passenger services are detailed below by line of route:

South West Main Line

- direct fast and semi-fast services to London Waterloo from Weymouth, Wareham, Poole, Bournemouth, Southampton Central, Eastleigh and Winchester
- direct semi-fast trains from Portsmouth Harbour to London Waterloo via Fareham and the Botley line
- direct trains from Bournemouth, Southampton Central, Southampton Airport Parkway and Winchester to Reading, the Midlands and the North
- trains predominantly on other routes as detailed in the following text.

Portsmouth and Bedhampton Lines (also Portsmouth Direct, partially in scope)

- direct fast and semi-fast services from Portsmouth Harbour/Portsmouth & Southsea to London Waterloo
- direct semi-fast trains from Portsmouth Harbour/Portsmouth & Southsea and Havant to Chichester which alternate beyond to Brighton or Gatwick Airport and London Victoria via Horsham
- direct semi-fast services from Southampton Central and Havant to Chichester which alternate beyond to Brighton or Gatwick Airport and London Victoria via Horsham
- direct stopping services between Portsmouth Harbour/Portsmouth & Southsea and Havant to Chichester and Littlehampton
- direct fast services between Portsmouth Harbour or Brighton, Fareham, Southampton Central and Bristol Temple Meads and South Wales
- direct semi-fast trains between Portsmouth Harbour, Fareham, Eastleigh and London Waterloo
- direct stopping service between Portsmouth Harbour/Portsmouth & Southsea and Southampton Central.

Netley, Botley and Cosham lines

- direct fast services Southampton Central to Fareham, Havant and Chichester, alternately continuing to Brighton or Gatwick Airport and London Victoria via Horsham
- direct fast trains Southampton Central to Fareham and Portsmouth Harbour from Salisbury, Bristol Temple Meads and South Wales
- direct stopping service between Southampton Central and Portsmouth & Southsea/ Portsmouth Harbour
- direct semi-fast trains Portsmouth, Fareham, Eastleigh to London Waterloo.

Test Valley and Chandler's Ford lines

- fast services from South Wales, Bristol Temple Meads, Salisbury, Romsey to Southampton Central, and Portsmouth or Brighton
- stopping services from Salisbury to Romsey via Southampton Central, Southampton Airport Parkway, Eastleigh and Chandler's Ford (and vice-versa).

Alton line (partially in scope)

- direct fast and semi-fast trains from Alton, Farnham and Aldershot to London Waterloo.

Non-London trains on the Alton and Portsmouth Direct lines are out of scope.

There is some overcrowding on certain peak services into both Southampton Central and Portsmouth & Southsea/Portsmouth Harbour, particularly those formed of two, three or four-car units although this was not identified as a gap by the SMG as an intervention has already been proposed by the Great Western RUS:

- Cardiff to Portsmouth services: five additional vehicles to enhance two morning peak services and three evening peak services (Great Western RUS, 8.3 Strategy for CP5).

Figure 11.3 – Solent and South Hampshire

Figure 11.4 – existing staion usage

Source: Office of Rail Regulation/Delta Rail – Station usage data 2009/10

11.3.4 Stations and station usage

Station usage statistics are shown in **Figure 11.4**. The interchange figures are rail-to-rail only and do not cover other modes of transport. There is a large variance in patronage between stations within the study area reflecting not only the size of the community the station serves but the provision of car parking, other facilities and local bus services. Station facilities are shown in **Figure 11.5**.

Key rail-to-rail interchange stations are Southampton Central, Eastleigh, Winchester, Fareham, Fratton and Havant. Some of these stations are for cross-platform or same platform interchange between faster and slower services, whilst others are for alternative routes/destinations.

Other modes of transport also interchange at many of the stations – motorists are attracted to the park and ride facilities at Southampton Airport Parkway, whilst many other stations have an interchange with local buses. A number of connecting and through ticketing arrangements have been made with bus operators across the area under the PLUSBUS branding. **Figure 11.5** shows the locations where such facilities exist.

Southampton Central station is an interchange for Isle of Wight ferries and cruise liners, via the local bus services or taxis, while Portsmouth Harbour provides direct interchange with Isle of Wight ferries.

A variety of cycle storage facilities exists at stations, from 'Sheffield' stands to lockers, with or without Closed Circuit Television (CCTV) coverage. Some stations have very limited cycle storage which makes mode shift from car to cycle and train harder to achieve as most train operators restrict the carriage of non-folding cycles on trains in peak periods.

Figure 11.5 – station facilities map

Figure 11.6 – freight terminals

11.3.5 Freight train operators

Of the current licensed freight operating companies (FOCs) the following operate services in the Solent and South Hampshire area:

- DB Schenker (DBS), which is the largest freight operator in Great Britain and is part of the German national railway company Deutsche Bahn AG. DBS runs trains for a large range of markets and is organised into three market-based groups: Logistics (door-to-door deliveries with or without rail haulage), Construction (aggregates, construction, waste and rail industry flows) and Industrial (movement of heavy raw materials such as coal, metal and petroleum products)
- Freightliner Group has two freight operating companies: Freightliner Limited and Freightliner Heavy Haul. Freightliner Limited is the largest rail haulier of containerised traffic in the UK, predominantly for the deep sea market. Freightliner Heavy Haul is a significant conveyor of bulk goods, predominantly coal, construction materials and waste. It also operates infrastructure services
- GB Railfreight (GBRf), part of Eurotunnel's Europorte rail freight business, operates in the following markets: Coal, Bulk Commodities (such as dry goods for the construction industry), Rail Services (rail industry movements), Intermodal (containers etc) and Infrastructure (trains for engineering works (infrastructure), de-icing, etc)
- Colas Rail, a subsidiary of a large French infrastructure company, Bouygues. Nationally Colas operates a number of services including timber, flyash, steel and Channel Tunnel intermodal flows
- Direct Rail Services (DRS) is a subsidiary company of the Nuclear Decommissioning Authority. The freight operations are split into the following sectors: Specialist Freight, Domestic Intermodal Freight (container traffic), Maintenance Services (locomotive and rolling stock maintenance), and Rail Infrastructure Support Services (such as infrastructure, weed-spraying and snow clearance trains).

11.3.6 Profile of the freight market

The Solent and South Hampshire area is a mixed traffic railway. Aside from the large number of passenger trains, there are a number of freight terminals within the area, as shown in **Figure 11.6**, including three terminals at Southampton Docks, which is the second-largest container port in the UK and one of the biggest in Europe.

The main freight flows are containers to/from Southampton Docks. Containerised traffic is intermodal – easily swapped between ship and train and/or truck. This traffic is most profitable where a long distance is to be covered by rail. Containers have developed considerably since the original standard shipping container was introduced. To meet these changes, specialist 'low deck' and 'pocket' wagons have been developed, but these result in either excessive wheel/rail wear because of unusually small wheels, or fewer containers per train because of redundant space over the bogies. The Freight RUS advocated a progressive programme of infrastructure work to increase the loading gauge so that larger containers can be carried on conventional wagons. The Strategic Freight Network funded through the CP4 HLOS included this investment for the direct route between Southampton Docks and the West Coast Main Line in the Midlands. **Figure 11.7** shows the loading gauges of routes with the area.

Regular automotive trains also operate between Southampton Eastern Docks the North West.

Infrastructure trains, for engineering works, are loaded and marshalled at Eastleigh East Yard. New ballast is loaded into trains here and old ballast is unloaded and recycled at an adjacent facility. Long welded rail trains are loaded using specialist equipment and unloaded on site by the train.

Oil trains operate between Fawley and Holybourne (between Farnham and Alton) and a range of rail diesel fuelling points nationally. These trains take tanker traffic off the roads and transport it directly from terminal to terminal.

A significant amount of Ministry of Defence traffic is carried to and from Southampton Military Port, Marchwood.

Aggregates traffic operates to Eastleigh, Botley and Fareham. Rail is particularly suited to the transportation of this commodity for both economic and environmental reasons. Aggregates products tend to have a relatively low unit value, as a result of which transportation costs comprise a large proportion of the end price. With a typical payload of at least 1,000 tonnes per train, rail can carry large volumes reliably and economically.

Aside from freight operations, FOCs are also involved in the movement of rolling stock in/out of storage/maintenance, Network Rail test trains, on-track plant operations, 'thunderbird'[2] locomotives, rail head treatment trains[3] and de-icer[4] operations.

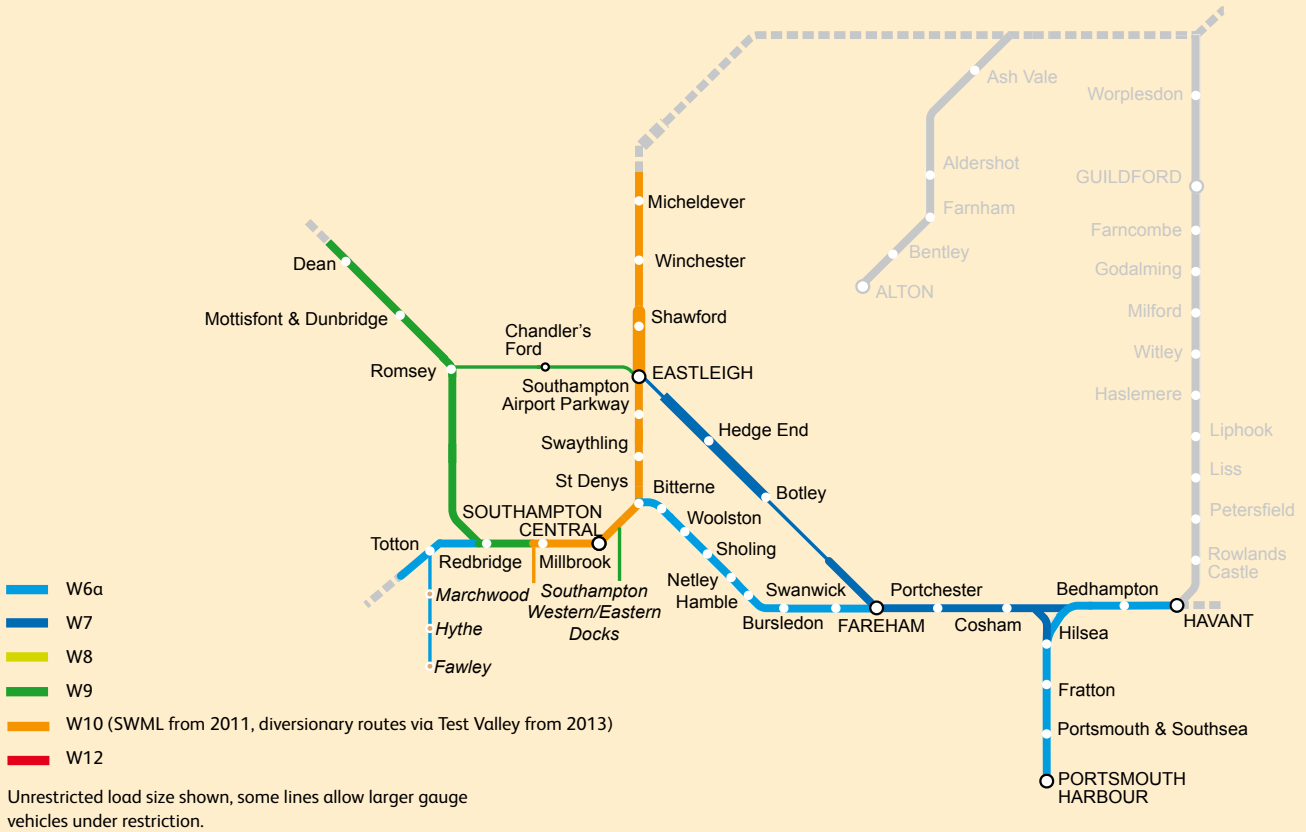
2 Thunderbird locomotives are standby locomotives which can be called upon to rescue/assist a broken down train.
3 Rail head treatment trains are operated during the autumn period to apply a sand mixture to the railhead to aid adhesion – these trains are either locomotive-hauled or self-propelled MPV (multi-purpose vehicle) operated.
4 De-icer trains operate over the third-rail network in winter to spray anti-icing fluid onto the conductor rail to prevent the formation of ice on the contact surface.

