Draft for Consultation

Anglia: Route Study

Long Term Planning Process

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Foreword

We are delighted to present the Anglia Route Study Draft for Consultation, which sets out the strategic vision for the future of this network over the next 30 years.

Today, the railway carries tens of millions of passengers a year. Working closely with industry stakeholders, Network Rail is delivering an ever expanding network for those passengers and for freight users. More people are choosing to travel by train and high levels of growth are predicted to continue, particularly flows to London. Demand for freight is also expected to continue to grow, predominantly intermodal traffic from the Port of Felixstowe and London Gateway.

Improvements to the network are already in development to cater for passenger and freight growth in Control Period 5. Enhancing the Felixstowe branch and the redoubling of Haughley Jn will support an increase in freight capacity while other improvements planned for the next few years include Ely North Jn remodelling to help provide additional capacity and improve the flexibility in the Ely area for both passenger and freight. The Gospel Oak to Barking Line is to be electrified as well as the freight branch to London Gateway.

Crossrail, which completes in 2018, brings significant investment to the London end of the Great Eastern Main Line. The programme will provide a cross-London train service between Reading/Heathrow and Abbey Wood/Shenfield via a new tunnel under central London. Work is also underway to develop an enhanced junction at Bow Jn (near London Liverpool Street) to support an increase in main line longer distance services in peak hours.

On the West Anglia route a scheme is being developed to provide an additional track from Coppermill Junction northwards to Angel Road, to support an increase in train frequency between Stratford and the Lea Valley.

This Route Study is amongst the first of a new generation of studies which will go on to inform choices for funders in the years from 2019 to 2024, as well as to set out how future growth in the very long-term to 2043 could be accommodated. The longer-term planning horizon to 2043 is deliberate. It enables consideration of changes to be made in the context of longer-term developments underway such as East West Rail and technological advancements, with a view to creating a prioritised context of requirements for Control Period 6 (2019 – 2024).

Using future service characteristics (such as capacity, frequency, and journey times) which the industry aspires to deliver over the next 30 years, the Anglia Route Study has developed options to deliver these outputs subject to test for value for money, deliverability and affordability. Analysis was undertaken into where the capacity and capability of the network in 2019 will be insufficient to accommodate these requirements, with a number of 'choices for funders' identified, initially making best use of the existing network before articulating further infrastructure interventions.

The dominant issue is the need to provide sufficient capacity in the peak periods to and from London and a series of options have been developed to cater for the future level of demand. The study has also developed options to provide sufficient capacity for freight growth and to improve the frequency of services to and from key centres. The strategy identifies longer term opportunities for improving capacity, connectivity, journey times and optimising the delivery of interventions to achieve the best industry cost.

The public consultation of this Draft for Consultation closes on 3rd February 2015; details of the consultation process can be found in Chapter 7.

Network Rail has led the production of this draft on behalf of the industry and as such it has been developed collaboratively with industry partners and wider stakeholders, including passenger and freight operators, the Department for Transport, Transport for London, Local Authorities and Local Enterprise Partnerships. We thank them for all their contribution.

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00: Executive Summary

This document, part of the Long Term Planning Process (LTPP), considers the potential outputs required by the railway network within the Anglia Route in Control Period 6 (2019-2024), as well as further ahead up to the year 2043. It offers funders sets of choices as to how those outputs might be met, having regard to value-for-money, affordability, and efficient delivery.

0.1 The Long Term Planning Process

0.1.1 The Long Term Planning Process (LTPP), of which this draft Anglia Route Study forms a part, is the successor programme to the previous series of Route Utilisation Strategies (RUSs).

0.1.2 The LTPP is designed to build on previous work, and also to take account of various evolutionary changes including:

- changes in administrations in England, Wales, and Scotland, together with very significant changes in planning policy
- long term strategic investments in the rail network, examples include the development of a high speed line between London and Birmingham and beyond to Leeds and Manchester (High Speed 2 – HS2)
- decisions to invest significantly in further electrification of the network
- changes to signalling technology through deployment of the European Rail Traffic Management System (ERTMS) and progression of the Network Rail Operating Strategy
- a need to inform future maintenance and renewal strategies for the rail network
- changes to funders' objectives in the light of a significantly tighter fiscal environment, including a clear policy shift towards revenue generation and making best use of the existing railway, along with a focus on investing to support sustainable economic growth
- the conclusions from the 'Rail Value for Money' report by Sir Roy McNulty in May 2011.

0.1.3 The LTPP consists of a number of different elements, which, when taken together, seek to define the future capability of the rail network. The individual elements are:

- Market Studies, which forecast future rail demand, and develop conditional outputs for future rail services, based on stakeholders' views of how rail services can support delivery of the market's strategic goals
- Route Studies, which develop options for future services and for development of the rail network, based on the conditional outputs and demand forecasts from the market studies. These options are assessed against funders' appraisal criteria and presented as choices for funders in each of Network Rail's devolved Routes
- Cross-boundary analysis, which considers options for services that run across multiple routes in order to ensure that consistent assumptions are made in respect of these services.

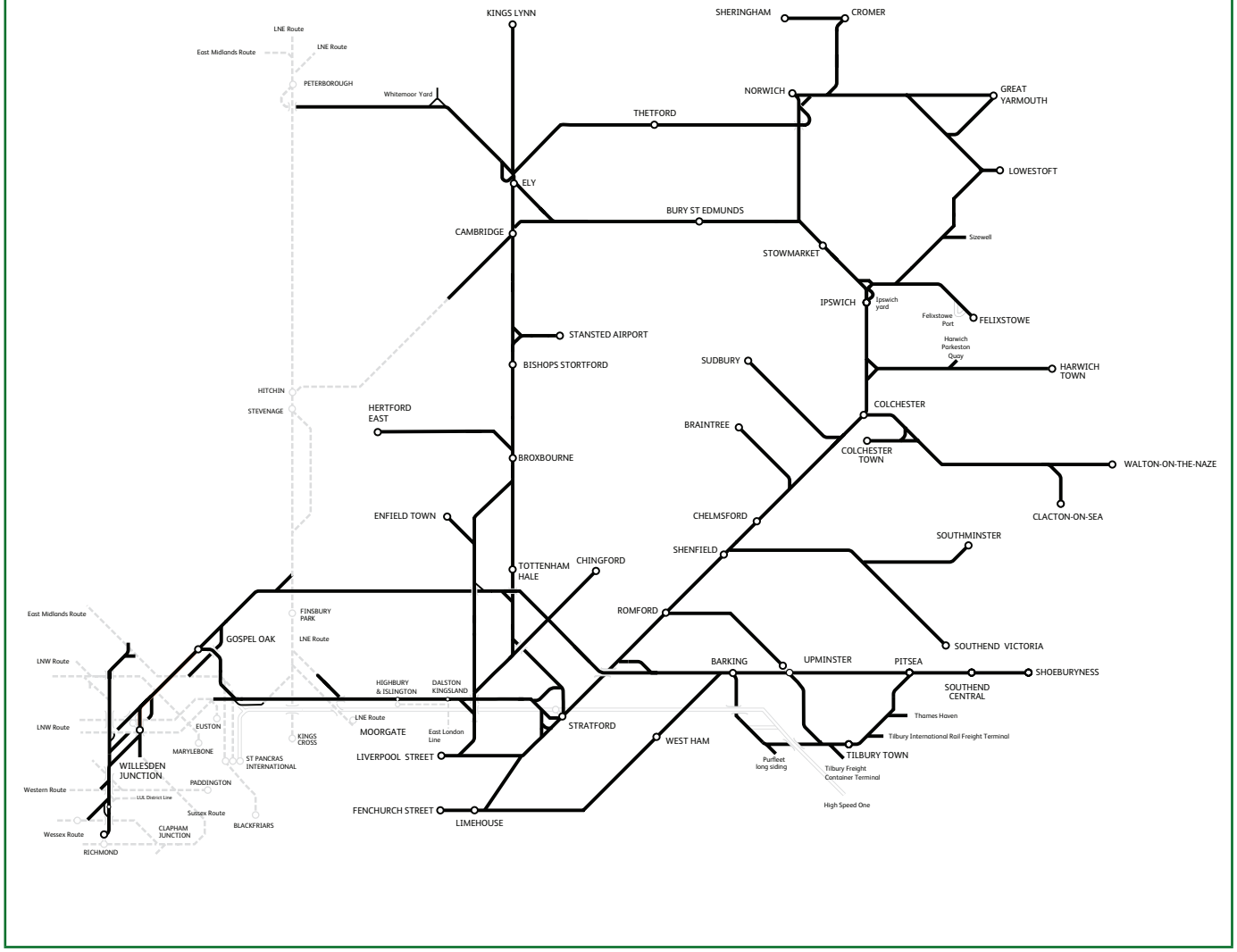
0.1.4 Chapter 1 of this document describes the background to, and objectives of, the LTPP in detail.

0.2 Geographic Scope and Baseline Assumptions

0.2.1 The Anglia Route comprises four major rail corridors, accounting for 1,426 track miles. These are:

- the Great Eastern Main Line (GEML), running from London Liverpool Street to Colchester, Ipswich and Norwich, together with associated branches
- the West Anglia Main Line, (WAML) running from London Liverpool Street to Cambridge, Ely and Kings Lynn, and associated branches
- the North London railways, including the North London Line (NLL) running from Stratford to Richmond and the Gospel Oak to Barking (GOB) line
- the London, Tilbury and Southend, or Essex Thameside, line running from London Fenchurch Street to Southend and Shoeburyness.

Figure 0.1: Anglia Route map



0.2.2 The base year for the Route Study is defined as 2019 (the start of Control Period 6). Between now and then, a number of schemes are expected (and are therefore assumed by this Route Study) to have been delivered, including:

- safety improvements, particularly involving level crossings
- the introduction of Crossrail services
- improvements to cater for freight growth between Felixstowe and Peterborough, such as double-tracking on the Felixstowe branch and also between Ely and Soham
- the transfer of certain West Anglia inner suburban services to London Overground
- remodelling of Bow Junction at Stratford
- remodelling of Ely North Junction
- electrification of the Gospel Oak to Barking line, and the Thameshaven freight branch
- the London Overground capacity improvement programme, which will see trains on the NLL lengthened from four to five carriages
- implementation of the National Operating Strategy, which will eventually have all signalling control on the route located at the Romford Rail Operating Centre
- capacity enhancements in the Lea Valley to enable an increase in services running to Stratford.

0.2.3 Looking further ahead into CP6 and beyond, a number of other schemes are at varying stages of development. These are not yet funded or committed, but include:

- East West Rail (Central Section), a project to establish a strategic rail corridor connecting East Anglia with Central, Southern and Western England
- High Speed 2 (HS2), to which Transport for London (TfL) are seeking to provide better connectivity by proposing a new station on the London Overground network at Old Oak Common, between Willesden Junction (High Level) and Acton Central
- Crossrail 2, a project that could link the suburban rail networks in Surrey and Hertfordshire via a new tunnel under central London
- a proposal to extend the GOB to a new housing development at Barking Riverside
- 'Norwich in Ninety', a scheme to cut journey times between London and Norwich to 90 minutes
- the 'Digital Railway' a programme to accelerate and exploit the use of digital technology across the entire scope of railway operations and management
- a suite of other new station proposals, of which the most advanced include new stations at Chesterton (between Cambridge and Waterbeach), Beaulieu Park (between Chelmsford and Hatfield Peverel), Soham (between Kennett and Ely), and Beam Park (between Dagenham Dock and Rainham)
- proposals to improve journey times between London and Cambridge/Stansted Airport.

0.2.4 Further details on all of these schemes and proposals can be found in Chapter 2.

0.3 Conditional Outputs for the Anglia Route

0.3.1 The various Market Studies identified a range of conditional outputs relevant to the Anglia Route. It should be emphasised that these conditional outputs are aspirations and not recommendations. They are conditional on being deliverable in a manner which represents both value-for-money and which is affordable to funders.