11.3.7 Freight-specific infrastructure

The loading gauges within the Solent and South Hampshire area are shown in **Figure 11.7** and a graphic illustrating the various gauges is shown in **Figure 9.1**. Loading gauge defines the maximum width and height of vehicles and their loads that can be safely accommodated without fouling structures such as bridges and platforms.

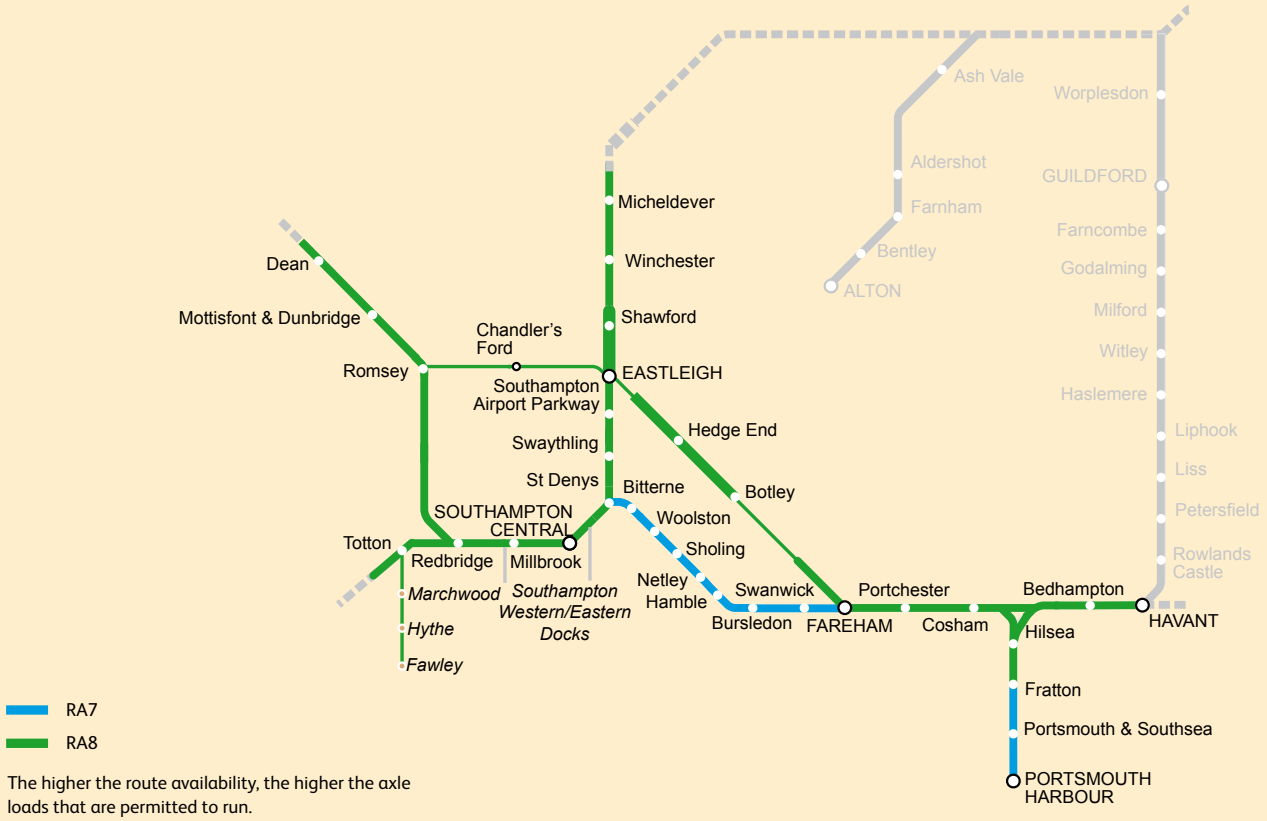
Route Availability (RA) is a system for determining which types of locomotive and rolling stock can travel over any given section of route and is normally a function of the strength of underline bridges in relation to axle load and speed. A locomotive rated as RA8, for example, would not normally be permitted on a route rated as RA6. **Figure 11.8** shows the RA for the study area.

Figure 11.7 – loading gauge



Unrestricted load size shown, some lines allow larger gauge vehicles under restriction.

Figure 11.8 – route availability



The higher the route availability, the higher the axle loads that are permitted to run.

11.3.8 General infrastructure

This section describes more general aspects of the infrastructure in the Solent and South Hampshire area, including:

- linespeeds
- signalling
- electrification
- platform lengths.

Figure 11.9 shows the existing linespeeds within the study area. Most of the network has maximum plain line speeds of between 60 mph and 100 mph. However, there are some sections of track where high speeds cannot be attained due to factors such as gradient, track curvature and level crossings, thus limiting capacity and adversely affecting journey times.

Figure 11.10 shows the four Area Signalling Centres (ASCs) and signal boxes and their boundaries within the Solent and South Hampshire area. Signalling headways are shown in **Figure 11.11** and the 40 level crossings of six different types are shown in **Figure 11.12**.

Most of the area has third rail 750V DC electrification. However, the Test Valley and Chandler's Ford lines are not electrified so passenger services are presently provided by Class 153, 158 and 159 diesel units. The Marchwood Branch and Southampton Eastern and Western Docks lines are also non-electrified. Freight traffic is predominantly hauled by diesel locomotives although a small fleet of Class 73 electro-diesel (dual powered) locomotives are also used. Some services that run in the Solent and South Hampshire area are also operated by diesel units by virtue of the fact that they originate on non-electrified routes outside the area. The main examples are the CrossCountry services from Manchester Piccadilly to Bournemouth and Newcastle to Southampton Central, as well as the FGW services between Cardiff Central and Portsmouth Harbour or Brighton.

Existing platform lengths are shown in **Figure 11.13**.

Eastleigh Works is used for storage, maintenance and refurbishment of trains. To the south of the Works there are numerous sidings operated by DBS and regularly used for maintenance and refuelling in addition to storing locomotives and rolling stock.

SWT's Class 444 & 450 Desiro fleet are based at Siemen's Northam Depot, between Southampton Central and St Denys and return here for maintenance and repairs. Day-to-day cleaning and berthing between duties are carried out at a number of depots such as Fratton.

CrossCountry's Class 220 & 221 and FGW's Class 158 units are also cleaned, refuelled and berthed at Eastleigh or Fratton.

In the Solent and South Hampshire area berthing sidings are located at Eastleigh, Winchester and Portsmouth & Southsea.

Figure 11.9 – linespeeds

Highest maximum permitted speed shown – may be applicable to one line only.

Figure 11.10 – signal boxes and Area Signalling Centres

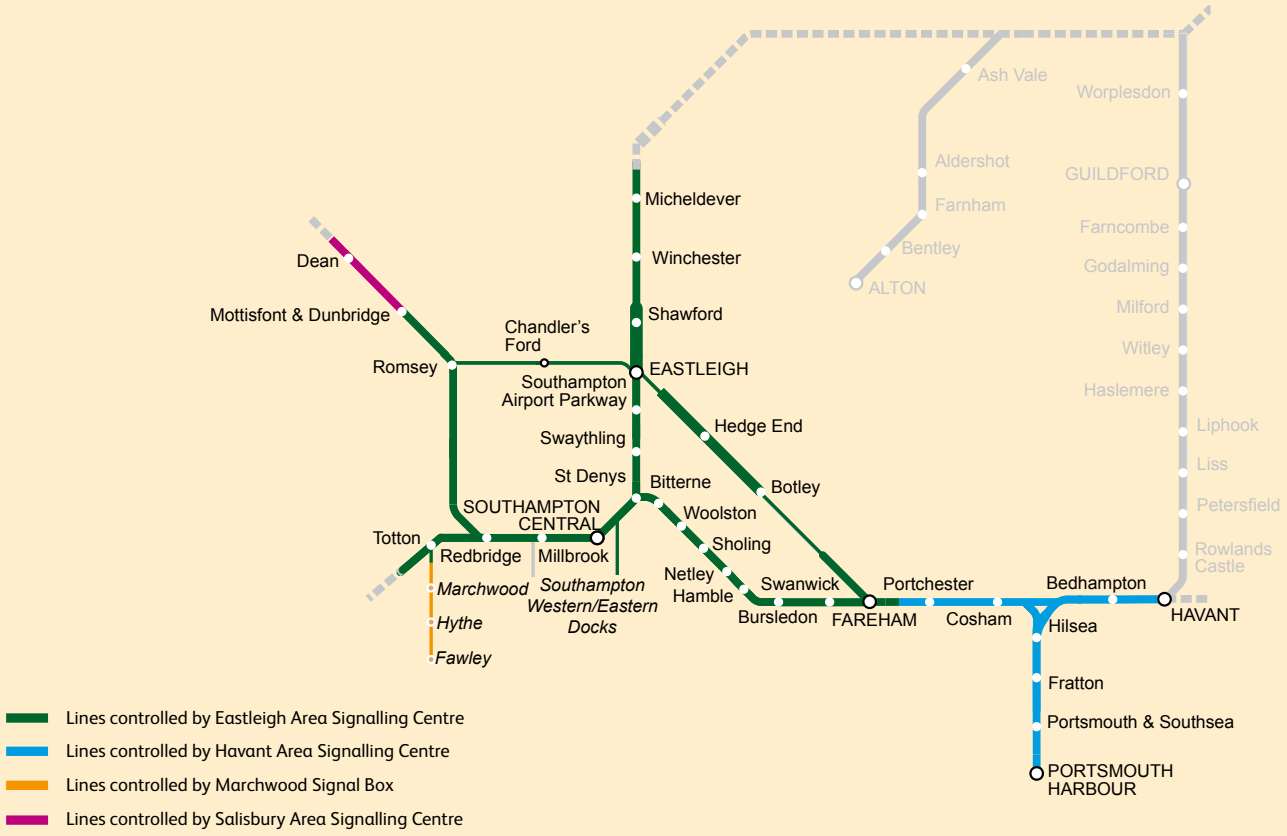


Figure 11.11 – signalling headways

Fast and slow trains often have different signalling headways eg 2 mins for Fast trains and 2½ mins for slow trains.

Hatched line shows the fast and slow train headways are in different time bands as shown above.

Figure 11.12 – level crossings

Figure 11.13 – platform lengths

Class 220, 221 & 444 units have 23.57-metre long vehicles.
Actual platform lengths may vary from those described above.

11.4. Committed service changes, associated schemes and Transport for South Hampshire proposals

11.4.1 Introduction

This section describes the planned train service changes, together with the committed (funded) infrastructure enhancement schemes due for implementation during the early years of the London and South East RUS to 2015. The RUS assumes that committed service changes and associated schemes will happen as planned and they therefore form part of the baseline. Any interventions proposed by the RUS are assessed against this 'do-minimum' scenario, rather than the present situation.

11.4.2 December 2010 timetable change

CrossCountry's hourly Newcastle to Reading service was extended to Southampton Central on a two-hourly basis from 12 December 2010. This provides an additional service between Reading and Southampton Central, normally calling at Basingstoke, Winchester, Southampton Airport Parkway and Southampton Central. Not all trains call at Winchester or Southampton Airport Parkway due to pathing difficulties.

11.4.3 May 2011 timetable change

SWT adjusted the Salisbury – Southampton Central – Romsey service in the May 2011 timetable change. This has moved the departure of the SWT service later from Salisbury so that it does not closely follow the FGW service, improving the frequency of trains to Southampton Central from Salisbury and shortened the long station stop at Southampton Central; journey times between Salisbury and stations north-east of Southampton Central have been shortened by eight minutes. Passengers heading to Southampton Airport Parkway and Eastleigh no longer need to change at Southampton Central or Romsey for a faster train.

11.4.4 Southampton to West Coast Main Line freight upgrade

The recent completion of this project has expanded the loading gauge to W10 between Southampton Docks and the West Coast Main Line (WCML) via Winchester and Oxford, so that tall deep-sea containers can be carried on conventional wagons.