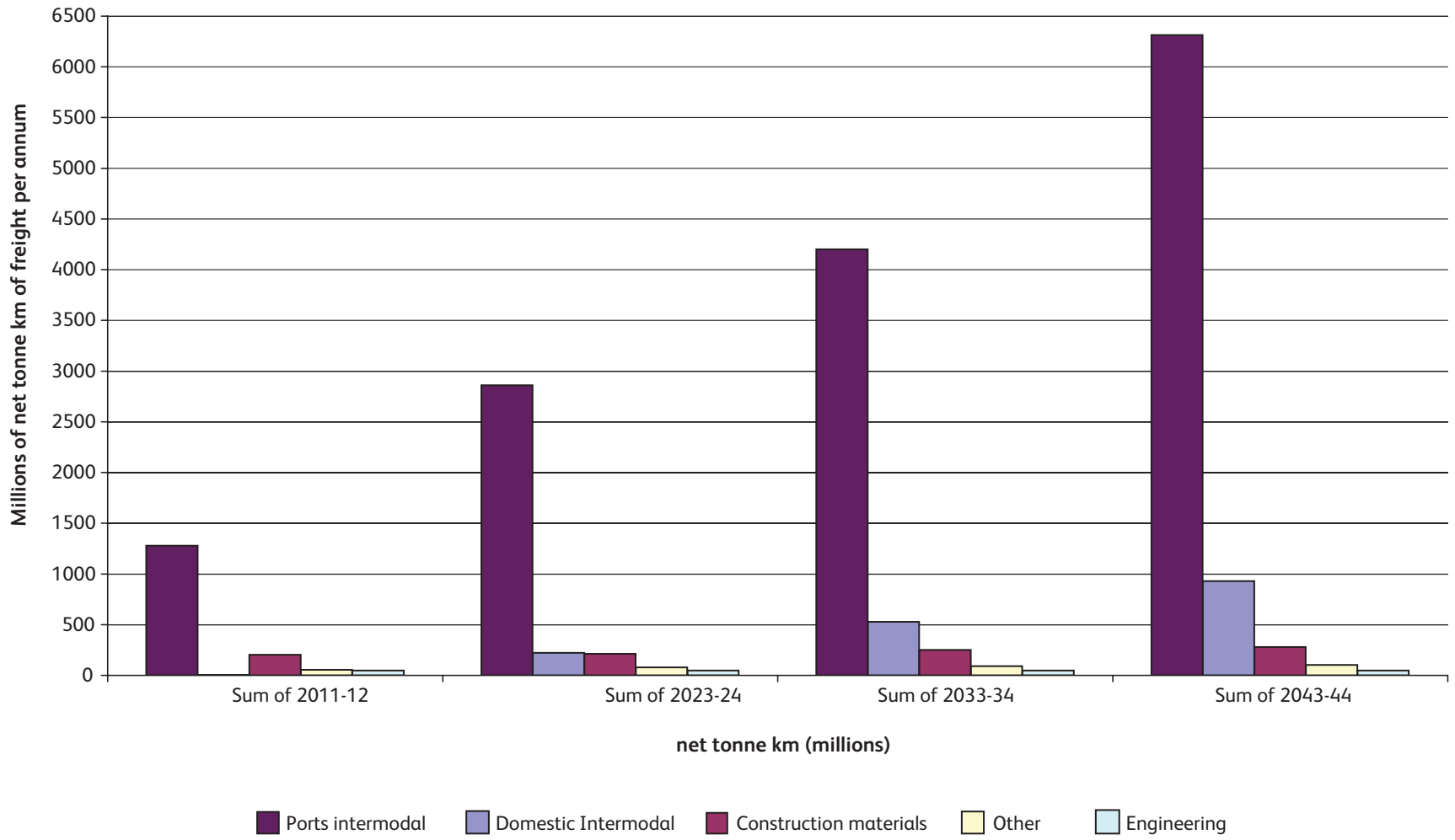
0.3.2 For the Anglia Route, most of the conditional outputs relate to the provision of sufficient capacity for both freight and passenger traffic, given the forecast growth up to the end of CP6 in 2024, and beyond then until 2043.

0.3.3 The predicted growth in passenger demand is shown in the table below.

Table 0.1 Increase in morning peak passenger demand into London Termini or at the busiest point on the route		
Corridor	2023	2043
Great Eastern Norwich and Outer suburban services	32%	75%
Great Eastern Inner suburban and Crossrail services	52%	83%
West Anglia Main Line – all services	18%	39%
North London Line/ West London Line	22%	55%
Gospel Oak to Barking	20%	46%
Essex Thameside	13%	46%
Source: L&SE Market study and TfL Railplan		

0.3.4 The predicted growth in freight demand is shown in the chart below, and clearly indicates the predominance of intermodal ports traffic.

Figure 0.2: Anglia Route Study Freight Conditional Outputs Net Tonne Km



0.3.5 The conditional outputs also call for journey time improvements in CP6 for journeys between:

- Liverpool Street and Colchester/Ipswich/Norwich
- Liverpool Street and Cambridge/Stansted Airport
- Fenchurch Street and Southend Central.

0.3.6 As far as frequencies are concerned, the conditional outputs specify an increase in:

- cross-boundary services between East Anglia and the East/West Midlands and beyond via Peterborough
- cross-boundary services between Cambridge and London via Hitchin
- a minimum of 2 trains per peak hour, in each direction, on each branch line within the route.

0.3.7 The conditional outputs are described in detail in Chapters 3 and 4.

0.4 Control Period 6 Priorities

0.4.1 The table below summarises the conditional outputs identified as being needed on the Anglia Route by the end of CP6.

Table 0.2: Control Period 6 conditional outputs

CP6 Conditional Outputs	Description
GECO1	To provide sufficient capacity for passengers travelling into central London during peak hours, taking into account anticipated growth over the period to the end of Control Period 6 (2023/2024) - Great Eastern Main Line services
GECO2	To provide sufficient capacity for cross-boundary services between Peterborough / Norwich and Cambridge via Ely, taking into account anticipated growth over the period to the end of Control Period 6 (2023/2024) – Cross-boundary services
GECO3	To provide journey time improvement for services on the route from Norwich to London – Great Eastern Main Line
F2NCO1	To provide sufficient capacity for freight travelling via the Felixstowe to Nuneaton route, taking into account anticipated growth over the period to the end of Control Period 6 (2023/2024) - Cross boundary services
WACO1	To provide sufficient capacity for passengers travelling into central London and other employment centres during peak hours, taking into account anticipated growth over the period to the end of Control Period 6 (2023/2024) - West Anglia services
WACO3	To provide journey time improvement for services from both Cambridge and Stansted Airport to London Liverpool Street - West Anglia services
CLCO1	To provide sufficient capacity for passengers travelling across London during peak hours, taking into account anticipated growth over the period to the end of Control Period 6 (2023/2024) – North London Line and Gospel Oak to Barking
CLFCO2	As identified to meet CLCO1, to provide sufficient capacity freight paths across London – Cross-boundary to the end of Control Period 6 (2023/2024)
ETCO1	To provide sufficient capacity for passengers travelling into central London during peak hours, taking into account anticipated growth over the period to the end of Control Period 6 (2023/2024) - Essex Thameside
ETFCO1	To provide sufficient capacity for freight travelling from the London Gateway Port via the Tilbury loop, taking into account anticipated growth over the period to the end of Control Period 6 (2023/2024) – Essex Thameside

Great Eastern Main Line (including cross-country freight)

0.4.2 In order to meet the conditional outputs GECO1, GECO2, GECO3, and F2NCO1, a range of options are presented to funders. These include:

- additional platform capacity at Liverpool Street
- headway reductions between Chelmsford and Stratford
- provision of a passing loop at Haughley Junction
- doubling of Trowse swing bridge
- headway reductions on the Bury St Edmunds line
- further doubling of the Felixstowe branch
- further doubling between Ely and Soham
- level crossing closures at Ely
- increased linespeeds to at least 110 mph between Shenfield and Norwich
- provision of a passing loop north of Witham.

West Anglia Main Line

0.4.3 In order to meet the conditional outputs WACO1 and WACO3, the options presented to funders are:

- platform lengthening to 12-cars at 18 stations
- increases in linespeeds up to 100 mph.

0.4.4 Further journey time improvements on services to Cambridge and Stansted Airport would depend on the ability to separate fast trains from slow trains south of Broxbourne. This is likely to require an additional pair of tracks between Broxbourne and Tottenham Hale, the cost of which, however, may not be justified by journey time improvements alone. Additional benefits (and funding streams) would need to be captured, such as the connectivity and capacity improvements proposed by the Crossrail 2 project or the need for additional capacity triggered by development in the Lea Valley. Some early enabling works are presented as options for CP6 including level crossing removal and land purchase.

North London Line and Gospel Oak-Barking Line

0.4.5 To meet the conditional outputs CLC01 and CLFCO1, it is the route study's assessment that the extra capacity planned for CP5 will be sufficient to accommodate the anticipated demand up to the end of CP6, for both passenger and freight services.

0.4.6 Despite this the study sets out several schemes that would support resilience on the routes in particular in relation to the mix of freight and passenger traffic. This are noted in the longer term sections below, but depending on the growth in freight traffic from North Thameside during CP5 and CP6 may be required earlier.

Essex Thameside

0.4.7 In order to meet the conditional outputs ETCO1 and ETCFO1, the following options are proposed:

- lengthening from 8-cars to 12-cars of eight trains in the three-hour morning peak
- works to improve passenger circulation at Fenchurch Street.

0.4.8 There is adequate capacity to meet the forecast demand for freight services up to the end of CP6.

Station Capacity – All Routes

0.4.9 A number of schemes to improve station pedestrian capacity are in development for implementation in CP5. Further interventions are proposed for CP6 as shown in the table below:

Table 0.3: CP6 Station Recommendations		
Station	**Conditional Output**	**Possible intervention**
Liverpool Street	GECO1	Increase capacity for passengers exiting/ entering platforms, vertical circulation from the concourse is also very constrained.
Fenchurch Street	ETCO1	Increase capacity for passengers exiting from all platforms to Tower Gateway exit so as to avoid restricting the passenger flow to the main concourse.
Limehouse	ETCO1	Potential increase in capacity for passengers exiting from all platforms required.
West Ham	ETCO1	Potential increase in capacity for passengers exiting the platforms and interchanging between National Rail and London Underground services required.
Seven Sisters	WACO1	Increase width of overground platforms and subway capacity for passengers interchanging and exiting at the station.

Summary

0.4.10 Chapter 5 of this document describes in detail the choices for funders to meet the CP6 conditional outputs. The main items are summarised in the chart below.

Figure 0.3: Control Period 6 choices for funders

Choice for Funders	West Anglia		Great Eastern			Essex Thameside
	Passenger capacity to end of CP6	Passenger capacity to end of CP6 and JTIs	Passenger capacity to end of CP6	F2N Freight - CP6	Norwich to London JTI	Passenger capacity to end of CP6
Lengthen trains on - extra 4 4 car units on Stansted, Cambridge, Hertford East * 2						
Platform lengthening on West Anglia suburban						
Line speed improvements (100mph) on current infrastructure						
Stratford platforms alternative to Liverpool Street platforms						
Ely Level Crossings						
Additional platforms at London Liverpool Street						
Felixstowe Branch line further doubling						
Haughley Junction Loop or Bury St Edmunds headway reduction						
Mainline headway - Chelmsford and Shenfield 7tph/ Shenfield to London Liverspool Street 28tph						
Shenfield to Liverpool Street headway reduction with ETCS Level 3 with ATO to deliver 32tph						
Doubling of Trowse swing bridge						
Line speed improvements (110mph) on current infrastructure						
Freight loops north of Witham						
The lengthening of some services to 12-car to meet demand						
Full doubling of Ely to Soham Line						
Fenchurch Street Station Passenger Capacity						

0.5 Accommodating the conditional outputs in 2043

0.5.1 The conditional outputs for 2043 fall into two categories: capacity outputs, and connectivity outputs.

0.5.2 The capacity outputs are summarised in Table 0.4:

Table 0.4: Longer term conditional outputs

Conditional Output	Description
GECO4	To provide sufficient capacity for passengers travelling into central London during peak hours, taking into account anticipated growth over the period to 2043 - Great Eastern Main Line services
GECO5	To provide sufficient capacity for cross-boundary (via Peterborough) and Cambridge passengers travelling to Norwich via Ely, taking into account anticipated growth over the period to 2043 – Cross-boundary services
F2NCO2	To provide sufficient capacity for freight travelling via the Felixstowe to Nuneaton route, taking into account anticipated growth over the period to 2043 – Cross-boundary services
WACO2	To provide sufficient capacity for passengers travelling into central London during peak hours, taking into account anticipated growth over the period to 2043 - West Anglia Main Line services via the Southbury Loop, Harlow Town & the Chingford branch.
WACO5	To provide sufficient capacity for passengers travelling to Stansted Airport all day, taking into account anticipated growth over the period to 2043
CLCO1	To provide sufficient capacity for passengers travelling across London during peak hours, taking into account anticipated growth over the period to 2043 - North London Line and Gospel Oak to Barking
CLFCO2	As identified to meet CLCO1, to provide sufficient capacity for freight across London – Cross-boundary
ETFCO2	To provide sufficient capacity for freight travelling from the London Gateway Port via the Tilbury loop and from HS1, taking into account anticipated growth over the period to 2043 - Essex Thameside
ETCO3	To provide sufficient capacity for passengers travelling into central London during peak hours, taking into account anticipated growth over the period to 2043 - Essex Thameside

0.5.3 The connectivity outputs are summarised in the following table:

Table 0.5: Longer term conditional outputs	
Conditional Output Reference	**Conditional Output**
GECO6 to GECO16	Increase in passenger service frequency on all the Great Eastern branch lines to 2 tph
WACO4	Improve cross London connectivity, connecting South West and North East London
WACO6	Increase in passenger service frequency between Kings Lynn and Cambridge to 2 tph
WACO7	Increase in passenger service frequency between Ipswich and Cambridge to 2 tph

Great Eastern Main Line (including cross-country freight)

0.5.4 Over and above the interventions required to meet capacity demand by the end of CP6 on the GEML, further measures would need to be considered to meet predictions for the end of CP10 detailed in conditional outputs GECO4, GECO5, and F2NCO2. Forecasts suggest that this will require infrastructure to accommodate:

- three additional morning peak services on the main line into Liverpool Street
- train lengthening (to-10-car) on Crossrail services
- up to five freight tph between Felixstowe and Peterborough.

0.5.5 A number of options are identified that would be required to meet these outputs :All are significant investments, and will need to be fully assessed against the likely scale of benefits.

0.5.6 Meeting the connectivity outputs (GECO6 to GECO16) of a minimum frequency of 2 tph on all the GEML branches would require additional infrastructure (such as passing loops, line doubling, additional platforms, etc) except on the following branches where no works would be required:

- Ipswich to Felixstowe (assuming the CP6 doubling works are done)
- Manningtree to Harwich
- Colchester to Walton-on-the-Naze
- Colchester to Clacton.

0.5.6 Where significant infrastructure is required, it seems unlikely that a positive business case could be made for increases in frequency, especially if additional rolling stock would also be needed.

West Anglia Main Line

0.5.9 Options for meeting passenger demand up to 2043 on the WAML (WACO2 and WACO5) include:

- four-tracking in the Lea Valley[1]
- doubling of Stansted Airport tunnel.

0.5.10 As far as four-tracking in the Lea Valley is concerned, it should be noted that in the absence of a Crossrail 2 scenario, this intervention alone and of itself does not provide significant additional capacity. This is because further major interventions would still be required to increase platform/track capacity at either or both of Liverpool Street and Stratford, together with the possible need to extend the four-tracking as far as Bethnal Green (if the majority of additional services were to go to Liverpool Street rather than Stratford). Four-tracking does, however, provide a means for improving journey times on longer distance services to Cambridge and Stansted Airport.

0.5.11 The connectivity outputs (WACO4, WACO6, and WACO7) could respectively be met by:

- Crossrail 2
- track-doubling between Littleport and Downham Market, or between Watlington and Kings Lynn (assuming the CP5 works at Ely North Junction are done)
- raising linespeed to 75 mph which would allow trains to pass at Dullingham.

North London Line and Gospel Oak-Barking Line

0.5.12 To meet the capacity outputs for 2043 on the NLL and GOB (CLCO1, CLFCO1 and CLFCO2), the following infrastructure options should be considered:

- signalling headway reduction on North London Line
- signalling headway reduction between Gospel Oak and Barking
- additional platforms at either Gospel Oak or Barking (or adequate provision at Barking Riverside if this scheme comes to fruition)
- freight regulation point at Gospel Oak
- freight regulation point at Kensal Rise
- train lengthening on the North London Line to 8-car (please also refer to the South East Route: Sussex Area Route Study, which discusses the need for 8-car trains on the West London Line)
- grade separation at Forest Gate Junction.

0.5.13 There are no connectivity conditional outputs relating to either the NLL or GOB.

Essex Thameside

0.5.14 To meet capacity conditional output ETCO3 on Essex Thameside by 2043, it is proposed that further passenger train lengthening is implemented. This also assumes that a crowding standard of 0.25m^2 per passenger is applied.

0.5.15 There is adequate capacity to cater for growth in freight demand.

0.5.16 There are no connectivity conditional outputs relating to Essex Thameside.

Summary

0.5.17 Further details on accommodating the conditional outputs in 2043 can be found in Chapter 6.

1 This could be sooner than 2043 if a case can be made for extra capacity as a result of earlier development in the Lea Valley.

0.6 Consultation and Next Steps

0.6.1 The Anglia Route Study has a formal consultation period of 90 days, and the deadline for receiving responses is 3rd February 2015. Earlier responses would be very much appreciated in order to maximise the time available for considering them.

0.6.2 After the conclusion of the formal consultation phase, the Anglia Route Study Working Group will consider further work that may be required to conclude the study, prior to publication of the final document in the summer of 2015.

0.6.3 Consultation comments are welcome, and can be sent to:

AngliaRouteStudy@networkrail.co.uk

Or by post to the address below:

Anglia Route Study Consultation
Network Rail (Group Strategy)
2nd Floor
Cottons Centre
Cottons Lane
London
SE1 2QG

01: Background

This chapter sets out the development of the Long Term Planning Process, and its relationship with the established suite of Route Utilisation Strategies and other emerging workstreams. The governance arrangements for the new process, and in particular for the Route Studies, is outlined as well as the structure of the remainder of this document.

1.1 Background to the development of the Long Term Planning Process

1.1.1 Since the late 1990s the national rail network has enjoyed a period of unprecedented growth. More passengers are using the network than ever before and the increase in the amount of goods transported by rail is considerable. The Department for Transport (DfT) recognises that the provision of attractive rail services is a significant driver of economic growth and this recognition is demonstrated by Governments' continuing desire to invest significantly in the provision of railway services, most recently through Network Rail's Control Period 5 (2014 – 2019) Delivery Plan. Forecasts suggest that demand for rail services is going to continue to grow strongly across all sectors.

1.1.2 In June 2005, following the rail review in 2004 and the Railways Act 2005, the Office of Rail Regulation (ORR) modified Network Rail's network licence to require the establishment and maintenance of Route Utilisation Strategies (RUSs), which prescribe interventions for the use and development of the network, consistent with the funding that is, or is likely to become, available.

1.1.3 The RUS programme, led by Network Rail on behalf of the rail industry, commenced in late 2004 and culminated with the establishment of the West Coast Main Line RUS in August 2011. As the network licence requires the maintenance of RUSs, the completion of the initial programme gave the opportunity to review how best to discharge this requirement into the future.

1.1.4 This review took into account:

- changes in administrations in England, Wales, and Scotland, together with very significant changes in planning policy
- long term strategic investments in the rail network, such as the development of a high speed line between London and Birmingham and beyond to Leeds and Manchester (High Speed 2 – HS2)
- decisions to invest significantly in further electrification of the network
- changes to signalling technology through deployment of the European Rail Traffic Management System (ERTMS) and progression of the Network Rail Operating Strategy
- a need to inform future maintenance and renewal strategies for the rail network
- changes to funders' objectives in the light of a significantly tighter fiscal environment, including a clear policy shift towards revenue generation and making best use of the existing railway, along with a focus on investing to support sustainable economic growth
- the conclusions from the 'Rail Value for Money' report by Sir Roy McNulty in May 2011.

1.1.5 The need was clear for the industry to consider network-wide long-term infrastructure development, rather than an incremental 'as now plus isolated enhancements' to the rail network. Network Rail and the industry worked together to produce a revised methodology to the RUS process to continue to develop the long term strategic direction of the rail network, taking into account the changes set out above.

1.1.6 This successor programme, the 'Long Term Planning Process' (LTPP), was endorsed by the ORR in April 2012. The LTPP will consider such changes and is designed to enable the industry to take account, and advantage, of long term strategic investment being made in Great Britain's rail network. The planning horizon for the LTPP is over a 30-year context; planning over 30 years clearly involves uncertainties, but the approach is intended to adapt to potential structural changes in the economy, and the approach to social and environmental responsibility, so that the rail industry can respond to change over the long term life of the assets used to operate the rail network.

1.1.7 Owing to the uncertainties of a 30-year horizon, the LTPP will be iterative. Future planning cycles will enable an updated view to take into account the changing context and requirements of the industry and economy. An objective of the LTPP is to understand the longer-term context whilst creating a prioritised view of requirements for the next Control Period (Control Period 6 (2019-2024), in order to present a clear strategy for funding as part of the

industry process. This commences with the submission of the Initial Industry Plan in September 2016. Future iterations of the LTPP will evolve, identifying requirements for future Control Periods as part of this on-going process.

1.1.8 The LTPP consists of a number of different elements, which, when taken together, seek to define the future capability of the rail network. The individual elements are:

- Market Studies, which forecast future rail demand, and develop conditional outputs for future rail services, based on stakeholders' views of how rail services can support delivery of the market's strategic goals
- Route Studies, which develop options for future services and for development of the rail network, based on the conditional outputs and demand forecasts from the market studies. These options are assessed against funders' appraisal criteria and presented as choices for funders in each of Network Rail's devolved Routes
- Cross-boundary analysis, which considers options for services that run across multiple routes to make consistent assumptions in respect of these services
- Network RUS – past publications include: Scenarios and Long Distance Forecasting, Electrification, Stations, Passenger Rolling Stock, and Alternative Solutions. A 'refresh' of the electrification strategy and a freight strategy coordinating cross-boundary freight recommendations and considering network capability are currently being developed.

1.1.9 The Market Studies, Route Studies, and Cross-boundary analysis are described in further detail in sections 1.2, 1.3, and 1.4 below.

1.1.10 The LTPP (and in particular the Route Studies) will provide a key part of the evidence base for future updates of the Network and Route Specifications. This will bring together all of the medium and long-term plans for the development of the route, currently drawing on sources including RUSs, renewal plans, development of major projects and resignalling programmes.

1.1.11 In addition, the existing Network RUS process will continue to look at network-wide issues. Further information on the LTPP, the current Network and Route Specifications, and the Network RUS can be found on Network Rail's website at www.networkrail.co.uk.

1.2 Market Studies

1.2.1 In October 2013, Network Rail published four Market Studies: Long Distance passenger, London & South East passenger, Regional Urban passenger and Freight. All four have been established by the Office of Rail Regulation and are available on the Network Rail website via the following link:

http://www.networkrail.co.uk/Long-Term-Planning-Process/

1.2.2 The three passenger Market Studies have clear connections to the three 'sectors' in which passenger train services are often divided. It is important to emphasise that each Market Study considers a particular market, rather than a particular set of train services.

1.2.3 The passenger Market Studies have three key outputs:

- identification of the long term strategic goals which define the successful provision of rail services to each of the three market sectors. These are based on the aspirations of current and likely future industry funders
- demand forecasts for the sector, over a 10 and 30-year planning horizon. Scenarios are used to reflect key uncertainties, where appropriate
- "conditional outputs" for the sector. The conditional outputs are aspired levels of service (in terms of, for example, frequency, journey time and/or passenger capacity on key flows in the sector). The conditional outputs reflect stakeholder views of how rail can support delivery of their strategic goals, opportunities created by planned investments, and reflecting current service levels and forecast future demand. The aim of the market studies is to provide demand forecasts, and conditional outputs, that are consistent across the Route Studies.

Conditional outputs should be viewed as aspirations for the future rather than recommended investment decisions.

1.2.4 The Freight Market Study produced demand forecasts over a 10 and 30-year planning horizon, with preferred routeing of services and the implied requirements in terms of network capacity and capability. Scenarios were used to reflect key uncertainties in particular markets. These demand forecasts form the conditional outputs for freight which are considered by the Route Studies.