11.4.5 Southampton to West Coast Main Line freight upgrade – diversionary routes

This is a follow-on project to the one detailed above. By June 2013 it will deliver W10 gauge between Southampton and the WCML via diversionary routes when the preferred route is unavailable. In the Solent and South Hampshire area the alternative route between Southampton and the WCML is via Andover, using the Test Valley or Chandler's Ford lines.

11.4.6 Enhanced signalling headway between Eastleigh and Southampton Airport Parkway

An additional signal is to be installed between Eastleigh and Southampton Airport Parkway to create an additional signalling section which will improve capacity towards Southampton Airport Parkway. This will enable two trains to occupy the line between Eastleigh and Southampton Airport Parkway instead of the current one, improving both the capability and capacity of the route.

11.4.7 Enhanced signalling headway between Fareham Tunnel and Fareham station

An additional signal is to be installed between Fareham Tunnel and Fareham Junction to create an additional signalling section on the Down Portsmouth line, improving the capacity of the line.

The current signalling at Fareham is restrictive – a train from Eastleigh (on the Botley line) has to wait at the end of the single line if a train is signalled into the station from Swanwick (on the Netley line). This new signalling section will enable the train to wait on the double track section between the tunnel and junction, allowing a train on the Up Portsmouth line to enter the single line section. The new signalling section will also enable a second train to leave Botley for Fareham before the first train has arrived at Fareham.

11.5 Transport for South Hampshire proposals

TfSH has been investigating a number of alternatives to heavy rail (National Rail services) on the Netley line and the Marchwood Branch. **Table 11.1** provides an explanation of these schemes with their benefits and disbenefits.

Table 11.1 – bus rapid transit, guided busway, light rail and tram-train systems
i. Bus rapid transit – high-capacity urban public transport system with its own dedicated roads and longer stop spacing than traditional bus routes. TfSH is already investing heavily in this technology by converting the old Fareham to Gosport branch line into a bus rapid transit system which will see fast buses using a dedicated road with defined bus stops. **Benefits:** buses are able to overtake each other, buses can use ordinary roads, buses require no modification, quite a flexible system. **Disbenefits:** removes the rail system, possibility of bus exclusivity being eroded by future administrations and becoming a normal road, poor public perception of buses.
ii. Guided busway – these systems use kerb guided buses on dedicated routes. This is used by the Fastway bus system in Crawley linking the town with Gatwick Airport and Horley. **Benefits:** lower cost than trams, buses are also able to use normal roads. **Disbenefits:** higher cost as buses and roadway need to be converted for use to the system (the roadway system is usually a continuous concrete roadway), inability to overtake, poor public perception of buses.
iii. Light rail – this is the modern evolution of the tram system, often utilising converted heavy rail lines to operate dedicated lines and street running of articulated vehicles, generally, though not necessarily, electric vehicles, with rapid acceleration and braking capabilities. Tramlink in Croydon and Metrolink in Manchester operate over a mix of converted heavy rail and street running routes which may be cheaper than converting existing heavy rail routes to concrete roadways for bus rapid transit or guided bus systems. **Benefits:** improved acceleration and deceleration to shorten point-to-point times, electrification to reduce CO2 emissions (particularly in an urban environment), good public perception, articulated vehicles capable of carry large numbers of passengers. **Disbenefits:** high start up costs, inability to overtake, restricted to dedicated tracks.
iv. Tram-train – this is a development of the light rail system where heavy rail routes are shared by heavy rail trains and light rail vehicles. The advantage is that low-floored trams would be able to stop at low level extensions to National Rail stations and take advantage of the higher speed of the heavy rail route, rather than continuous street running. Possible to diverge away from the heavy rail line to make stops at the front of stations before rejoining the heavy rail line, giving better accessibility and interchange with buses while enabling heavy rail services to pass. **Benefits:** all the benefits of light rail but with the use of heavy rail routes too, may be possible to fit vehicles with retractable third rail power collection system. **Disbenefits:** as light rail but also vehicles must be fitted with heavy rail safety systems.
The Network RUS may examine this further but generally speaking, these solutions are best used in and between urban areas.

Whilst heavy rail traffic has to remain on the Marchwood line as it is a branch with no alternative rail access, Network Rail and TfSH have been looking at infrastructure options to enable the diversion of services from the Netley line to the Botley line. TfSH had an aspiration to take over the Netley line, requiring all four trains per hour in each direction to be diverted via Botley, although they are now only considering sharing the line with a tram-train operation. Various reports have been produced detailing potential infrastructure options that may be required. These are summarised in **Table 11.2**.

Table 11.2 – infrastructure options for trains between the Botley line and Southampton Central
a) Fareham to Botley redoubling – the Knowle single line is a particular problem as it would not be simple or cheap to redouble as a second bore would be required adjacent to Tapnage Tunnel. There are various sub-options for the tunnelling (includes redoubling): • cut and cover – £52.2 million[5] • single bore – £128.3 million[5] • two new bores – £110 million[6] – This cannot be recommended due to the high capital cost of investment in tunnelling.
b) Fareham to Botley partial redoubling – • redouble the lines on either side of Tapnage Tunnel but leave the tunnel as single line – £38.5 million[5] • redouble the lines on either side of the tunnels but not the tunnels – £65 million[6]. – This cannot be recommended due to the high capital cost of redoubling but may be relevant in the long term.
c) Eastleigh South Junction to Eastleigh Station redoubling (with or without an additional platform at Eastleigh Station) – redouble the Portsmouth Single line to increase capacity as trains arriving at Eastleigh from the Botley line would be able to sit outside the station until a platform becomes free. If this is tied in with a new platform, increased flexibility and capacity could see improved platform use and reduce arrival and departure times: • it is estimated to cost in the region of £10m in today's prices with the platform. – See also **Option S1.4**.
d) Eastleigh Chord – there are various versions of this scheme, it is a new line that avoids Eastleigh and saves journey time because services do not need to reverse at Eastleigh before heading south to Southampton Airport Parkway. The greatest problem is the main reason for its requirement – Southampton Airport. Airports have runway end safety areas, Southampton's extends to 240 metres beyond the end of the runway which would prevent the construction of the Eastleigh chord running around the southern perimeter of the Eastleigh Works site at grade, therefore, the line would have to be underground at the site of the runway end safety areas. A further version was looked at where a short, slow speed chord is constructed just south of Eastleigh station but involved very complicated track work at the throat of Eastleigh Works. Brief details are detailed below: • chord with at grade junctions – at grade junction on the Botley line, south of Eastleigh works, to an at grade junction north of Southampton Airport Parkway. Two alignments were identified with differing linespeeds: – 30mph chord – £88.7 million[5] – 50mph chord – £103.7 million[5] – 30mph chord which does not avoid the runway end safety areas – £15 million[6] • This cannot be recommended due to route conflicts affecting capacity caused by at grade junctions on the SWML • chord with grade separated junction north of Southampton Airport Parkway and at grade junction on the Botley line – 30 mph chord – £116.9 million[5] – 50 mph chord – £131.4 million[5] • This cannot be recommended due to high capital cost of investment in tunnelling/'cut and cover' construction • tunnel chord – a 30 mph chord which diverges from the Botley line around Eastleigh South Junction but then runs in a tunnel under the works to a grade separated junction north of Southampton Airport Parkway – £255.6 million[5] • This cannot be recommended due to the high capital cost of investment and the lack of benefits that this option provides (particularly slow line speed) • at grade chord – a very slow speed chord just south of Eastleigh station, crossing the works site and joining the SWML in the vicinity of Campbell Road bridge: – Less than 30mph chord – £10 million[6] • This cannot be recommended due to the slow line speeds and conflicts that this would cause with SWML traffic.
e) Three or four-tracking between Eastleigh and Southampton Airport Parkway – construction of an additional parallel line either from Eastleigh station or the Eastleigh Chord to Southampton Airport Parkway, allows two trains to serve the station in the same direction simultaneously, this is particularly relevant here as most trains have a 90-second dwell time so one train could be preparing to depart whilst another arrives. Three-tracking would require a reversible middle line to allow for tidal flows in busy periods. The station would require significant reconstruction to both platforms and may need some staggering to allow the wider formation to close back to two-tracks south of the station. • No costings have been developed for this scheme at this time – This cannot be recommended due to the likely high capital cost but may be relevant in the long term.

5 Atkins/Hampshire County Council 2004 report – 2003 prices
6 Network Rail 2008 prices

Table 11.2 – infrastructure options for trains between the Botley line and Southampton Central
f) Three or four-tracking between Southampton Airport Parkway and St Denys Junction – this would only be carried out if the Eastleigh to Southampton Airport Parkway section was tripled or quadrupled and would enable parallel operation, overtaking moves and regulating trains without stopping all trains in that direction. Extremely expensive solution as it would require the complete reconstruction of Swaythling and St Denys stations: • No costings have been developed for this scheme at this time – This cannot be recommended due to the likely high capital cost but may be relevant in the long term.

11.6. Future passenger demand

The RUS has developed a high level forecast for the Solent and South Hampshire area. This forecast considers the future demand that can be expected due to drivers external to the rail industry, such as changes in population, housing and employment distribution.

The forecast has been developed using Passenger Demand Forecasting Handbook (PDFH) methodology. The PDFH is the industry standard tool for developing rail passenger demand forecasts. The data sources for the main demand drivers considered in the forecast are listed in **Table 11.3**.

Table 11.3 – external drivers of demand	
PDFH exogenous demand drivers	Source.
Fares	standard DfT assumptions.
Gross Value Added (GVA) per capita	Oxford Economics Forecast Update for Passenger Demand Forecasting Council (PDFC) Members, January 2010.
Employment	Oxford Economics Forecast Update for Passenger Demand Forecasting Council (PDFC) Members, January 2010.
Population	TEMPRO.
Car ownership	TEMPRO.
Fuel cost	standard DfT assumptions, webTAG Guidance.

An exercise comparing the level of growth PDFH methodology would have predicted against actual growth over the past 10 years showed that the PDFH methodology would, on average, have under-represented historic growth in the Solent region by about one per cent per annum. As a direct result of this exercise, the final version of the forecast has been uplifted to better reflect historic growth, see **Figure 11.14**.

Total passenger demand in the Solent and South Hampshire area is expected to grow at roundly three per cent per annum between 2010 and 2021, due to external factors alone.

Figure 11.14 – all day passenger demand (normalised to 2008 levels)

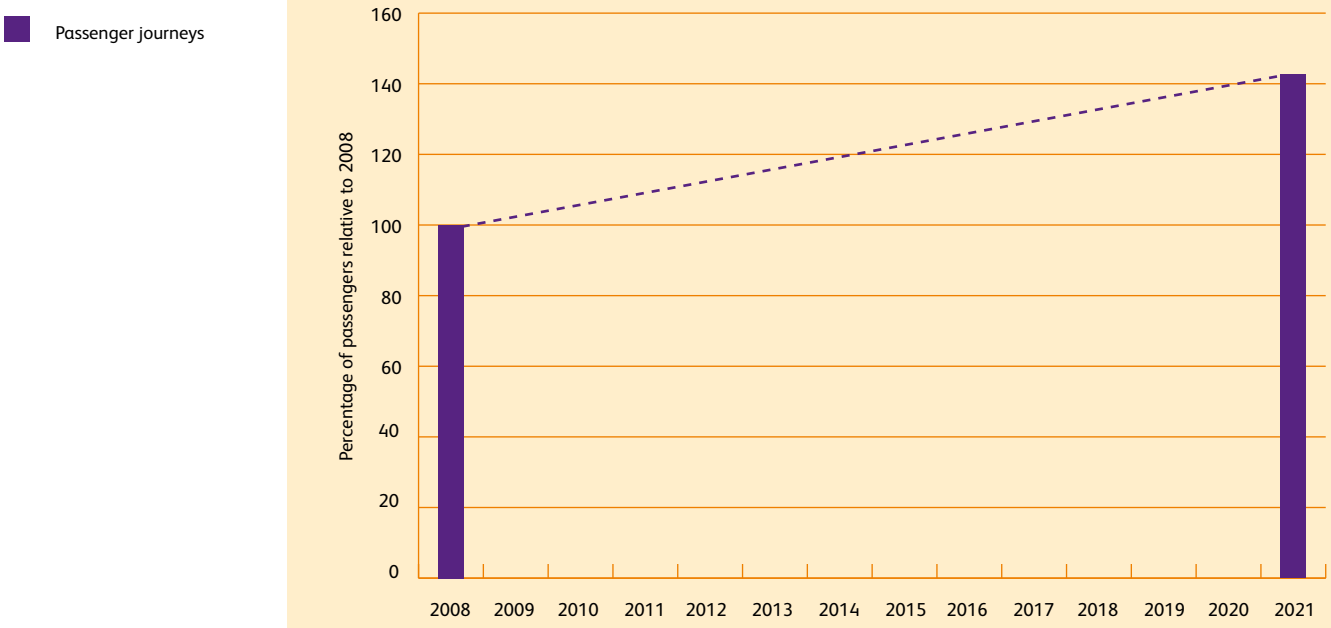
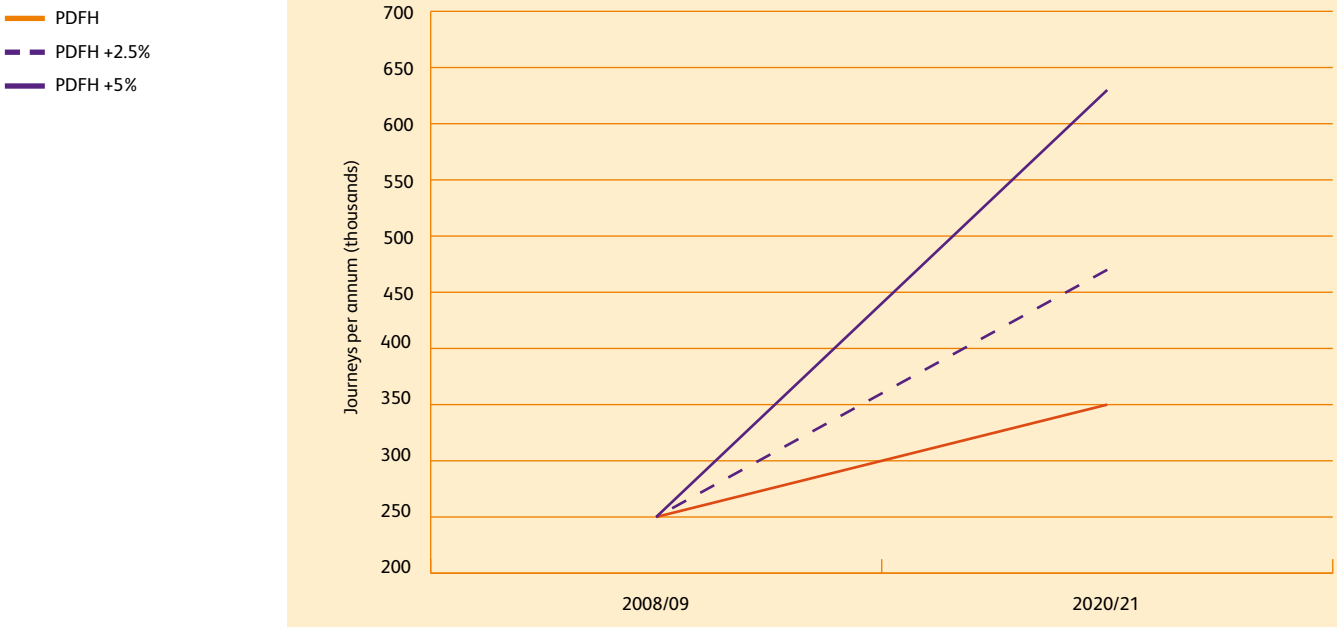


Figure 11.15 – future growth scenarios at Southampton Airport Parkway

Future growth scenarios		Implied annual growth rate to 2021	
Low	External growth only, no change in market share	3.0 %	PDFH
Medium	External growth and 5 % rail market share increase	5.5 %	PDFH + 2.5 % pa
High	External growth and 10 % rail market share increase	8.0 %	PDFH + 5 % pa



11.6.7 Southampton Airport

The back-casting exercise described on the previous page showed significantly higher demand growth than the PDFH would have predicted. This primarily reflects growth in market share driven by improvements to the frequency of rail services to the airport.

The demand forecast for Southampton Airport Parkway has therefore taken into account the potential to further grow the rail market at the airport. The PDFH forecast, with no increase in market share, represents the 'low growth' scenario for this station. **Figure 11.15** shows the low, medium and high scenarios. All option appraisals have used the medium growth scenario for airport passengers, with high growth as a sensitivity.

11.7 Gaps

In developing a preferred strategy each RUS considers where the current or future railway system does not or will not meet the requirements that will be placed upon it, unless intervening action is taken.

In order for a gap to be considered appropriate for study, within the RUS process, it should generally conform to the following criteria:

- supply and demand are mismatched now
- supply and demand are predicted to be mismatched in the future
- Funders 'key outputs' that are in scope and consistent with funds that are or are likely to be available.

The process of gap identification for the Solent and South Hampshire section of the London and South East RUS has therefore been undertaken as follows:

- review of existing mismatches between supply and demand – as detailed in **Section 11.3**
- review of likely future demand – **Section 11.6** – and any further gaps identified as a result of this
- review by the London and South East RUS SMG and the Solent and Hampshire working group of identified gaps and consideration of any further gaps that meet RUS criteria but are not immediately apparent from comparison of modelled demand and supply.

The results from this exercise have been grouped into the main gaps detailed opposite:

Gap S1 – Direct connectivity and frequency of services to Southampton Central and Southampton Airport Parkway

- poor services to Southampton Airport Parkway from the east
- poor connectivity between the cities of Southampton and Portsmouth
- poor service to Southampton Airport from Salisbury and beyond.

The SMG decided that the service on the SWML from the West to Southampton Central had been adequately covered by the South West Main Line RUS and no gaps were identified.

Gap S2 – Poor public transport links between Southampton and Waterside

Gap S3 – Inadequate car park provision to match demand for parking at certain stations

- Southampton Airport Parkway
- Swanwick
- Eastleigh
- Netley
- Shawford

Gap S4 – Uncompetitive journey times on the Portsmouth Direct and Alton lines

Gap S5 – Capacity and capability to accommodate anticipated freight growth

11.8 Options

11.8.1 Introduction

For each gap identified in **Section 11.7**, a range of options was considered and sifted at the RUS SMG and Solent and South Hampshire working group meetings. Those options likely to meet the key RUS criteria of being practical, fundable within the timescale considered by the RUS and likely to address the gap outlined were progressed to appraisal.

The options that have been developed have been subject to an economic appraisal which is compliant with the Department for Transport's Transport Analysis Guidance (webTAG). All figures in the appraisals are presented in 2002 market prices. Where appropriate, Benefit Cost Ratios (BCRs) are reported, which indicate the value for money of the scheme. DfT funding criteria permit recommendation for funding through the RUS process if the BCR is at 1.5, which is indicative of medium value for money. However, schemes involving infrastructure investment are typically required to offer high value for money indicated by a BCR of at least 2.0.

For others, there appears to be a weak case for implementing the option as described, so the RUS will not be able to provide a recommendation,

however there may be some commentary on next steps or the reason for rejection of the option.

11.8.2 Options responding to Gap S1 – Direct connectivity and frequency of services to Southampton Central and/or Southampton Airport Parkway

The development of this RUS looked at each route to Southampton Central and Southampton Airport Parkway individually and at a high level. Given the Airport's aspiration for higher rail share than at present, the complete lack of direct services from the east is likely to reduce this market because of the requirement to change trains at Southampton Central or Eastleigh.

The approaches to Southampton from the east are from the Havant and Portsmouth lines which combine at Cosham and split again, at Fareham, into the Netley line (which follows the coast to St Denys and Southampton Central) and the Botley line (which heads north-west to Eastleigh).

The Netley line has eight stations between Fareham and Southampton Central. **Figure 11.4** shows the passenger footfall of the stations in this area. The current train service of four trains per hour along this route only has one train that stops at all stations. A further two trains call at Swanwick. Passengers have to change at Southampton Central for services to Southampton Airport Parkway.

The Botley line has two stations between Fareham and Eastleigh. The current service is the hourly Portsmouth Harbour to London Waterloo via Eastleigh. Passengers from Botley and Hedge End have to change trains at either Eastleigh or Fareham for trains to Southampton Central, or at Eastleigh for trains to Southampton Airport Parkway. **Figure 11.4** shows the footfall for these stations.

The footfall at the intermediate stations on both lines is quite low. Swanwick has the highest footfall on the Netley line, followed by St Denys and Woolston. Hedge End and Botley have relatively high passenger numbers but this is because of the direct service to London Waterloo.

Passenger figures at Woolston are higher because it is a useful interchange for the local bus services to local destinations and across the Itchen Bridge to East Southampton and Ocean Village.

There is a relatively frequent rail service between Portsmouth and Southampton – an hourly fast service (FGW's two or three-car Portsmouth Harbour to Cardiff Central service) and an hourly stopping service (SWT's four-car Portsmouth Harbour to Southampton Central service). These trains take 41 and 60 minutes respectively. This is not competitive with the roads on which the journey should take 31 minutes between the two cities, except during peak times when road congestions means that rail is comparable or quicker.

From the north, **Figure 11.16** shows the stopping patterns (for trains between 12:00 and 12:59 on a weekday). As can be seen, all trains call at Winchester and Southampton Airport Parkway but only a few call at Eastleigh. All electric trains calling at Southampton Airport Parkway are subject to a 90-second dwell time against the usual 30 or 60 second stops. Diesel services formed of two or three-car units have a dwell time of 60 seconds.

Southampton Central is served by stations to the north-west from Salisbury and Romsey via either the Test Valley line to Redbridge, the direct route, or via Chandler's Ford and Eastleigh, which has the benefit of a Southampton Airport stop. Trains also run directly to Southampton Central from Weymouth, Bournemouth and Brockenhurst.