1.2.5 It is also important to state that the conditional outputs shown are conditional on affordability, fundability, and a value for money business case for current and potential rail industry funders being made for any interventions that subsequent Route Studies in the LTPP may consider as a way to deliver them. Equally the conditional outputs will need to be deliverable technologically, operationally and physically.

1.3 Route Studies

1.3.1 There is generally one Route Study for each of Network Rail's devolved routes. The full Route Study programme setting out current timescales for each of the forthcoming Route Studies can be found on the Network Rail website here:

http://www.networkrail.co.uk/improvements/planning-policies-and-plans/long-term-planning-process/route-studies/

1.3.2 A Route Study develops and assesses options for the long term use and development of the network. Its starting point is to determine whether the conditional outputs from the relevant Market Studies can be accommodated on the existing network, with committed enhancements. It then develops train service options, corresponding to different uses of the network, (and hence to different trade-offs between stakeholders' strategic goals). Only then will consideration be given to choices involving infrastructure investment.

1.3.3 These choices are assessed against funders' decision making criteria, including quantitative assessment as in the previous RUS process. The process also includes, where appropriate, a wider assessment against factors such as strategic fit, wider economic impacts and affordability.

1.3.4 'Choices for Funders' identified within this Route Study are intended to inform the development of proposals within rail industry funding discussions for Control Period 6. Equally, other potential rail industry funders, for instance Local Authorities or Local Enterprise Partnerships, may wish to consider the information this Route Study contains, when taking forward their own plans and proposals which may impact upon the rail network.

1.4 Cross-boundary Analysis

1.4.1 Services that run across more than one Route Study area are considered in a separate "cross-boundary" workstream. This workstream has developed and assessed options for cross-boundary services (passenger and freight). The output from the cross-boundary analysis is a set of common assumptions that Route Studies should adopt regarding cross-boundary services. Assumptions include the frequency and calling pattern of passenger services and the frequency and operating characteristics (e.g. gauge, speed, tonnage) of freight services.

1.4.2 The workstream may also specify options for cross-boundary services to be examined in more detail in Route Studies, in order to better understand the trade-offs between cross-boundary and other services. The assumptions regarding cross-boundary services may be revised from time to time based on feedback and analysis completed in Route Studies.

1.5 LTPP Governance Arrangements

1.5.1 The LTPP is designed to be as inclusive as possible with contributions encouraged both from the rail industry and wider stakeholders. Overall governance responsibility for the process lies with the Rail Industry Planning Group (RIPG) whose membership comprises:

- Department for Transport (DfT)
- Freight Operators
- London TravelWatch
- Network Rail
- Office of Rail Regulation (ORR)
- Passenger Focus
- Passenger Transport Executive Group (PTEG)
- Rail Delivery Group

- Rail Freight Group
- Rail Freight Operators Association
- Railway Industry Association
- Rolling Stock Leasing Companies
- Transport for London (TfL)
- Transport Scotland
- Welsh Government.

1.5.2 RIPG meets every two months and provides strategic direction and endorsement of the constituent publications of the LTPP process.

1.6 Route Study Governance Arrangements

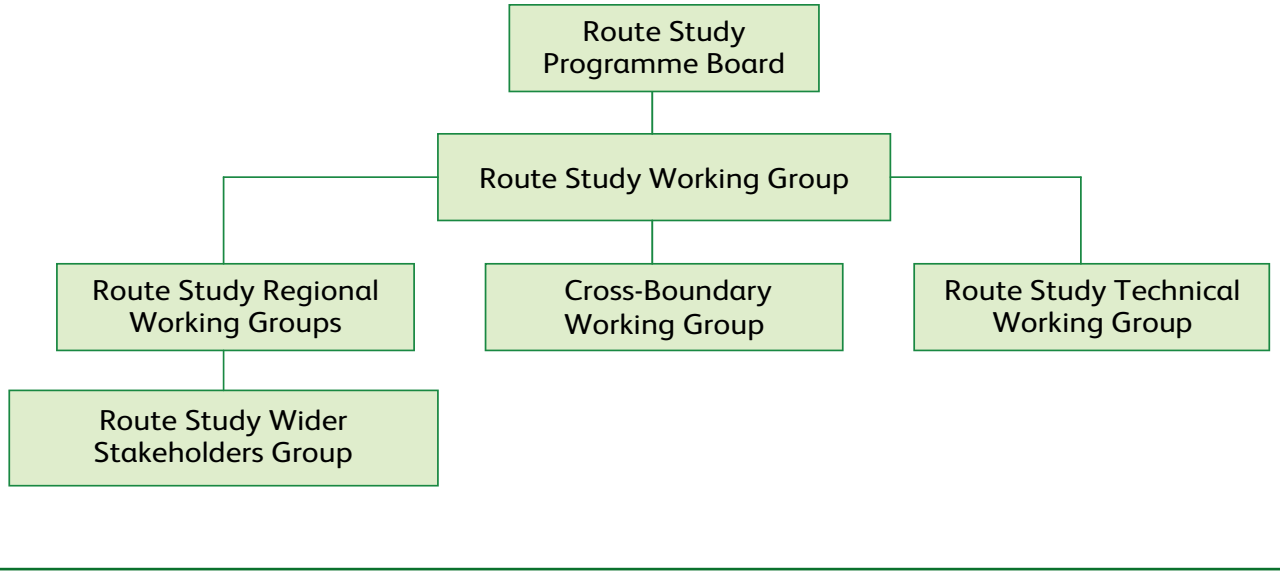
1.6.1 A three-tier structure for stakeholder dialogue has been established to oversee and help produce this Anglia Route Study.

- A Route Study Programme Board, chaired by Network Rail's Route Managing Director Anglia, with senior level representation from passenger and freight train operating companies, Rail Delivery Group, DfT, TfL and the ORR. The Route Study Programme Board directs the output from the Route Study Working Groups and provides a forum to resolve any significant issues which the Working Group wish to remit to the board for decision
- A Working Group comprising representatives from DfT, TfL, the current Train Operating Companies (both passenger and freight) who operate on the route, Rail Delivery Group, Network Rail, and the Office of Rail Regulation (ORR) as an observer. The Working Group determines how and whether the conditional outputs from the Market Studies can be accommodated on the route. Where conditional outputs cannot be accommodated, options and trade-offs are developed for both services and infrastructure, and choices for funders are presented for both Control Period 6 (the period from 2019-2024) and 2043. The Working Group has a mandate to discuss the study on behalf of the rail industry with other stakeholders. The Working Group is supported by a Technical Working Group led by Network Rail which evaluates options for technical feasibility and cost
- A Regional Working Group providing location specific oversight as well as an opportunity to collaborate in the production of the Route Study with the rail industry. The Regional Working Group membership comprises Local Authorities, Local Economic Partnerships, Airports and Freight stakeholders on the route.

1.6.2 Cross-boundary assumptions for the study have been managed by the Cross-Boundary Working Group. This national group, consisting of representatives of the passenger and freight operators along with funders, meets to consider the implications of cross-boundary services across the country.

1.6.3 Following publication of this document, the Anglia Route Study Draft for Consultation, the views of wider stakeholders on the route will be taken into account in finalising the Anglia Route Study.

Figure 1.1: Anglia Route Study Governance Arrangements



1.7 Document Structure

1.7.1 The rest of this document is structured as follows:

Chapter 2: Geographic Scope and Baseline Assumptions

Chapter 3: 2043 Conditional Outputs

Chapter 4: Cross-boundary Analysis

Chapter 5: Control Period 6 Priorities

Chapter 6: Accommodating the Conditional Outputs in 2043

Chapter 7: Consultation and next steps

1.7.2 This document has been published exclusively on Network Rail's website. If you would like a paper copy, please write or e-mail to the following address:

Anglia Route Study Consultation
Network Rail (Group Strategy)
2nd Floor
Cottons Centre
Cottons Lane
London
SE1 2QG

E-mail: AngliaRouteStudy@networkrail.co.uk

02: Geographic Scope and Baseline Assumptions

This chapter details the geographic scope and anticipated 2019 baseline for the Anglia Route Study.

2.1 Introduction

2.1.1 This chapter describes the geographic scope of the Anglia Route Study, and then lists the baseline assumptions used as a starting point for the analysis - these constitute the existing railway together with the committed schemes that are planned to be implemented during Control Period 5 (CP5). It then discusses a number of other schemes, which, whilst not yet committed or funded, are being proposed or developed for implementation in the route over the next 30 years.

2.1.2 The base year for the route study is defined as April 2019 (the start of Control Period 6).

2.1.3 Further details about the planned works during CP5 are available in Network Rail's CP5 Delivery Plan which can be found here.

2.2 Geographic Scope

2.2.1 The route study area comprises 1,426 track miles covering the whole of East Anglia and routes into and around London. The route covers four main lines through Greater London, Essex, Cambridgeshire, Suffolk and Norfolk. Full details are available in Network Rail's Network and Route Specifications which can be found here.

Great Eastern Main Line

2.2.2 Figure 2.1 shows a schematic of the Great Eastern Main Line (GEML) route. The GEML runs between London Liverpool Street and Norwich with a large number of branches in between. It carries key commuter flows into London as well as a fast-growing long distance flow, together with a significant amount of freight generated by the port of Felixstowe.

West Anglia Main Line

2.2.3 The West Anglia Main Line (WAML) runs between London Liverpool Street and Kings Lynn, also shown in Figure 2.1. The route carries busy commuter traffic from Stansted Airport and Cambridge into London Liverpool Street.

North London Lines

2.2.4 The North London Line (NLL), together with the Gospel Oak to Barking Line, form a vital part of London's transport infrastructure and a major link between key arterial routes to and from the capital. They provide a nationally important freight route as part of the Strategic Freight Network, and accommodate a key orbital urban passenger service around London. The lines connect with every arterial route north, east and west of London, and with parts of the southern railway network. A schematic of the NLL is shown on Figure 2.2.

Essex Thameside

2.2.5 The Essex Thameside route runs from London Fenchurch Street to Shoeburyness, with a loop line between Barking and Pitsea via Tilbury. These lines carry a mixture of commuter and leisure traffic along with substantial freight movements to and from the ports at Tilbury and London Gateway. The Essex Thameside route schematic is shown in Figure 2.3.

Figure 2.1: Great Eastern and West Anglia Main Lines

Great Eastern Main Line
West Anglia Main Line
Southbury Loop
Fen Line
Cambridge to Haughley Junction
Ely to Peterborough Line
Felixstowe Branch Line
Chingford Branch Line
Shenfield to Southend Line
Bittern Line
East Suffolk Line
Wherry Line
Crouch Valley Line
Romford to Upminster Line
Breckland Line
Sizewell Branch
Gainsborough Line
Braintree Branch
Colchester to Clacton/Walton)
Hertford East Branch