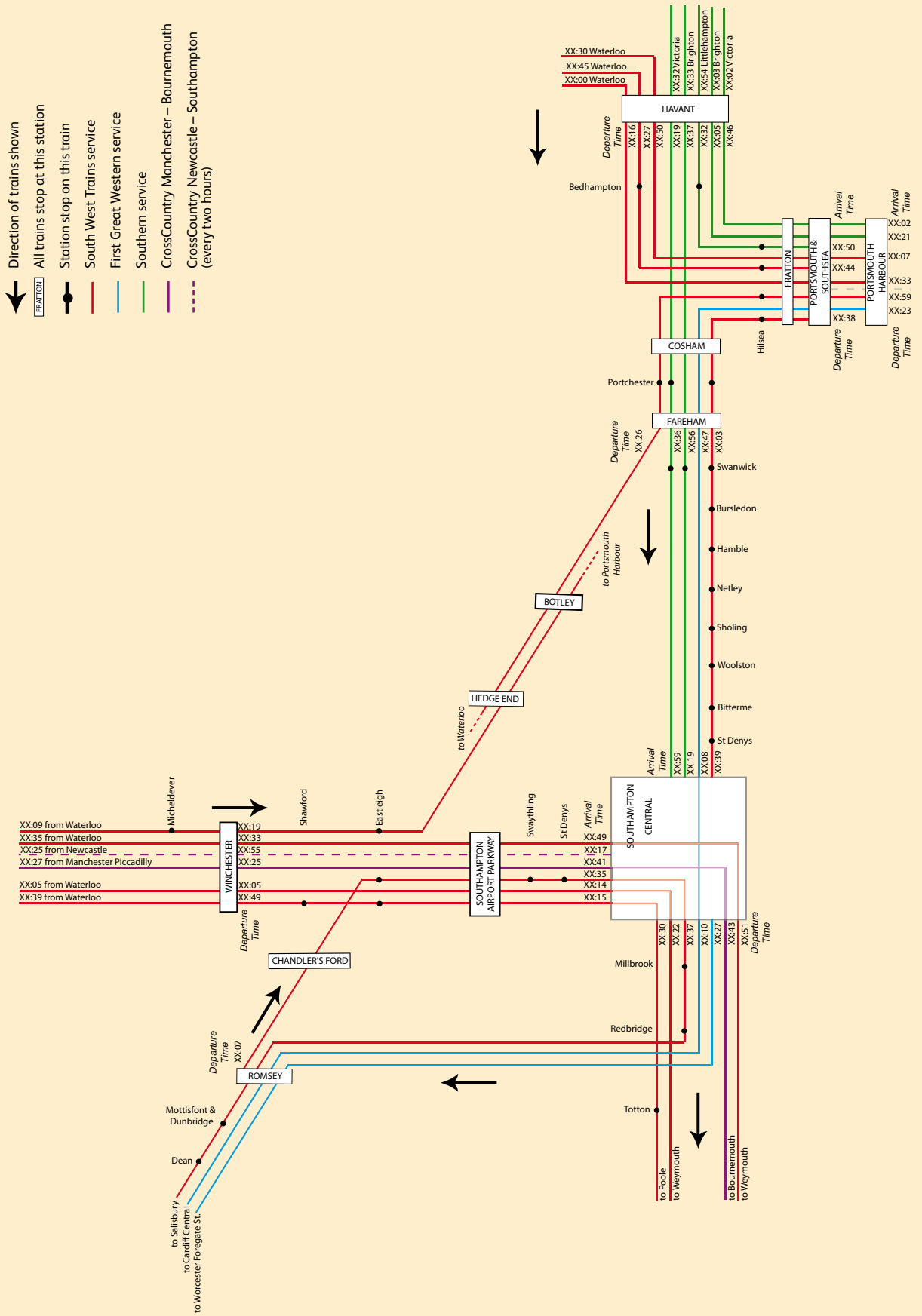
Figure 10.17 shows which sub-elements of **Gap S1** are addressed by each of the following options.

Figure 11.17 sub-options addressing gap S1

Option	Access to Southampton Airport Parkway from the East	Southampton – Portsmouth connectivity	Access to Southampton Airport Parkway from the West
S1.1	✓		
S1.2	✓		
S1.3		✓	✓
S1.4	✓	✓	
S1.5		✓	Contingent on S1.2
S1.6			✓
S1.7			✓

Assessment of Option S1.1 – diversion of Southern's Brighton to Southampton Central service via Eastleigh and Southampton Airport Parkway (in this direction only)		
Concept	Southern's Brighton to Southampton Central service (in this direction only) to run via Botley calling additionally at Eastleigh and Southampton Airport Parkway and not calling at Swanwick. This is already a franchise commitment.	
Operational analysis	Analysis shows that this is possible suject to further timetable adjustments to provide robust pathways.	
Infrastructure required	No additional infrastructure required.	
Passenger impact	Extended journey times between Fareham and Southampton Central and not stopping at Swanwick, however, introduces a direct service from the East to Southampton Airport Parkway and provides an additional service between Eastleigh and Southampton Airport Parkway/Central. Only operates in one direction so passengers to Fareham and the East would have to board the service and remain on board whilst the train crew changed ends at Southampton Central.	
Freight impact	Requires a pathway between Eastleigh and St Denys and reduces available pathways on the Botley line. Also a possible conflict with freights changing train crew at Eastleigh.	
Financial and economic analysis	**60-year appraisal**	**Present value £m**
	Costs (present value)	
	Investment cost	0.0
	Operating cost	0.0
	Revenue	-6.9
	Other Government impacts	1.4
	Total costs	**-5.5**
	Benefits (present value)	
	Rail users benefits	7.8
	Non users benefits	3.2
	Total quantified benefits	**11.0**
	NPV	**16.5**
	Quantified BCR	**Financially positive**
Link to other options	**S1.2** diverts this train in both directions.	
Conclusion	Analysis suggests that an even higher revenue figure can be realised if the train is scheduled as a loop service running Brighton – Eastleigh – Southampton Central – Swanwick – Brighton rather than two separate trains Brighton – Southampton Central and Southampton Central – Brighton. This option is recommended for implementation at the earliest opportunity subject to resolving remaining conflicts with a small number freight paths.	

Figure 11.16 – current service pattern in the Solent and South Hampshire area



Assessment of Option S1.2 – diversion of Southern's Brighton to Southampton Central service via Eastleigh and Southampton Airport Parkway (in both directions)		
Concept	Southern's Brighton to Southampton Central service (in both directions) to run via Botley calling additionally at Eastleigh and Southampton Airport Parkway and not calling at Swanwick.	
Operational analysis	Initial timetable analysis suggested that this might be possible without additional infrastructure although more detailed ongoing analysis suggests otherwise.	
Infrastructure required	No additional infrastructure has been included in the appraisal however ongoing analysis suggests that a 4th platform at Eastleigh or redoubling the Portsmouth Single line between Eastleigh South Junction and Eastleigh Station may be required which would significantly worsen the appraisal result.	
Passenger impact	Extended journey times between Fareham and Southampton Central and not stopping at Swanwick, however, introduces a direct service from the east to Southampton Airport Parkway and provides an additional service between Eastleigh and Southampton Airport Parkway/Central, also provides a direct return journey.	
Freight impact	Requires a pathway between Eastleigh and St Denys and reduces available pathways on the Botley line. Also a possible conflict with freight services changing train crew at Eastleigh.	
Financial and economic analysis	**60-year appraisal**	**Present value £m**
	Costs (present value)	
	Investment cost	0.0
	Operating cost	10.2
	Revenue	-6.0
	Other Government impacts	1.2
	Total costs	**5.4**
	Benefits (present value)	
	Rail users benefits	3.7
	Non users benefits	2.7
	Total quantified benefits	**6.4**
	NPV	**1.0**
	Quantified BCR	**1.2**
Link to other options	**S1.1** diverts this train in one direction.	
Conclusion	Unlike option **S1.1**, operating the return trip to Brighton via Eastleigh does not produce a financially positive business case as it requires an additional train and train crew. Moreover the apparently positive BCR would be significantly worsened if it is found that additional infrastructure is required. It is recommended that further development takes place on option **S1.1** instead.	

In addition to the diversion of the Brighton to Southampton Central service, the diversion of other Netley line services to the Botley line to provide a half-hourly service on this route were examined as follows:

- FGW's Portsmouth Harbour to Cardiff Central. See assessment of **Option S1.3** below
- Southern's London Victoria to Southampton Central – this was ruled out because of excessive journey time disbenefit for existing users
- SWT's Portsmouth Harbour to Southampton Central stopping service – this was ruled out because it would not be able to call at seven of the 14 stations as it would be diverted away from the route.

Assessment of Option S1.3 – diversion of First Great Western's Portsmouth Harbour to Cardiff Central service via Eastleigh and Southampton Airport Parkway (in both directions) instead of Southern service in Options S1.1 and S1.2		
Concept	FGW's Portsmouth Harbour to Cardiff Central service (in both directions) to run via Botley calling additionally at Eastleigh and Southampton Airport Parkway.	
Operational analysis	Extended journey time could lead to a requirement for additional train crew and rolling stock resources but this has not been included in the appraisal.	
Infrastructure required	No additional infrastructure required.	
Passenger impact	Extended journey times between Fareham and Southampton Central.	
Freight impact	Requires pathways between Eastleigh and St Denys and reduces available pathways on the Botley line. Also a possible conflict with freights changing train crew at Eastleigh.	
Financial and economic analysis	**60-year appraisal**	**Present value £m**
	Costs (present value)	
	Investment cost	0.0
	Operating cost	0.0
	Revenue	2.6
	Other Government impacts	-1.0
	Total costs	**1.5**
	Benefits (present value)	
	Rail users benefits	-24.1
	Non users benefits	-12.9
	Total quantified benefits	**-36.9**
	NPV	**-38.5**
	Quantified BCR	**Not defined**
Link to other options	None identified.	
Conclusion	Not recommended due to excessive journey time disbenefit.	

An additional service was then examined, to provide a half-hourly service between Cosham/Fareham and Southampton Central via Eastleigh, starting from Portsmouth & Southsea. Timetable analysis shows that whilst it would be possible to operate between Fareham and Eastleigh South Junction, the Portsmouth Single line (between Eastleigh South Junction and the station) and platform capacity at Eastleigh is insufficient to operate this additional train. Modelling was carried out with an estimation of around £10 million to redouble the line and construct a new Platform 4 at Eastleigh, **Option S1.4**, although the benefits were outweighed by the costs the quantified BCR 0.7 is still short of the 2.0 required for a scheme to be developed. **Section 11.8.6** details the impact of the extra platform on freight services.

Assessment of Option S1.4 – introduction of a new service between Southampton and Portsmouth & Southsea via the Botley Line with the redoubling of the Portsmouth Single and a new platform at Eastleigh		
Concept	A new service between Southampton and Portsmouth & Southsea via the Botley Line.	
Operational analysis	Feasible with current layout but would be more robust with the infrastructure detailed below.	
Infrastructure required	Redoubling of the Portsmouth Single and a new Platform 4 at Eastleigh.	
Passenger impact	New direct service from Portsmouth & Southsea to Southampton Central via Eastleigh. New journey opportunities to Southampton Airport Parkway.	
Freight impact	Without the infrastructure detailed above, it would be difficult for freight services to change crew at Eastleigh in the down direction and reduces available pathways on the Botley Line.	
Financial and economic analysis	**60-year appraisal**	**Present value £m**
	Costs (present value)	
	Investment cost	10.9
	Operating cost	47.4
	Revenue	-19.7
	Other Government impacts	4.0
	Total costs	**42.5**
	Benefits (present value)	
	Rail users benefits	19.7
	Non users benefits	8.9
	Total quantified benefits	**28.6**
	NPV	**-14.0**
	Quantified BCR	**0.7**
Link to other options	**S1.1** and **S1.2** which divert Southern's Brighton to Southampton Central service via Botley and Eastleigh.	
Conclusion	Not recommended due to poor value for money business case.	

If the diversion of the Brighton to Southampton Central service via the Botley line as recommended in **Option S1.1** is implemented then the number of services on the Netley Line is reduced. Timetable analysis shows that the theoretical maximum number of trains it is possible to operate on the Netley Line is much higher than the current four trains, however, the stopping service extends the journey times for the faster services as the signals are located quite far apart, see **Figure 11.11**, which severely restricts capacity by extending headways. To replace the Brighton to Southampton Central service, an additional Portsmouth to Southampton Central service has been modelled, but whilst this service provides extra journey opportunities between the two cities and replaces the missing train, the journey time means that the rolling stock and train crew costs outweigh the benefits, **Option S1.5** details this.

Assessment of Option S1.5 – introduction of a new service between Southampton and Portsmouth & Southsea via the Netley Line		
Concept	Provide a new semi-fast service between Southampton Central via Netley to Fareham and the east.	
Operational analysis	Provides an additional service between Southampton Central and Fareham (and beyond).	
Infrastructure required	None.	
Passenger impact	Extra service between Southampton Central and Fareham (and beyond).	
Freight impact	Will reduce available pathways on the Netley Line.	
Financial and economic analysis	**60-year appraisal**	**Present value £m**
	Costs (present value)	
	Investment cost	0.0
	Operating cost	47.4
	Revenue	-21.5
	Other Government impacts	4.4
	Total costs	**30.3**
	Benefits (present value)	
	Rail users benefits	28.6
	Non users benefits	11.8
	Total quantified benefits	**40.4**
	NPV	**10.1**
	Quantified BCR	**1.3**
Link to other options	**S1.1** and **S1.2** which divert a service via the Botley line.	
Conclusion	Not recommended at this stage further timetabling work required, also subject to timetable slots at the Portsmouth end.	

The current journey time for a stopping service between Portsmouth and Southampton via Netley is 60 minutes city to city, which does not compete with road. The high frequency bus service and the road system is causing some potential passengers to travel by alternative modes leaving rail with a small minority of passengers preferring to catch the train. Timetable analysis has shown that, theoretically, skip-stop operation may be a solution, see **Figure 11.18** and could enable all trains to run to Portsmouth Harbour to serve Gunwharf Quays and the ferries without changing at Fratton or Portsmouth & Southsea. It is possible to get from any station on the Netley line to any other on the Netley line without having to change service, however the journey time improvement is insufficient to reduce the operating costs – which would require the journey from Portsmouth to Southampton Central to be operated in around 50 minutes rather than the 56 minutes caused by skip-stops.

Figure 11.18 – calling patterns of three alternating services

Station	Service 1	Service 2	Service 3
Fareham	●	●	●
Swanwick	●	●	●
Bursledon	●	●	●
Hamble	●	●	●
Netley	●	●	●
Sholing	●	●	●
Woolston	●	●	●
Bittern	●	●	●
St. Denys	●	●	●

● = stopping ● = passing

As part of the consultation process, users views were requested for replacing the current off-peak train service with a frequent, fast non-stop service, limited stop trains or a skip-stop service. There was no conclusive preference for any of these variants. The working group examined stopping patterns across this route and feel that many of the smaller stations are lightly used however, it was suggested that the Department for Transport should revisit these options when renewing the South Western and South Central franchises, in around five years' time.

Transport for South Hampshire has clarified that they have a long-term aspiration to operate tram-train services on this line if more trains were diverted to run via Eastleigh or an Eastleigh Chord. Lightweight vehicles would operate between Fareham and Woolston, where they would diverge from the existing line and head to Southampton via the Itchen Bridge. This would enable Network Rail and the train operators to continue to use the line for heavy rail longer distance services and as a diversionary route for when the SWML is closed between Southampton and Basingstoke. **Table 10.1** contains more information on the tram-train, light rail, guided bus or bus rapid transit solutions.

Southampton Central is also served by trains from Salisbury and the West Country. These services are:

- FGW's hourly Cardiff Central to Portsmouth Harbour service which runs fast from Salisbury to Romsey then fast to Southampton Central via the Test Valley line
- SWT's hourly Salisbury to Romsey 'Figure 6'[7] service which calls at all stations via the Test Valley and returns to Romsey via the SWML and Chandler's Ford.

The SWT service departs Salisbury around 25 minutes after the FGW service but only takes about six minutes longer to get to Southampton Central. Consideration was given to diverting the FGW service via Chandler's Ford to Southampton Central to provide an additional Salisbury (and the west) connection with Southampton Airport Parkway. The train crew would have to change ends at Southampton Central before the journey could continue to Portsmouth, however, this would cause excessive journey time disbenefit to existing users. See **Option S1.6**.

7 The SWT service that calls Salisbury – Romsey – Southampton Central – Eastleigh – Chandler's Ford – Romsey.

Assessment of Option S1.6 – diversion of the First Great Western Cardiff Central to Portsmouth Harbour service via Chandler's Ford	
Concept	Divert the Cardiff Central to Portsmouth Harbour service via Chandler's Ford.
Operational analysis	Restrictive pathways over single line. Possible requirement for additional rolling stock, or implications for performance given reduced turnround times at Portsmouth.
Infrastructure required	None.
Passenger impact	Extended journey times between Romsey or Fareham and Southampton Central but new journey opportunities between Salisbury/Chandler's Ford/ Eastleigh and Southampton Airport Parkway/Portsmouth.
Freight impact	Will reduce pathways on the Chandler's Ford line.
Financial and economic analysis	N/A.
Link to other options	None identified.
Conclusion	Not recommended due to excessive journey time disbenefit.

An alternative was to look at the 'Figure 6' service to see if returning to Salisbury, **Option S1.7**, would improve the connections between Salisbury and Southampton Airport Parkway by giving a new journey opportunity via Chandler's Ford. The extension would require the whole service to be retimed and would require extra rolling stock.

Assessment of Option S1.7 – extension of the South West Trains 'Figure 6' service back to Salisbury	
Concept	Extend the 'Figure 6' service back to Salisbury.
Operational analysis	Would require further work on platforming at Salisbury and unit/crew diagrams.
Infrastructure required	None.
Passenger impact	Reduce the Chandler's Ford to Salisbury journey time by 16 minutes, introduce a quicker direct route to Salisbury.
Freight impact	Will reduce pathways on the Chandler's Ford line.
Financial and economic analysis	N/A.
Link to other options	None identified.
Conclusion	Not recommended as the service has already been retimed in the May 2011 timetable change and insufficient passenger demand between Southampton Airport Parkway and Salisbury.

11.8.3 Options responding to Gap S2 – Poor public transport links between Southampton and the Waterside area

Another aspiration of TfSH and the local authorities is the reopening of the Marchwood line to passenger traffic. This line is currently a freight only line between the yard at Totton and Fawley Oil Terminal. Around two or three freight trains per day operate in each direction on and off the branch.

The line branches away from the SWML at Totton, the next station west of Redbridge and runs through Totton Yard and onto the single line to Marchwood. The old station is still in-situ at Marchwood but is a private residence. The Marchwood signal box is still staffed and controls the line (sharing control of the Totton end with Eastleigh Area Signalling Centre). There are manual rail gates protecting the level crossing here and at School Road, which are operated by the signaller. The line is double-tracked through the old station and is the passing point for the line, and the junction for the Marchwood military port. The single line continues to the former Hythe station and on to Fawley Oil Terminal. The proposed Dibden Bay container terminal would also branch off this section of the line. Should the Dibden Bay terminal be developed, then it is highly likely the route would see regular container trains in addition to current traffic.

Timetable analysis shows that it would be possible to run two passenger trains per hour in each direction and one freight train in a single direction between Totton and Marchwood. Beyond Marchwood and with minimum headways, it would be possible to run an hourly passenger service in both directions and up to three freight trains in the same direction. This assumes that the existing infrastructure is capable of handling passenger services and that the platforms at Marchwood and Hythe have been returned to operational use (in accordance with Disability Discrimination Act (DDA)). Additional infrastructure would be required for two passenger trains per hour between Marchwood and Hythe, which would require a further additional platform linked by a DDA-compliant footbridge.

A shuttle service could be introduced if the bay platform at the Totton end of Southampton Central was brought back into use. SWT does not currently have any one-car (Class 153) units in their fleet and are unlikely to be able to source a spare Class 158 two-car unit for this service so additional units would have to be provided. Failing that, the line could be electrified and an existing service extended to terminate at Marchwood or Hythe.

Several consultation responses suggested that SWT's Figure 6 service could instead be operated as a Salisbury to Hythe via Chandler's Ford service, however, this would still require extra rolling stock and would no longer provide a second relatively fast service between Southampton Central and Romsey/Salisbury.

Bluestar buses currently operate a high frequency bus service between Southampton City Centre, Central Station and Hythe, calling at the main housing estates on the way. Three buses per hour operate most of the day and an hourly service runs until 3am on Friday and Saturday nights. Given this high frequency service and relatively low fares, it would appear that rail would be an unattractive alternative. However, many of the consultation responses highlighted delays and lengthened journey times between Southampton and Hythe in the peak, with journeys of up to an hour reported. An alternative to the buses is the Hythe Ferry, which runs a half-hourly service across Southampton Water to Town Quay where a free bus is waiting to take passengers into the city centre and to Southampton Central station.

The high capital cost of reintroducing DDA compliant stations and the need to procure additional rolling stock mean that a scheme to introduce passenger services to the line will have a low value for money business case. In addition, depending on the level of investment in infrastructure on the branch to facilitate a new passenger service, there could be conflicts between a regular passenger service and freight growth if a large container port were to be developed at Dibden Bay.

The RUS therefore does not recommend the conversion of the Marchwood Branch for passenger use but Network Rail will continue to work with Transport for South Hampshire, the local authorities and other stakeholders on the development of a robust business case as new evidence emerges, in line with the factors detailed above.

11.8.4 Options responding to Gap S3 – Inadequate car park provision to match demand for parking at certain stations

Figure 11.7 shows the current car parking provision and usage at stations across the Solent and South Hampshire study area.

South West Trains have completed a programme to provide 2,000 additional spaces in the current franchise but are considering additional capacity at a number of commuter stations largely on the basis of single deck expansions.

Southampton Airport Parkway station has recently had its car park enlarged by the construction of a 5½ floor multi-storey building. This car park is intended for rail passengers rather than airport users as there are National Car Parking (NCP) parking facilities opposite the terminal building.

Network Rail and the TOCs are working with local stakeholders on a range of car parking capacity schemes across the RUS area. Additional capacity is planned or under consideration at a number of congested locations.

Local authorities have offered to work with the rail industry to provide extra parking spaces and improve access to the stations across the area, which is welcomed by all parties. Multi-deck car parks are an efficient way to maximise the number of car parks at stations so these should be considered for more locations in the mid to long term.

11.8.5 Options responding to Gap S4 – Uncompetitive journey times on the Portsmouth Direct and Alton Line

Network Rail has been reviewing the Permanent Speed Restrictions and maximum permissible linespeeds around the South East. This workstream has identified a number of locations where current speed limits may be changed to improve journey times. Some of the speeds will be raised as part of the rolling programme of maintenance and renewals and others will be the focus of a line of route review scheme. The Portsmouth Direct line falls into the latter category.

The Portsmouth Direct line diverges from the SWML at Woking Junction and heads south to Havant, via Guildford. The two-track railway is sinuous and steeply graded. On the Alton line, some line speeds may be improved but the biggest constraint is the single line section between Farnham and Alton, despite the passing loop at Bentley.

Both lines of route have been examined in detail with engineers from Network Rail. Several sites are being taken forward for further investigation and development as journey time improvement schemes. If implemented these will see point-to-point times reduced on both routes

11.8.6 Options responding to Gap S5 – Capacity and Capability to accommodate anticipated freight growth

Freight traffic is expected to increase significantly by 2030 at the Port of Southampton, requiring up to three pathways an hour between Basingstoke and Southampton for access to the port. Eastleigh is an important site for DB Schenker and Network Rail's National Delivery Service (NDS). NDS moves new and waste materials for rail maintenance and renewal schemes across the UK. Eastleigh is key in the South East as it provides ballast and spoil trains, recycling facilities, long welded rail trains and pre-assembled track.

A timetable study was carried out to investigate whether it would be possible for three (**Option S5.1**) or four (**Option S5.2**) freight train paths per hour to be scheduled between Basingstoke and Southampton. The fourth path would be available for NDS trains, charter passenger services or late running freight trains. The study found that, whilst theoretically possible, robust pathways could not be found for a third or fourth freight train between Basingstoke and Southampton Central. The timetable study showed that an average of 2½ freight trains per hour could be operated over this route throughout the day.

Assessment of Option S5.1 – three freight tph in each direction between Basingstoke and Southampton	
Concept	Provide additional pathway within the standard hour clock face timetable to enable the three freight train pathways per hour required to meet future freight demand.
Operational analysis	Timetable analysis shows that this pathway is available in some hours of the day although some amendments to other services would be required.
Infrastructure required	None.
Passenger impact	Slight amendments to existing timetable.
Freight impact	Reserved freight pathways every 20 minutes.
Financial and economic analysis	N/A.
Link to other options	N/A.
Conclusion	To be taken forward by the Strategic Freight Network.

Assessment of Option S5.2 – four freight tph in each direction between Basingstoke and Southampton	
Concept	Provide two additional pathways within the standard hour clock face timetable to enable the four freight train pathways per hour required to meet future freight demand.
Operational analysis	Timetable analysis shows that these pathways are not available on the current infrastucture.
Infrastructure required	None.
Passenger impact	Cannot be implemented on existing timetable.
Freight impact	Reserved freight pathways every 15 minutes to cater for late running services, additional engineers' trains and charter passenger trains.
Financial and economic analysis	N/A.
Link to other options	N/A.
Conclusion	To be taken forward by the Strategic Freight Network to develop a holistic solution for freight services between Southampton and the north.