* New Station Proposed

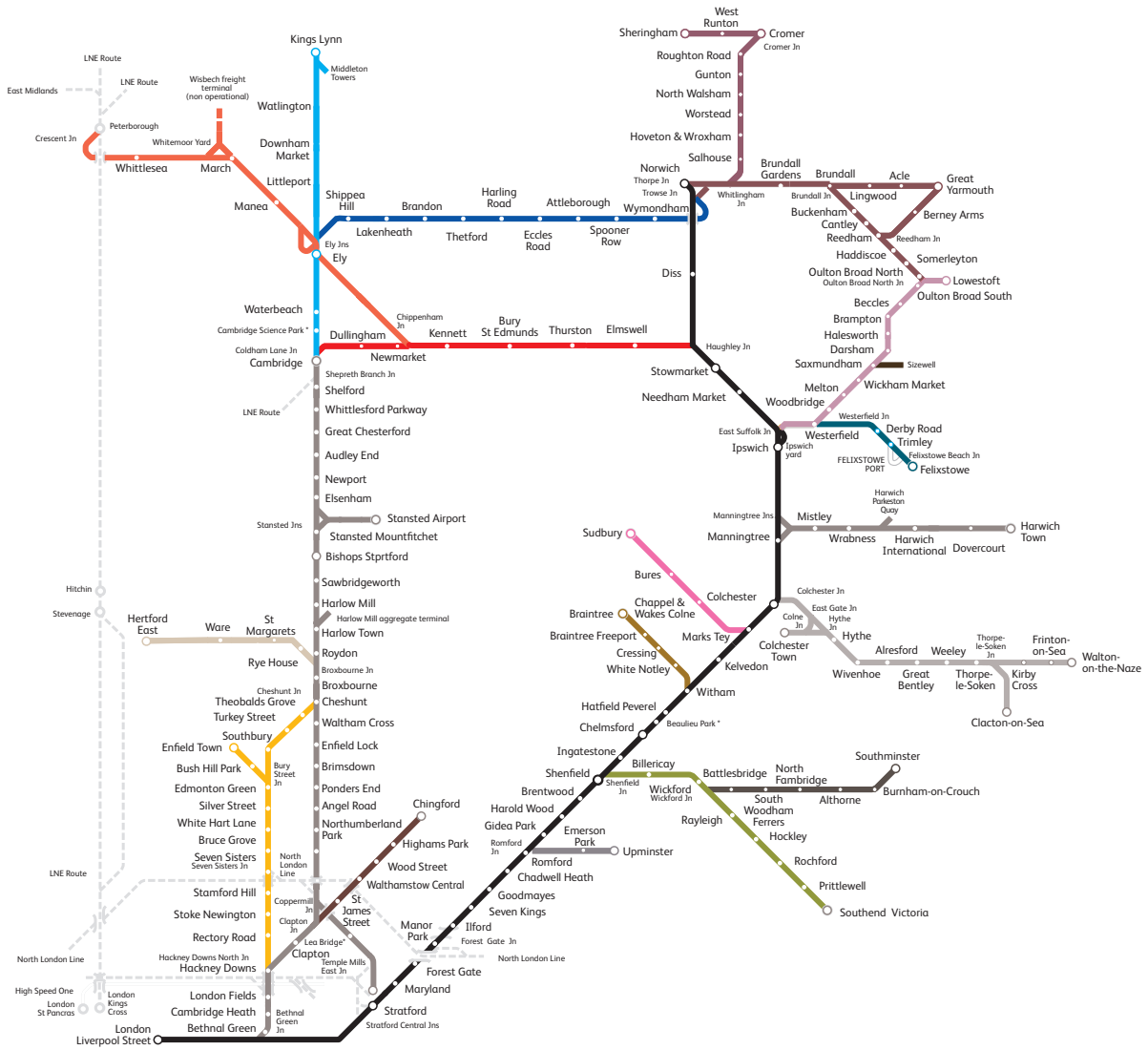


Figure 2.2: North London Lines

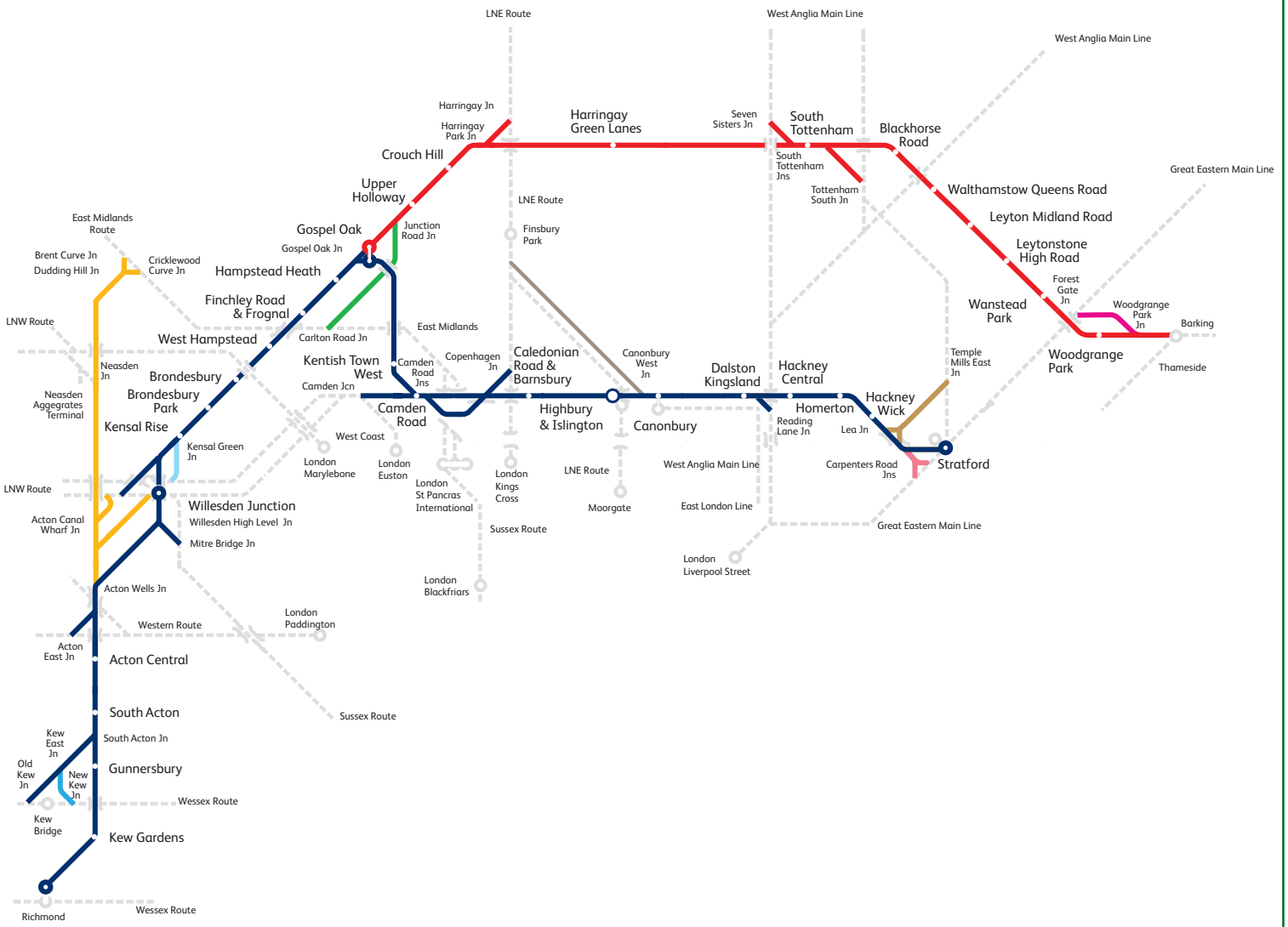
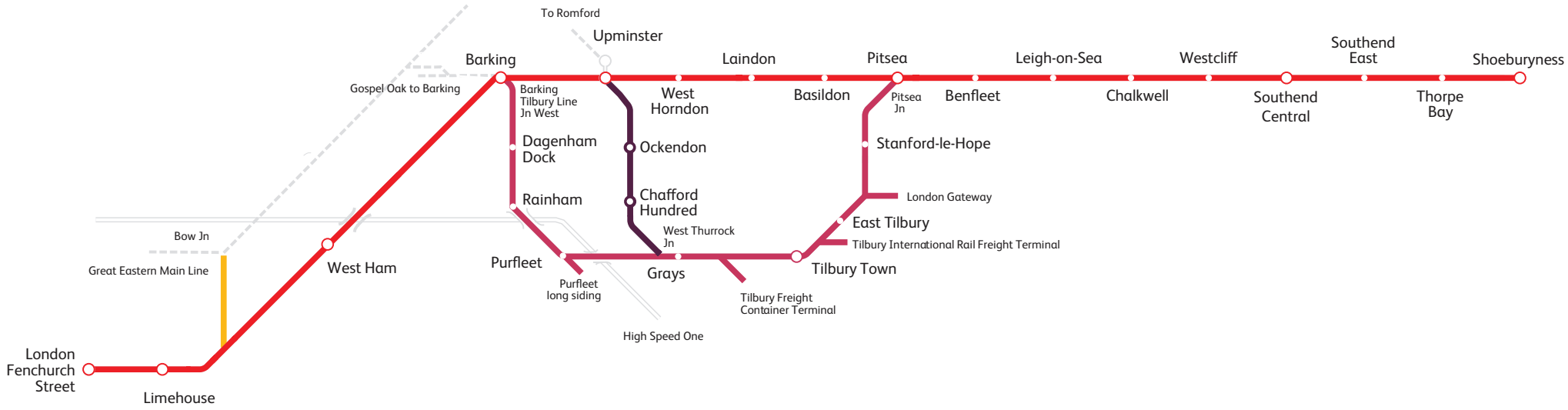


Figure 2.3: Essex Thameside



Essex Thameside

Tilbury Loop Line

Upminster to Grays

Gas Factory Jn to Bow Jn

2.3 Baseline assumptions – route-wide

Safety Matters

2.3.1 Network Rail set out its vision for safety in its 'Transforming Safety & Wellbeing' strategy through to 2024. Many of the 'Choices for Funders' set out in this document are at an early stage of development and safety will be considered in depth as proposals are developed. By their very nature however, proposals to remove junction conflicts, eliminate crossing movements and ease the flow of passengers at stations, will improve the safe operation of trains, and the passengers and freight using those trains. Where proposals have the potential, for example, to eliminate level crossings, these have been identified and will be highlighted if those 'choices for funders' are developed further.

Performance

2.3.2 In developing the schemes set out in this document, the rail industry has principally considered how the conditional outputs set out in the preceding Market Studies could be met, both for Control Period 6, and in the longer term to 2043. In the shorter term, within Control Period 5, Network Rail has been set targets to improve performance, and these are set out in detail within the Delivery Plan for Control Period 5. The trajectory of these changes is to improve performance, measured through the Public Performance Measure such that 92.5 per cent is reached in England, Wales and Scotland by the end of Control Period 5.

2.3.3 The performance objectives for the rail industry in Control Period 6, are not yet known. However the direction of travel is likely to be to continue to improve the performance of the rail industry. As the proposals for CP6 set out in Chapter 5 are developed, emerging priorities can be considered in more depth.

Resilience

2.3.4 The resilience of transport networks was brought into sharp focus by the winter storms of 2014 and the breach of lines on the Cambrian and Cumbrian Coast lines, as well as most prominently at Dawlish on the Great Western Main Line west of Exeter, which resulted in the closure of the line to Plymouth, Paignton and Cornwall for eight weeks. Whilst these line breaches were on the coastline, line blockages also occurred due to inland flooding, significant landslips of embankments or cuttings, and fallen trees across the network caused significant delays and a number of long periods of line closures.

2.3.5 These events have highlighted changes in climate, the vulnerability of the railway to storm damage, and the increased incidence of weather related events. Whilst the immediate response in addressing these problems has been well received, there is also a need to consider in more depth what the strategic issues for the railway might be.

2.3.6 For each Route Study, specific issues are likely to differ. In taking thinking forward, the industry will need to consider the outputs from work on resilience that Network Rail is undertaking, and apply them to the specific needs of each route, for example in thinking through electrification priorities.

2.3.7 Each route has developed a Weather Resilience and Climate Change Adaptation Plan (WRCCAP). For the Anglia Route the WRCCAP was published at the end of September 2014. This document sets out a management plan for weather resilience and climate change supported by an evaluation of the resilience of rail infrastructure to historical weather events and an awareness of potential impacts from regional climate change projections.

2.3.8 The approach taken is consistent across all Network Rail's Routes, providing an opportunity to improve the future reliability of the entire railway network and managing a railway fit for the future. A link to the Network Rail resilience plans can be found here.

The Digital Railway

2.3.9 The Digital Railway is a rail industry-wide programme designed to benefit Great Britain's economy by accelerating the digital enablement of the railway.

2.3.10 The scope of the Digital Railway vision is to be defined in the early part of CP5. The business case framework will be aligned to the Long Term Planning Process and supported by the Department for Transport (DfT). The real challenge now facing the industry is to reach consensus on the elements of the vision that can be accelerated, to build a roadmap for how this can be realised, and to build the business case for Government to invest in accelerating towards that vision. This will need to consider the operational

processes and people-related changes as well as technology acceleration. The Digital Railway programme is setting out to build the industry business case to accelerate the digital-enablement in several key areas of the railway, namely:

- train operation – transforming the rolling stock landscape, tariffs, journey sale and settlement, and potentially even the franchise operating model. This is the 'Digital Train Operator'
- capacity allocation – long-term network planning through to sale of access to capacity in real-time. This is the 'Digital System Operator'
- passenger – simplifying journeys, from planning, purchase to on-the day travel. This is the 'Digital Passenger'
- infrastructure – digital assets, digital workforce
- stations and interchanges – retail and transport hubs with key interconnects to other modes of transport including driverless electric cars. This is the 'Digital Station'.