The Strategic Freight Network (SFN) is improving the gauge for clearance of W10 trains from Basingstoke via Andover and the Test Valley/Chandler's Ford line to Southampton by March 2013. This is not just for diverted freight services but also for scheduled freight trains that cannot be accommodated on the SWML. It would then be possible to run two freight trains per hour of W10 gauge via the SWML and two freight trains per hour of W10 gauge via the Test Valley. A study has been initiated by the SFN to review the route from Southampton to the north via the West Coast Main Line. This scheme will highlight the pinch points and identify the work required to operate a robust mixed traffic railway.

A number of freight services currently change traincrews in the station platforms at Eastleigh. This can import performance risk when trains are perturbed. The additional quantum of freight paths required to accommodate growth and the current requirement to stop freight trains at Eastleigh to change traincrews has been considered and this is reported in **Option S5.3** below.

If the amount of passenger traffic increased on the Botley line to an extent that the construction of a new platform at Eastleigh was required, then some freight services could run via the new platform line to change train crews in the down direction. In the up direction, train crew changes would benefit from the extension of the up loop line (Platform 1), **Option S5.3**, as following trains could use the through line or cross to Platforms 2 or 3.

Assessment of Option S5.3 – managing freight train crew changes at Eastleigh	
Concept	Extension of the up loop/slow line to the south for up trains and new access to Platform 3 (and possible future Platform 4) via the yard for down trains.
Operational analysis	Extending the up loop and gaining access to the down side of the station through Eastleigh Yard takes the rear of the train off the main line, freeing up alternative routes for other services.
Infrastructure required	New, higher speed crossovers into Platform 1 and an extension of the approach line and higher speed crossovers into the south-end of the down yard to access Platform 3 (and potential future Platform 4).
Passenger impact	Improved journey times due to reduced pathing time waiting freight services to change train crew, improved performance during perturbation.
Freight impact	Careful scheduling required.
Financial and economic analysis	N/A.
Link to other options	S1.2 which suggests the construction of Platform 4 at Eastleigh.
Conclusion	This RUS recommends that the up Loop (Platform 1) at Eastleigh is lengthened for 662/775m freight trains. Further work is required to develop the proposal for access to Platform 3 via Eastleigh Yard. Eastleigh Platform 4 is detailed in Table 11.2c.

The scheme mentioned in **Section 11.8.2**, is also looking to reduce journey times for freight trains to enable the crew to operate from terminal to terminal, obviating the requirement for a crew change at Eastleigh.

Should Dibden Bay container terminal be constructed, freight services could run via the Test Valley but would have to run round at Millbrook which is not ideal. A chord from the Test Valley directly onto the SWML, heading westbound, was dismissed due to the severe speed restrictions required and the excessive cost that such infrastructure would incur. The chord would have to diverge from the Test Valley line just north of, and then pass under, the A35 Redbridge Causeway road before joining the SWML on the causeway viaduct.

11.9 Consultation process and overview

11.9.1 The Draft for Consultation

This section details the responses relevant to the Solent & South Hampshire workstream.

11.9.2 Consultation responses

The consultation garnered around 30 specific responses for the Solent & South Hampshire area. Formal responses were received from:

- The RUS Stakeholder Management Group
  - Department for Transport
  - Office for Rail Regulation
  - Association of Train Operating Companies
  - Stagecoach South West Trains
  - First Great Western
  - DB Schenker
  - Passenger Focus
  - Freightliner Group
- Statutory and voluntary rail user groups
  - South Hampshire Rail Users' Group (SHRUG)
- Regional/local authorities and umbrella groups
  - Hampshire County Council
  - Southampton City Council
  - Portsmouth City Council
  - Winchester City Council
  - Eastleigh Borough Council
  - Fareham Borough Council
  - Havant Borough Council
  - Test Valley Borough Council
  - New Forest District Council
  - Transport for South Hampshire
  - International Air Rail Organisation
  - Association of Transport Coordinating Officers
- Political, campaigning and charitable organisations
  - Railfuture
  - Rail Freight Group
  - Winchester Action on Climate Change
- Companies, other public or private organisations, elected representatives and private individuals
  - Associated British Ports
  - Southampton Railway Systems Research
  - Southampton International Airport Ltd.
  - Three private individuals

Copies of the responses can be found in the London & South East RUS section at **www.networkrail.co.uk**

11.9.3 Key themes in the consultation responses

Introduction/general themes

The responses which Network Rail received were well-considered and in a number of cases comprehensive. As a result, it is difficult to provide an individual précis of each one. Instead some of the key and recurring themes are summarised below.

A number of respondees queried the content of the Transport Economic Efficiency Tables detailed in **Chapter 10** of the Draft for Consultation. To provide a better explanation of these tables a worked example has been included in **Appendix A.**

The local authorities explained the consequences of the Localism Bill and how the South East Plan and Regional Spatial Strategies are to be abolished. There was explanation and introduction to the Local Enterprise Partnerships (LEPs). These comments are reflected in the changes made to **Section 11.2.7**.

Almost all of the local authorities detailed their growth plans, which is useful in itself but it must be noted that these figures will have been reflected in the growth models which come from Central Government.

Interestingly, the local authorities and others suggest that predicted growth at the Port of Southampton and local housing and employment growth will happen but that Southampton Airport will not see the large growth in passenger figures predicted in its masterplan.

In addition to the freight growth at the Port of Southampton, there is a lot of support for the growth of the cruise market. Indeed, there will be an increase to 50 direct trains to the Docks for cruise passengers in 2012.

Several respondents commented on diverting FGW's twice-daily Brighton – Great Malvern/Worcester services via Botley and Chandler's Ford to release a pathway through Southampton Tunnel and reduce the overall journey time to the FGW passengers. This train is the return working of the peak time service to/from Brighton which provides additional journey opportunities and capacity in the peak.

11.9.4 Marchwood Branch reopening to passengers

Many consultees responded to show their support for the proposal to reopen the Marchwood Branch to passenger services. Hampshire County Council has commissioned a report on the subject from Atkins.

The responses from Hampshire County Council, TfSH and Southampton Railway Systems Research assisted with verification of the facts and figures behind the various reports and favourable business cases.

In order to operate passenger trains over this line there are a number of elements required for the scheme which are not optional, and which were not all included in the various reports:

- signalling enhancement
- extra signalling/level crossing staff
- level crossing upgrades
- stations must have appropriate lighting, public address systems, Customer Information System displays, help points, CCTV coverage, tactile paving, Disability Discrimination Act compliant platforms and access.

Extra stations have been suggested for Hythe and Hounsdown along with a possible additional platform at Marchwood. These too would have to be constructed to applicable Railway Group Standards[8].

11.9.5 Netley Line stopping patterns

Many respondents noted that Woolston is served by many bus routes and would be an ideal interchange station with the bus network to the east of Southampton. The stations on either side, Bitterne and Sholing, are served by these buses so these stations could be omitted off-peak The South Hampshire Rail User Group (SHRUG) proposed an off-peak timetable which has been passed on to the train operators. This included route changes such as a direct service between Portsmouth and London Waterloo via the Netley line and Southampton Central and the extension of the Brighton – Southampton Central service to Bournemouth. Given the support for each of the various options and the proposals by SHRUG and a member of public, the RUS recommends that the DfT considers these when refranchising the South Western and South Central franchises.

11.9.6 Botley Line

A common theme of response to the Draft for Consultation was that the bus service from Hedge End to Southampton Central takes about an hour so a stop at this station would be popular in the Brighton – Southampton Central via Eastleigh service. If **Option S1.1** is taken forward and the train only operates in one direction, this will only be beneficial in that direction. Passengers returning to Hedge End would either have to change at Eastleigh or Fareham or revert to the bus. Some local authorities are calling for a new station to be constructed between Botley and Fareham on the single line. This is not supported as stopping trains on the single line would considerably reduce capacity, which is already constrained.

Another option would be to redouble the single line from Botley to a point beyond the proposed new station serving Fareham New Town, which would overcome the difficulty and create additional capacity. However, this would involve considerable capital cost investment and is unlikely to demonstrate a value for money business case.

11.9.7 Eastleigh Chord

Transport for South Hampshire requested that the RUS include conclusions as to whether the construction of a Chord permitting services to operate direct between the Botley line and Southampton Airport Parkway should be recommended.

The various options for the Chord are detailed in **Table 11.2d**.

In the short to medium term, the construction of Platform 4 at Eastleigh should be sufficient to cope with the extra traffic and would have the additional benefit of being useful for the freight train crew changes.

8 See also "Investment in Stations: a guide for promoters and developers" available at www.networkrail.co.uk

11.10 Strategy to 2030

11.10.1 Introduction

The previous sections of this chapter have described the railway as it exists today, detailed interventions which are already in hand but have not yet been implemented, then described the future demand forecasts the railway industry is working to. Based on this background **Section 11.7** identified a series of strategic 'Gaps' between supply and demand elements, whilst **Section 11.8** focussed on the description and appraisal of 'Options' which seek to bridge those Gaps during the next 20 years. This section now brings together the conclusions from the RUS analysis into a strategy to 2030 in the same order as the strategic gaps identified in **Section 11.7**. Where relevant, the strategy is subdivided between those recommendations that are deliverable in CP4 and those that are likely to be implemented only in CP5.

11.10.2 Gap S1 – Direct connectivity and frequency of services to Southampton Central and Southampton Airport Parkway

Section 11.3 detailed the current connectivity to Southampton Central and Southampton Airport Parkway and explained that Southampton Airport Parkway has no direct services from the East. Passengers from Fareham, Portsmouth, Havant and beyond have to change trains at Southampton Central or Eastleigh. The impact of the airport growth, detailed in **Section 11.6**, combined with the car park expansion at the station which has just been completed, will see a rise in passenger numbers from this station, which already has strong growth.

The RUS recommends the diversion of Southern's Brighton to Southampton service in one direction to operate via Eastleigh and Southampton Airport Parkway, subject to further timetabling work, for implementation at the earliest opportunity. Stopping this service at Hedge End should also be investigated. In order to improve passenger and freight capacity at Eastleigh and improve performance, further work should be carried out to investigate the provision of an additional platform to the east of the existing platforms. In the medium term, if Platform 4 at Eastleigh has been delivered, it is recommended that consideration is given to the operation of this service in both directions via Eastleigh and Southampton Airport Parkway or that a new service between Southampton and Portsmouth via Southampton Airport Parkway is provided. Partial redoubling of the Botley line and redoubling of the Portsmouth Single between Eastleigh station and Eastleigh South Junction may also be required.

In the long term, if passenger demand justifies it and in particular if the long term aspiration of Transport for South Hampshire to operate tram train services on the route between Fareham and Southampton City Centre via Netley comes to fruition then, the RUS recommends revisiting the option for a fast, grade separated junction and chord just north of Southampton Airport Parkway.

On the Netley Line, the loss of one service in one direction (when Southern's Brighton to Southampton Central service is diverted via Eastleigh) makes a direct replacement difficult.

The RUS recommends that the DfT revisits options, detailed below, for stopping patterns on this line during the refranchising process for the South Western and South Central franchises:

- skip-stops
- not stopping at smaller stations off-peak
- maintaining the current mix of stopping patterns.

The RUS recommends, subject to business case, that extra signalling sections are installed on the Netley Line in the next resignalling scheme, to reduce the section running times and improve the flexibility, of the route.

The RUS supports the recommendation of the Great Western RUS that FGW's Portsmouth to Cardiff services should be lengthened and suggests that lengthening to five coaches will provide additional seating capacity between Portsmouth and Bristol, the busiest section of the journey, in the peaks.

The RUS recommends that, when the timetable on the SWML is being reviewed, the opportunity be taken to endeavour to standardise the stopping patterns of CrossCountry Newcastle – Southampton services. In the long term it is recommended that a holistic review of the timetable between Southampton Central and Basingstoke is undertaken to ascertain any further infrastructure interventions that are required to accommodate freight and passenger growth.