2.3.11 In most areas, work to develop technical capability is already underway. The programme will seek to determine what is required to align and accelerate different initiatives to bring them into a single roadmap underwritten by the whole industry.

2.3.12 The output of the programme will be a business case to Government, presented through the Initial Industry Plan in September 2016.

2.3.13 However, as these proposals are still at an early stage of development, for the purposes of the Anglia Route Study, no benefits from the Digital Railway have been assumed. The Route Study has assessed where specific opportunities for new technology would support achieving conditional outputs. For example where early introduction of European Train Control Systems (ETCS) would support delivering the required train service.

2.3.14 References to timescales for the introduction of the ETCS are based on asset renewal dates. These dates may change as a result of the Digital Railway proposals and the impact of this would need to be considered accordingly when known, as would any other proposals that may arise that could impact on the Anglia Route Study.

Interoperability

2.3.15 The Railways (Interoperability) Regulations 2011 and associated Technical Specifications for Interoperability (TSI) apply to the entire UK rail network with the exception of the exclusions defined on the DfT website.

2.3.16 Network Rail, along with other Infrastructure Managers in the UK, is legally obliged to comply with the Interoperability Regulations when the nature of the works being undertaken so requires European and UK legislation defining objectives for Interoperability and the Trans European Network-Transport (TEN-T) will be taken into account in the development of this Route Study. Network Rail and the wider rail industry have sound practical experience in applying the respective Regulations and associated TSIs. The experience has been used to good effect in:

- demonstrating legal compliance with the requirements and providing feedback to government and the European Railway Agency on practical issues of application
- leveraging the benefits associated with the Interoperability principles
- developing plans to assess the full potential of an interoperable network, including connectivity with continental Europe.

2.3.17 For works being carried out on the UK component of the TEN-T network, EU funding support is available for qualifying projects. Network Rail will work with the DfT to ensure that the UK takes maximum benefit from this opportunity.

Traction power

2.3.18 Traction power modelling, along with power supply upgrades, will take place to provide enhancements to the existing traction power infrastructure needed to support the forecast increase in electrically-operated rolling stock for CP5 and the future. This will highlight works, which will need to be agreed with the electricity supplier, at a number of feeder stations across the Anglia route. The project is developing the requirements for electric traction power to provide additional power to support the capacity increases into London Liverpool Street. It will also consider the implications associated with future service increases, rolling stock changes, and potential electrification schemes in CP6.

National Operating Strategy

2.3.19 Network Rail's National Operating Strategy will migrate all signalling and control functions into 14 Rail Operating Centres (ROCs), from more than 800 signalling locations which exist across the country today.

2.3.20 The Romford ROC, completed construction in September 2014, with the migration of all Anglia route signal boxes within the next 10 years the ROC will become the primary location for the control of all signalling within the Anglia route.

Level crossings

2.3.21 There are a number of level crossing closures planned in CP5 across the Anglia route. Further information on level crossings will be provided in the Final Document.

Line speeds

2.3.22 Network Rail is looking at improving line speeds across the Anglia route where current speeds could be increased without the need for major improvements to infrastructure - particularly where they may be scope for easing historic speed restrictions. The current line speed profiles are detailed in Figures 2.4, 2.5 & 2.6.

Figure 2.4: Great Eastern and West Anglia Main Lines, Line Speeds

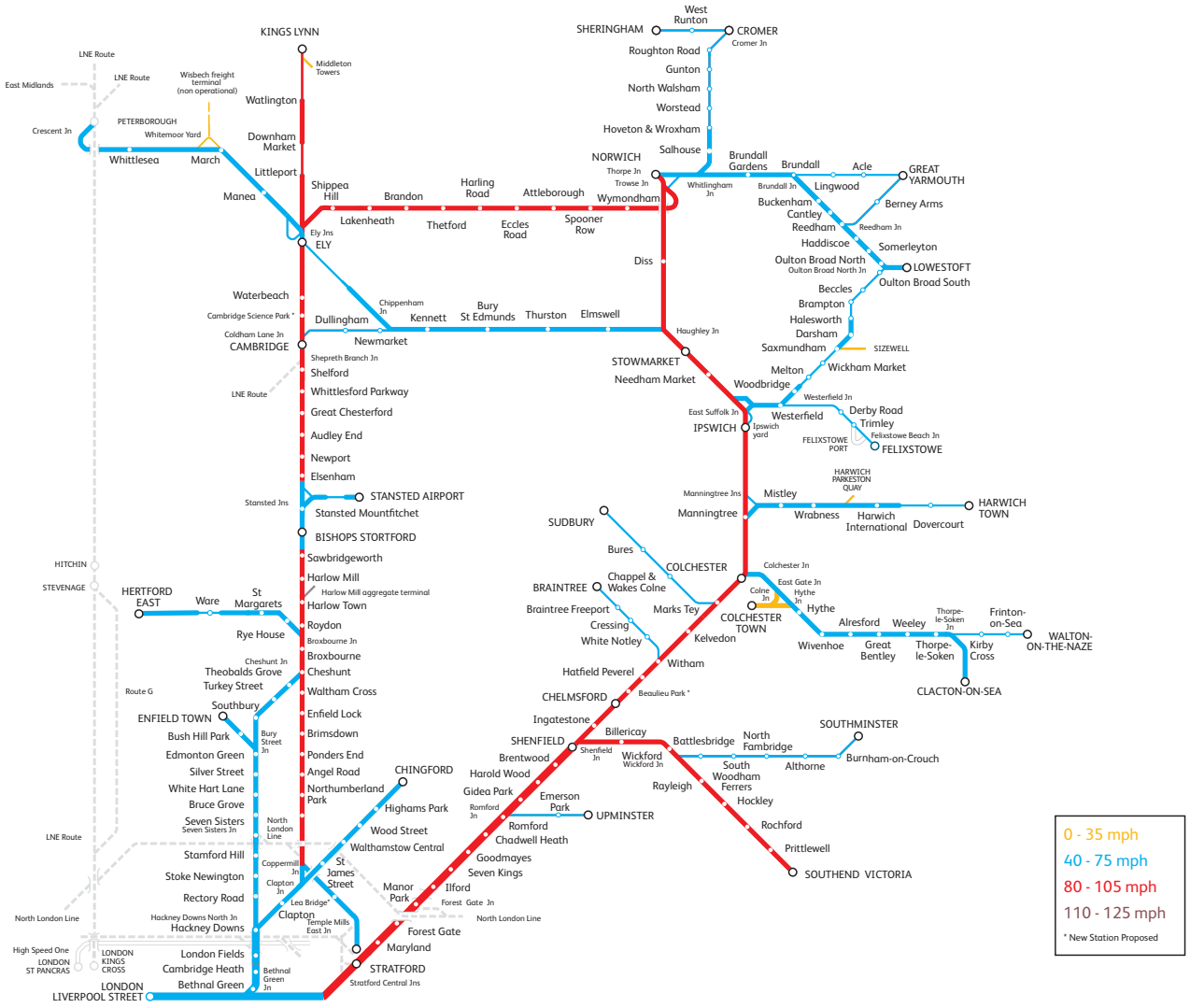


Figure 2.5: North London Lines, Line Speeds

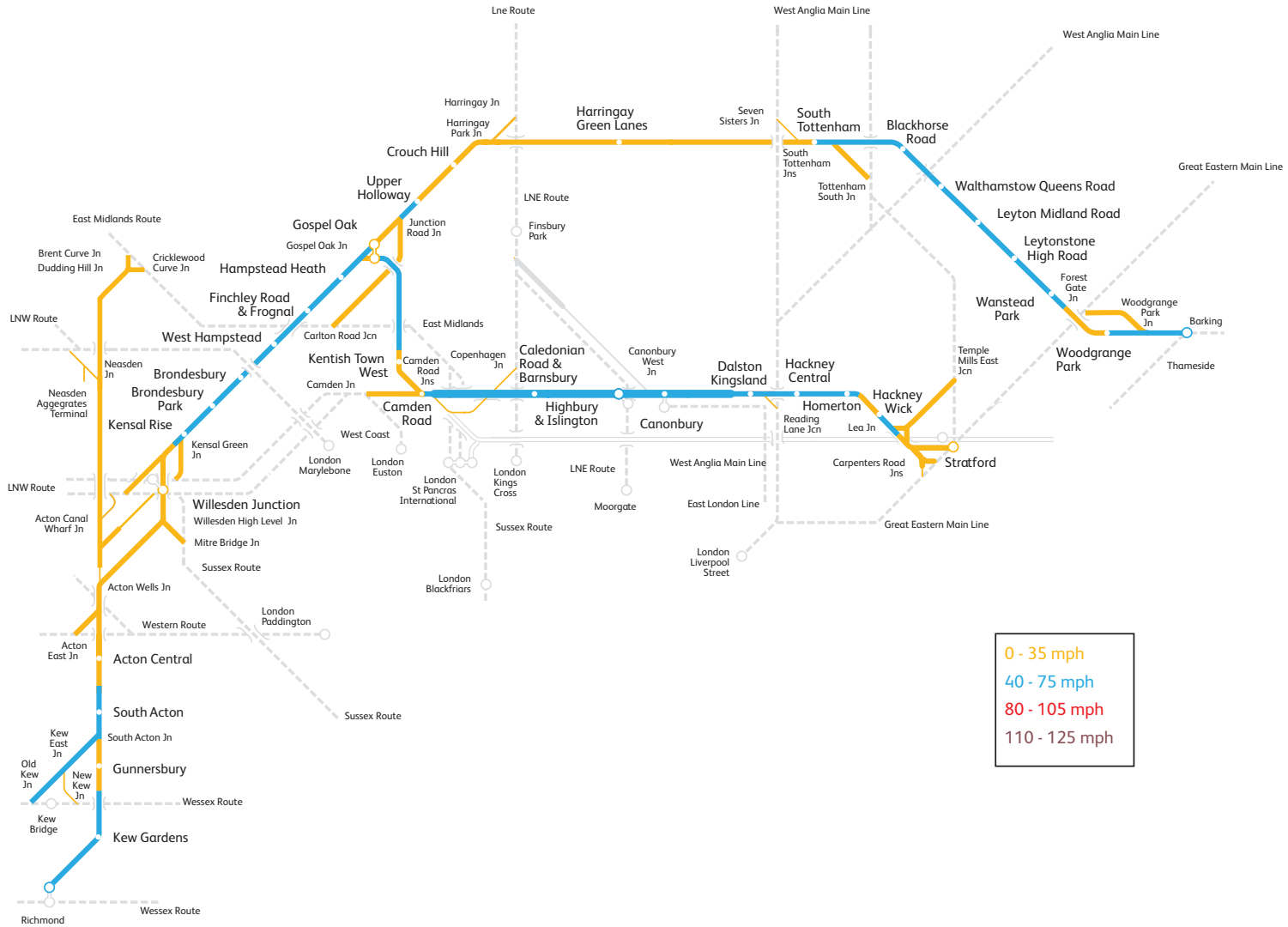
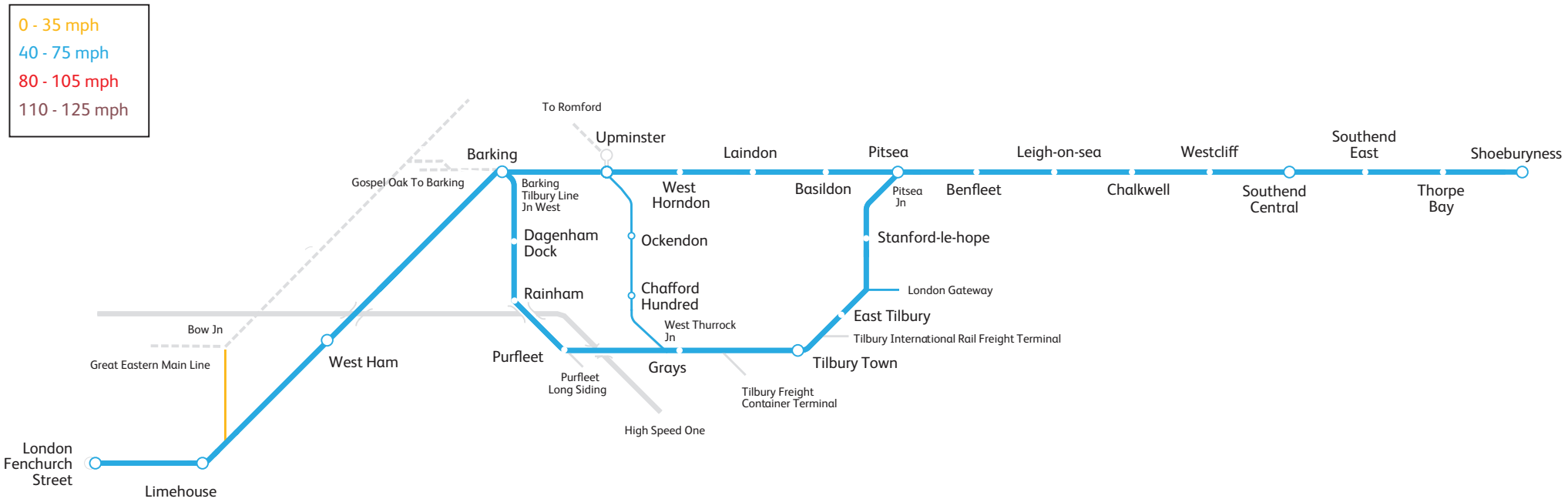


Figure 2.6: Essex Thameside, Line Speeds.



2.4 Baseline assumptions – Great Eastern Main Line

2.4.1 The significant infrastructure and service changes taking place on the GEML during CP5 are described below:

Crossrail

2.4.2 Crossrail is jointly funded by the Government and Transport for London (TfL) and will provide a cross-London train service between Reading/Heathrow in the west and Abbey Wood/ Shenfield in the east, via a new tunnel under central London. Construction works will be ongoing until July 2018 when the initial service becomes operational. Full service operation commences in December 2019 and will operate with 9-car electric trains, capable of carrying around 1500 passengers in each train delivering substantial economic benefits across London and the south east.

2.4.3 At peak times Crossrail will run 12 tph along the Electric Lines between Shenfield and the tunnel portal at Stratford, calling at all stations. In addition during peak times, a Crossrail residual service will operate 4 tph between Gidea Park and the existing London Liverpool Street terminus station.

2.4.4 Following the introduction of Crossrail services, the number of platforms at London Liverpool Street station will reduce from 18 to 17. This is to enable platforms 16 and 17 to be lengthened to accommodate Crossrail trains; platform 18 will be taken out of commission.

Bow Junction remodelling

2.4.5 Network Rail are developing a scheme for CP5 that will remodel Bow Junction to allow trains running on the Main Lines to make use of the Electric Lines between the Crossrail tunnel portal at Stratford and London Liverpool Street station. This will enable longer-distance trains to make better use of the platform capacity freed up at London Liverpool Street by Crossrail. Initially, this project will provide the infrastructure to support an additional two peak tph main line services, likely to originate from the Southend line. This will increase the number of trains using the Main Lines between Shenfield and Stratford by two tph in the high peak morning hour.

Freight driven schemes

2.4.6 To cater for freight growth on the Felixstowe to Nuneaton corridor (which is anticipated to be 48 trains each way per day by CP6), two schemes are being developed on the GEML for implementation in CP5. These are:

- enhancement of the Felixstowe branch, to encompass either full or partial doubling of the current single line
- re-doubling of Haughley Junction.

2.5 Baseline assumptions – West Anglia Main Line

Stratford to Angel Road

2.5.1 A scheme is currently in development that will increase the number of trains along the West Anglia route between Stratford and Angel Road to provide increased station stops and additional capacity on the route. This will be achieved by providing an additional track from around the Coppermill Junction area northwards to Angel Road. This scheme is intended to address the medium-term demand arising from industrial and residential developments in the vicinity of Lea Bridge, Tottenham Hale, Northumberland Park and Angel Road stations with a view to achieving a standard four tph service between Stratford and Angel Road stations, two of which will continue north to Bishops Stortford.

2.5.2 As part of this scheme, it is planned to reinstate Lea Bridge station situated between Stratford and Tottenham Hale, by the end of CP5. The re-opening of the station will provide connectivity for the communities around the Lea Bridge catchment area to Stratford where there is the Westfield Shopping Centre, access to jobs in the Docklands via connections to the LUL Jubilee Line and the Docklands Light Railway and Olympic Legacy venues. The area is currently poorly supported by public transport except via a long bus ride.

Transport for London Concession

2.5.3 From May 2015 Transport for London (TfL) will take over the train services from London Liverpool Street to Enfield Town, Cheshunt (via Seven Sisters) and Chingford.

Additionally, TfL will also take over the Romford to Upminster services.

The services will be run by London Overground operator, LOROL, from 31 May until November 2016 when the current London Overground concession is due to end. The London Liverpool Street services will then become part of the overall London Overground concession which will be re-let.

Ely North Junction remodelling

2.5.4 The single lines at Ely North Junction have been identified as a constraint to increasing passenger services in the Ely area. This scheme is being developed to help provide additional capacity and improve operational flexibility in the Ely area for both passenger and freight services. The objective is to remodel the junction, providing the most capacity, best performance resilience and operational flexibility as possible.

2.5.5 It should be noted that the remodelling of Ely North Junction alone will not provide additional capacity across the route and various other interventions delivered by the Felixstowe to Nuneaton project are required to deliver additional services, these interventions include reducing headways and mitigating the increased level crossing risk.

Freight driven schemes

2.5.6 To cater for freight growth on the Felixstowe to Nuneaton corridor (which is anticipated to need to convey up to 48 trains each way per day by CP6), three schemes are being developed on the WAML for implementation in CP5. These are:

- full or partial doubling of the single line between Ely and Soham
- extension of Ely goods loop
- improvement to headways in the Ely area.

2.6 Baseline assumptions – North London Lines

Gospel Oak – Barking electrification

2.6.1 During CP5 the Gospel Oak to Barking line will be electrified, along with the freight branch to London Gateway port. This will enable more efficient operation of passenger services, as well as providing a second electrified route across London for Thameside freight - thereby relieving capacity constraints between Forest Gate Junction and Stratford on the Great Eastern route.

2.6.2 The two-car Diesel Multiple Units (DMUs) that operate the current passenger services between Gospel Oak and Barking will be replaced by four-car Electric Multiple Units (EMUs), providing significant additional passenger carrying capacity.

London Overground Capacity Improvement Programme (LOCIP)

2.6.3 LOCIP is a programme of works addressing the increasing demand on the London Overground network. It includes conversion of the existing fleet of London Overground Class 378 four-car trains to five-car trains on all routes.

2.7 Baseline assumptions – Essex Thameside

2.7.1 As stated in 2.6.1 above, the freight branch to London Gateway will be electrified in CP5.

2.7.2 During Control Period 4 (CP4) work started at the Tower Hill entrance of London Fenchurch Street to ease passenger congestion and is planned for completion by the end of 2014.

Beyond that, no significant infrastructure changes are expected on this line of route during CP5.

2.7.3 In June 2014 the Essex Thameside franchise was awarded to National Express who will continue to run these services for 15 years until 2029. This franchise will deliver new rolling stock as well as additional capacity – including a high-peak metro service between Barking and London Fenchurch Street, with more services calling at Barking, West Ham and Limehouse.

2.8 Longer-term, uncommitted or aspirational schemes

2.8.1 In addition to the committed CP5 schemes described above, there are a number of other initiatives and schemes which are either being, or are likely to be, developed during the period which this Route Study covers. Whilst these schemes cannot be considered as part of the 2019 baseline, it is important to be aware of them in order that planning decisions can be fully informed.

Electrification

2.8.2 Network Rail is currently undertaking a refresh of the Network RUS: Electrification strategy to consider future options for electrification in the longer term following the completion of publicly committed schemes. The Network RUS: Electrification will look at the case for further opportunities to develop the electrified network in Control Period 6 and beyond. Examples of schemes that have been identified for potential further development as part of the Electrification Strategy relevant to this route study include:

- Felixstowe to Nuneaton
- Chippenham Junction to Coldham Lane Junction.

High Speed 2 (HS2)

2.8.3 The current HS2 proposals do not include a connection to the London Overground services that currently pass through the area in which Old Oak Common station will be located. Transport for London is leading a study on options for linking HS2 to the London Overground network, namely the West London Line (WLL) and the North London Line (NLL). A new London Overground station would allow passengers to interchange between HS2, Great Western Main Line, Crossrail and London Overground services, which would enable the creation of a key strategic interchange point for West London, similar to that in Stratford, East London.

2.8.4 HS2 passengers would be able to connect for onward journeys southwards towards Clapham Junction and Richmond, or eastwards towards Stratford without having to enter central London. The new station would also allow passengers travelling to Heathrow Airport from North London the opportunity to change at Old Oak Common for direct Heathrow and/or Crossrail services. Further information on the current proposals can be found on the TfL website here.

East West Rail

2.8.5 East West Rail is a major project to establish a strategic railway connecting East Anglia with Central, Southern and Western England.

2.8.6 The 'Western Section' is now a committed, funded scheme to re-introduce passenger and freight services between Bedford and Oxford, Milton Keynes Central and Aylesbury. It involves upgrading and reconstructing sections of existing and 'mothballed' rail track, which is to be delivered by Network Rail.

2.8.7 The project is being promoted by the East West Rail Consortium – a group of local authorities and businesses with an interest in improving access to and from East Anglia and the Milton Keynes South Midlands growth area.

2.8.8 The Consortium is also working to develop a business case to extend the railway to Cambridge to enable train services to continue to Norfolk and Suffolk, referred to as 'The Central Section'. Further information on the current proposals can be found on the East West Rail website here.

2.8.9 If implemented this may enable further options for meeting both freight and passenger conditional outputs.

Crossrail 2

2.8 10 Crossrail 2 is the proposed new high-frequency, high-capacity rail line running through London and into Surrey and Hertfordshire. It would add much needed capacity to London's rail network and support economic regeneration. Further information on the current proposals can be found here.

Barking Riverside

2.8.11 Barking Riverside is a planned redevelopment in Barking, East London, adjacent to the River Thames. The site has planning permission for 10,800 homes. The Gospel Oak to Barking line will be extended from Barking to Barking Riverside to allow for the development to be completed. Although capital and operational funding is still not clear, and there are several operational issues which need to be addressed, both the Department for Transport and Network Rail are supportive.

'Norwich in Ninety'

2.8.12 As part of the "Norwich in Ninety Taskforce", Network Rail and other industry partners are closely involved with work to improve journey times right along the Great Eastern Main Line. It is recognised that a variety of changes to infrastructure, rolling stock and service patterns will be needed to achieve these improvements, several of which are considered in this study.

Improving connectivity

Network Rail has been working on a project examining a different approach to planning the network and services that can operate, based on other European countries such as Switzerland. A seperate consultation will be published on this concept in November 2014 on the Network Rail website to gain feedback on the value of this approach and where it could be applied across the network.

Proposals for new stations

- Chesterton Interchange

The new station will be on the main line between Cambridge and Waterbeach located in the suburb of Chesterton, close to Cambridge Science Park. The current station proposal is formed of two through and one bay platform.

- Beaulieu Park

The proposal is for a new station approximately three miles to the north-east of Chelmsford Station on the Great Eastern Main Line. The current plans consist of a four-platform station and includes proposals for approximately 1,400 car parking spaces at the station, including 25 disabled spaces, comprising 300 premium spaces and 1,100 spaces in a multi-storey car park. Cycle parking and storage for 500 cycles will be provided. The station will also be a bus interchange for services in the Springfield area.

- Soham

The proposal is for a new station on the line between Ely and Bury St Edmunds, approximately 5 miles to the east of Ely. The current station proposal is formed of two platforms and the local councils are leading plans to develop the scheme further.

- Beam Park

The proposed new station is on the line between Dagenham Dock and Rainham. The current recommended option has two platforms. The local council and the Greater London Authority (GLA) are leading plans to develop the scheme further.

03: 2043 Conditional Outputs

Conditional outputs are aspirations that the rail industry should seek to achieve, conditional on there being a value for money and affordable way of delivering them.