11.11.3 Gap S2 – Poor public transport links between Southampton and the Waterside area

The RUS does not recommend the reopening of the Marchwood line to passenger traffic due to the following factors:

- no robust business case
- high cost of conversion to passenger operations
- potential future freight traffic levels.

The RUS recommends that Network Rail continues to work with Transport for South Hampshire, the local authorities and other stakeholders on the development of a robust business case in line with the factors listed above.

11.10.4 Gap S3 – Inadequate car park provision to match demand for parking at certain stations

The RUS recommends that Network Rail, the train operating companies and the local authorities continue to work closely on the development of car park improvement schemes where this will not result in rail-heading.

11.10.5 Gap S4 – Uncompetitive journey times on the Portsmouth Direct and Alton Line

The Portsmouth Direct line suffers from a sinuous route with steep gradients. The signalling system and level crossings on this line also restrict the speed. The Alton Line is similarly sinuous with a single line section between Farnham and Alton, with a passing loop at Bentley.

The RUS recommends that these lines are thoroughly examined prior to resignalling in order to maximise the journey time benefits of eased speed restrictions and improved spacing of signals. In the interim, opportunities presented by track renewals etc, should be taken to improve speeds. Both routes would benefit from line of route resignalling rather than piecemeal resignalling as each signal box reaches the end of its life.

11.10.6 Gap S5 – Capacity and Capability to accommodate anticipated freight growth

The predicted level of growth of freight traffic to 2030 in addition to the passenger service (current and planned in this strategy), will make the SWML between Basingstoke and the port facilities at Southampton one of the most congested mixed traffic lines on the network.

The SFN Southampton to West Coast Main Line study will consider the impact of freight growth on capacity and whether there is any scope for freight journey time improvements on this corridor.

In the long term, once other capacity initiatives (such as train lengthening or 6/7-day a week operation) have been exhausted, it is likely that additional infrastructure will be required on the route if demand is to be met.

In the medium term more use will need to be made of the Test Valley route via Andover for freight services upon completion of the W10 Gauge clearance project currently underway. In the long term, the proposed port expansion at Dibden Bay will generate significantly more traffic. Network Rail will wish to work closely with the developers and planning authorities in relation to any proposed port expansion, in order to ensure that an appropriate funding stream for any necessary rail enhancements is identified and agreed at an early stage in the planning process. It would be likely that some existing traffic may need to operate via the Test Valley as freight services from the Marchwood branch would generally operate via Eastleigh (to avoid lengthy run-round movements in the Southampton area). This growth in traffic may warrant the redoubling of the route from Eastleigh to the Test Valley via Chandlers Ford so as to allow freight services to operate via both routes (and to provide a gauge cleared diversionary route).

The RUS notes the performance impacts arising from freight services changing traincrews in the platforms at Eastleigh. In the short term extension of the up slow loop line is recommended. In the longer term. the SFN study between Southampton and the West Coast Main Line should seek freight journey time improvement opportunities to obviate the need to change train crews in the station platforms at Eastleigh.

Appendix A

Appendix A – explanation of the Transport Economic Efficiency tables			
Concept	Details of the option.		
Operational analysis	Commentary on the timetable and operational analysis.		
Infrastructure required	Description of any additional or altered infrastructure required for the option to work.		
Passenger impact	How passengers will be affected by the option.		
Freight impact	How freight will be affected by the option.		
Financial and economic analysis	***60-year appraisal***	***Present value £m***	***Explanation***
	Costs (present value)		This section represents cost of investment (infrastructure etc), operating (additional rolling stock, crew etc.), ticket revenue and Government impacts (such as loss of fuel tax through mode shift). Negative figures show extra money coming in, ie income. Positive figures represent money going out ie expenditure/losses.
	Investment cost	2.0	
	Operating cost	1.0	
	Revenue	-6.9	
	Other Government impacts	1.4	
	Total costs	**-2.5**	
	Benefits (present value)		This section shows the quantified benefits to rail users (eg journey time improvement) and non-rail users (eg reduced congestion). Negative figures represent a cost. Positive figures represent a socio-economic benefit.
	Rail users benefits	7.8	
	Non users benefits	3.2	
	Total quantified benefits	**11.0**	
	NPV (Net Present Value)	**13.5**	Total quantified benefits less total costs. (The NPV figures is negative if the costs outweigh the benefits and vice versa).
	Quantified BCR	**Financially positive**	The total benefits divided by the total costs. If this is 2.0 or above, the option offers a high value for money. An option is 'Financially Positive' if the revenue covers the operating and investment costs.
Link to other options	Other options that may be affected by this one.		
Conclusion	RUS recommendation or description of next steps.		

Glossary

Term	Meaning
ATOC	Association of Train Operating Companies.
BAA Heathrow Airtrack	Proposed new rail link to connect Heathrow Terminal 5 to the Windsor lines for direct trains to Reading, Guildford and London Waterloo.
BCR	Benefit Cost Ratio.
BML	Brighton Main Line – Brighton to London line via Gatwick Airport.
BML2	Brighton Main Line 2 – third party aspiration to connect Uckfield with the East Coastway line and to provide a new route from the Sanderstead area towards New Cross via Elmers End.
Chiltern Line	The routes from London Marylebone to the Midlands.
Chord	Short line linking two other lines ie the Eastleigh Chord would link the Botley Line to the South West Main Line enabling trains to bypass Eastleigh.
Class 91 + Mark IV coaches	East Coast Main Line dedicated Class 91 electric locomotives and Mark IV coaches are operated as semi-permanently coupled rakes similar to an electric multiple unit. Introduced in the 1990s following the electrification of the route.
Control Period 4 (CP4)	The 2009/14 period, used by the ORR's funding determination for Network Rail.
Control Period 5 (CP5)	The 2014/19 period, used by the ORR's funding determination for Network Rail.
Control Period 6 (CP6)	The 2019/24 period, used by the ORR's funding determination for Network Rail.
Crossrail	A new high frequency line connecting Maidenhead and Heathrow Airport in the west with Shenfield and Abbey Wood in the east via twin tunnels under Central London.
Crossrail line 2	Safeguarded route for proposed new Chelsea to Hackney line.
DfT	Department for Transport.
Down	The direction of trains normally when travelling away from London or large urban centre where direct trains to London do not operate.
ECML	East Coast Main Line – the route from London King's Cross to Yorkshire, Newcastle and Scotland.
ELL	East London Line – extended former London Underground route which connects Highbury & Islington/Dalston Junction with Crystal Palace, West Croydon and New Cross. Operated by London Overground.
ERTMS	European Rail Traffic Management System – Europe-wide system for signalling and controlling trains. Currently being trialled in the UK but becoming widely used in other European countries.
Evergreen 3 project	The upgrade of the Chiltern Line delivering journey opportunities between Oxford and London Marylebone and raising the linespeed to 100mph with other improvement works to significantly reduce journey times.
FOC	Freight Operating Company.
FPM	Freight Performance Measure – the new benchmarking process used to measure freight train performance.
ftph	Freight trains per hour.
GEML	Great Eastern Main Line – the routes from London Liverpool Street to East Anglia.
Generation One RUS	The original route-based RUSs.
Generation Two RUS	Reviews, updates and develops the original Generation One RUSs with an overview of a wider area of coverage.
GDP	Gross Domestic Product – the market value of all final goods and services made within the country in a year.

Glossary

Term	Meaning
GN	Great Northern services from King's Cross/Moorgate.
GRIP	Guide to Railway Investment Projects – eight point investment life cycle for major projects.
GWML	Great Western Main Line – the routes from London Paddington to the South West and Wales.
HEX	Heathrow Express
High speed rail network	Networks of new lines constructed specifically for running at speeds in excess of the conventional high speed (in the UK that is 125 mph) with no level crossings. HS1 and HS2 are the first routes to be constructed and planned respectively in the UK.
HLOS	High Level Output Specification.
HST	High Speed Train – 1970s developed 125mph train still widely used on long distance services.
HS1	High Speed 1 – the high speed rail link between Ashford International and London St Pancras International stations.
HS2	High Speed 2 – the proposed high speed rail link between London and the West Midlands and potentially beyond.
IEP	Intercity Express Programme – the next generation of high speed train to replace the existing 125mph trains.
Infrastructure	This includes signalling, track, structures and telecom assets associated with the rail network.
Kent Route	Network Rail strategic rate aligned with Southeastern rates and HS1's routes.
LDHS	Long distance high speed.
LEP	Local Enterprise Partnership
Loading gauge	Loading gauge is the profile for a particular rail route within which all vehicles or loads must remain to ensure that sufficient clearance is available at all structures.
LTS	London, Tilbury and Southend line – the routes from London Fenchurch Street to the south Essex coast.
MML	Midland Main Line - the routes from London St Pancras International to the East Midlands and South Yorkshire.
MMLTLK	Midland Main Line Thameslink services from the Midland Main Line to Blackfriars and beyond via Farringdon.
MOIRA	An industry standard passenger demand forecasting model which uses many of the principles published in the Passenger Demand Forecasting Handbook.
Multiple unit trains (DMU, EMU & DEMU)	These are trains composed of self-contained units, rather than locomotive hauled/pushed, coupled together so that they work in unison under the control of the driver at the front of the leading unit. Units are normally composed of one, or more vehicles which are semi-permanently coupled and a driving compartment is provided at each end of every unit. There are diesel multiple units (DMU), electric multiple units (EMU) and diesel-electric multiple units (DEMU).
NLL	North London Line – the route between Richmond and Stratford.
NPV	Net present value – the whole-life economic benefit and revenue generated by a rail capability change minus the whole-life cost of this change.
Optimism bias	A proportional uplift to scheme cost estimates to allow for historical systematic optimism on the part of UK scheme promoters.
ORR	Office of Rail Regulation – the regulator for the railway industry in Great Britain.
Oxford Economics	A leading forecasting consultancy used as a data source for GDP, employment statistics etc.
PDFH	Passenger Demand Forecasting Handbook - industry standard publication containing detailed research on passenger behaviour and trends.
PiXC	Passengers in eXcess of Capacity – overcrowding measurement.
PPM	Public Performance Measure – the benchmarking process used to measure passenger train performance.
RPI	Retail Price Index – measure of UK inflation.
S&C	Switches and Crossings – track components which allow trains to change from one line to another.

Term	Meaning
SDO	Selective Door Operation – used where the whole train does not fit into a station platform to unlock only the doors at the platform.
SMG	Stakeholder Management Group.
SOFA	Statement Of Funds Available – the Government's allocation of funding for rail schemes. Network Rail bids for this funding through its Strategic Business Plan which is then reviewed and allocated by the ORR for Network Rail's next Control Period.
Sussex Route	Network Rail strategic route aligned with Southern's core routes.
SWML	South West Main Line – the line between London Waterloo and Weymouth.
TfL	Transport for London.
TfSH	Transport for South Hampshire.
Thameslink Programme Key Output 1	Upgrade of the Brighton to Bedford route to allow 12-car trains to operate, including station works at London Blackfriars and Farringdon.
Thameslink Programme Key Output 2	Remodelling of the London Bridge station and the eastern and western approaches, including grade separation at Bermondsey and connections to the new viaduct at Borough Market. A new connection will be provided from London St Pancras International low level onto the ECML.
TOC	Train operating company.
tph	Trains per hour.
TT	Timetable – these are usually published in May and December.
TWA	Transport and Works Act orders – the usual way of authorising a new railway or tramway scheme in England and Wales.
Up	The direction of trains normally when travelling towards London or large urban centre where direct trains to London do not operate.
WCML	West Coast Main Line – the routes from London Euston to the West Midlands, North West, North Wales and Scotland.
WCML DC lines	Third rail electrified routes between London Euston and Watford Junction.
Windsor lines	Routes between London Waterloo and Reading via Twickenham and to Windsor & Eton Riverside.
WLL	West London Line – the line between Clapham Junction and Willesden Junction/West Coast Main Line.
25kV AC	25,000 volts alternating current is the electrical supply for the overhead electrified routes.
750V DC	750 volts direct current is the electrical supply for the third rail system.

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