3.1 Introduction

3.1.1 The London and South East, Long Distance, Regional Urban and Freight Market Studies, established in autumn 2013, articulate conditional outputs in consultation with the rail industry, funders, local authorities and other interested parties. This chapter provides a short summary of the conditional outputs in the market studies and then goes on to interpret them for the Anglia Route Study.

3.2 Strategic Goals

3.2.1 The strategic goals are aligned with the strategic goals of the transport sector and are as follows:

- enabling economic growth
- reducing carbon and the transport sector's impact on the environment
- improving the quality of life for communities and individuals
- improving affordability and value for money.

3.3 Conditional Outputs

3.3.1 The conditional outputs describe the rail industry aspirations over the longer term and can be summarised as:

- the level of rail capacity required to accommodate the demand for passenger journeys, taking into account forecast growth
- the level of rail connectivity between large towns and cities across the country (by for example, the frequency of train services, journey times, and the provision of direct journeys which do not require an interchange)
- the level of freight demand forecast between pairs of locations in terms of the tonnes for a given commodity
- the level of capacity required at stations for better passenger circulation, especially during the peaks
- the level of capacity for leisure travel at evenings and weekends specified in the London and South East Market Study
- the level of connectivity required to airports, ports, higher education establishments and HS2 stations
- improved rail connectivity for weekend leisure travel specified in the Long Distance Market Study
- improved local access to the rail network
- improved passenger satisfaction.

3.3.2 It should be emphasised that the conditional outputs are aspirations and not recommendations. They are conditional on being deliverable in a manner which represents both value for money and is affordable to funders. The conditional outputs will also need to be deliverable technologically, operationally and physically.

3.3.3 The next section describes the generic conditional outputs that are relevant to the Anglia Route Study. Sections 3.5 to 3.8 then interpret some of the generic conditional outputs into specific conditional outputs for the Great Eastern, West Anglia, North London lines, Gospel Oak to Barking, and Essex Thameside subdivisions of the Anglia Route.

3.4 Generic conditional outputs for the Anglia Route

Passenger capacity to cater for demand

3.4.1 The passenger market studies established a conditional output to provide sufficient capacity to accommodate the anticipated future passenger demand.

3.4.2 In order to inform the decision over the level of rail capacity required, the three passenger market studies generated growth forecasts for the network under four separate scenarios for the UK economy in both 2023 and 2043. These scenarios were:

- prospering in isolation
- prospering in global stability
- struggling in isolation
- struggling in global turmoil.

3.4.3 Each scenario reflects possible alternative futures for the UK economy, taking into account various factors which influence the demand for travel such as macroeconomic factors, microeconomic factors, demographics, consumer tastes and the supply of travel opportunities. The conditional outputs for capacity

are to meet the highest set of these demand forecasts (namely prospering in global stability) in both 2023 and 2043.

3.4.4 The Passenger Market Studies produced forecasts of passenger growth. These have been used by the Anglia Route Study in conjunction with passenger counts information and the implications of any baseline service improvements to understand the passenger capacity required by 2043 and by the end of Control Period 6 (CP6) in 2023.

3.4.5 The London and South East Market Study provides the most relevant forecasts for the Anglia Route Study. Table 3.1 describes the forecast growth in peak rail trips into London by corridor at the busiest point in 2023 and 2043.

3.4.6 Service improvements as a result of the introduction of Crossrail that will provide significantly more capacity and through services to employment centres in central London without interchanging at Stratford or Liverpool Street and are expected to drive demand increases on the GEML suburban services. This is expected to abstract some demand from the Essex Thameside and West Anglia Main Line routes, through direct abstraction and competition for central London employment. There is also a tendency for longer distance commuting to grow faster than shorter distance commuting, therefore passenger demand on the GEML Outer suburban services and Norwich services is expected to grow relatively fast. There are a large proportion of commuters from Witham, Colchester, Manningtree, Ipswich and Norwich. In comparison, growth in peak passenger numbers on the West Anglia Main Line and Essex Thamesside is expected to be more in line with the expected increase in central London employment. Uncommitted improvements in capacity, service and quality of rolling stock could drive demand increases on either route, and these have not been taken into account in the forecasts. The impact of changes in expected demand at Stansted Airport and population growth are among many factors that could influence these forecasts further. Regular monitoring and updating of these forecasts to take account of known changes in supply and demand should be undertaken, particularly in light of the Davies Commission recommendations on airport capacity.

3.4.7 With the exception of the North London Line and the Gospel Oak to Barking route, these forecasts assume the same level of crowding constraint throughout the period.

Table 3.1 Increase in morning peak passenger demand into London Termini or at the busiest point on the route

Corridor	2023	2043
Great Eastern Norwich and Outer suburban services	32%	75%
Great Eastern Inner suburban and Crossrail services	52%	83%
West Anglia Main Line – all services	18%	39%
North London Line/ West London Line	22%	55%
Gospel Oak to Barking	20%	46%
Essex Thameside	13%	46%
Source: L&SE Market study and TfL Railplan		

Freight capacity to cater for demand

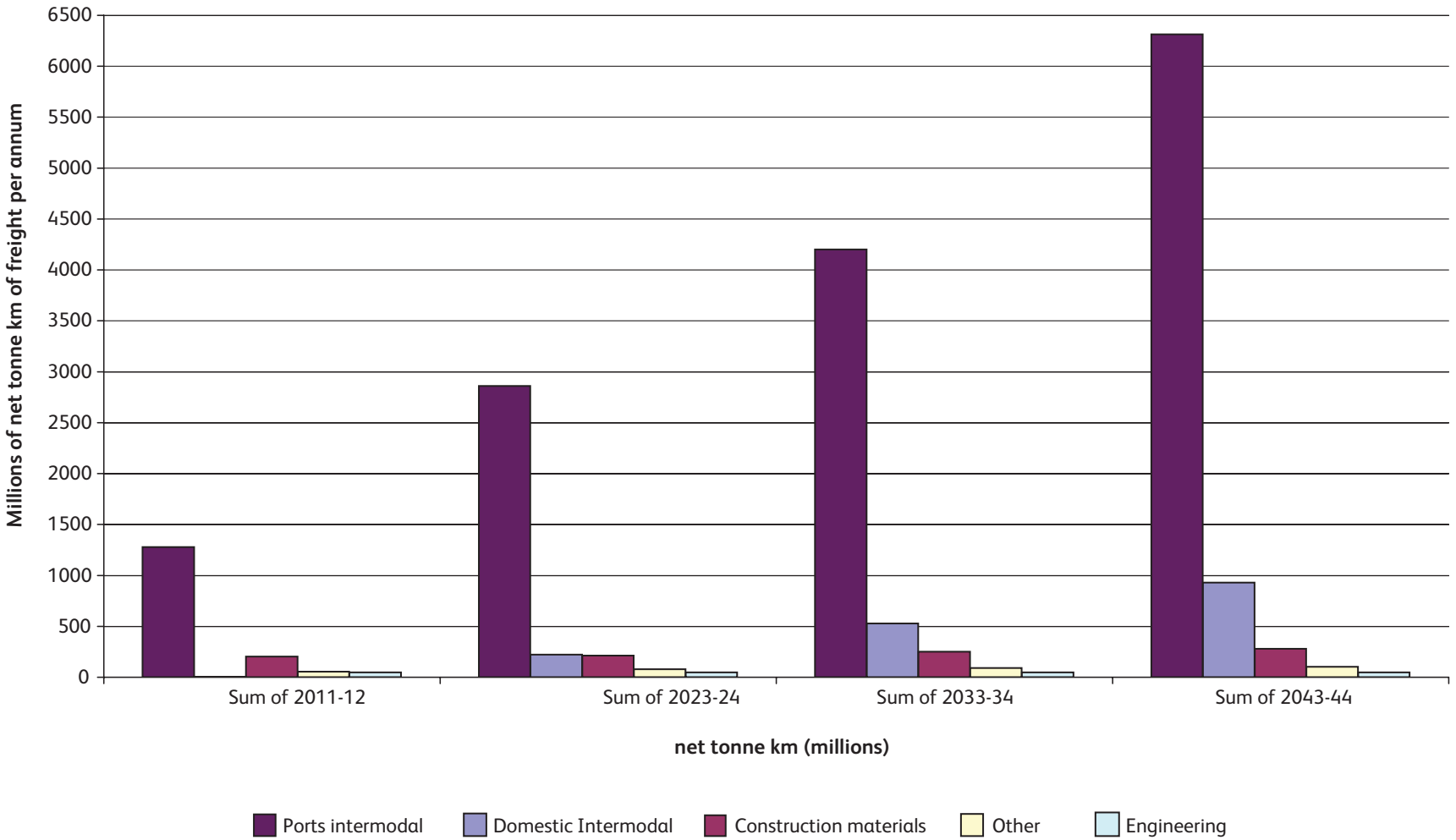
3.4.8 For freight, the conditional outputs are to accommodate the forecast level of freight demand set out in the Freight Market Study in 2023 and 2043.

3.4.9 The overall forecast freight growth across Great Britain is for an increase in total tonne-kilometres of 2.9 per cent annual growth to 2043, compared to annual growth of about 2.5 per cent since the mid-1990s. In terms of total tonnes lifted, the forecast is for 2.0 per cent annual growth to 2043, compared with the recent trend of broadly stable tonnage. The forecast growth rate in terms of tonnes is lower than that for tonne-kilometres as a result of changes in the composition of traffic, such as the forecast reduction in coal flows and the forecast increase in longer distance intermodal flows.

3.4.10 Currently intermodal traffic comprises around 41 per cent of tonne-kilometres nationally. This is forecast to grow to an 80 per cent share of total tonne-kilometres by 2043 as a result of strong forecast growth in intermodal traffic, coupled with the forecast decline in coal traffic. Forecasts for Great Britain show average annual growth in intermodal to 2043 of approximately six per cent, in terms of tonne-kilometres. This reflects growth of about five per cent per annum for the ports and Channel Tunnel sub-sectors, and 10 per cent per annum for the domestic sub sector. The overall growth reflects forecast trade growth and an improvement in the competitiveness of the rail industry. This improvement in competitiveness reflects the forecast growth in fuel and labour costs which affects road freight proportionally more than rail.

3.4.11 The graph in Figure 3.1 shows the existing tonne kilometres transported on the route by commodity; it shows that demand for freight paths in Anglia is largely driven by growth in intermodal traffic from the ports of Felixstowe and Tilbury. Most of this freight is expected to be carried to destinations outside the Anglia Route.

Figure 3.1: Anglia Route Study Freight Conditional Outputs Net Tonne Km



3.4.12 The forecast changes in freight market demand have been mapped onto the rail network in Great Britain using routeing assumptions which were developed through extensive collaboration and one-to-one discussion with the Freight Market Study Working Group. In summary, three steps were used to allocate freight flows to the network:

a) Where assumptions developed in previous generations of Route Utilisation Strategies have not altered, these routeings were used in the Freight Market Study and are carried forward into this Anglia Route Study. Key assumptions relevant to the Anglia Route Study were:

- freight from Felixstowe Port to the Midlands was all assumed to be routed via the Felixstowe to Nuneaton route rather than via London
- freight from Essex Thameside to the Midland Main Line (MML) southern freight terminal cluster was assumed to be routed 66 per cent via Gospel Oak to Barking and MML - 33 per cent East Coast Main Line (ECML then from Peterborough to Syston (option for 100 per cent of traffic to go via the MML)
- freight from Essex Thameside to the MML northern freight terminal cluster was assumed to be routed 40 per cent via Gospel Oak to Barking then north up the MML – 60 per cent via ECML then from Peterborough to Syston and north on the MML to Trent Junctions.

b) Where there have been some specific changes either in the form of new infrastructure schemes or to routeing policy since the RUSs were established, the Freight Market Study considered possible routeing options and proposed either a preferred routeing or options to be tested.

c) For new flows that have commenced since the RUSs were established, the Freight Market Study assumed that services will be routed via the shortest distance unless there is a strong logic to do otherwise. The routeing recognises that freight operators will have a desire to use particular routes, but that operational issues such as time awaiting a suitable path, could mean that it is more efficient for the service to operate via an alternative which may mean that a higher average speed, and therefore shorter journey time is achieved. The needs of differing types of freight services, for example fast intermodal or heavy coal traffic, have also been considered. For intermodal freight it was assumed that a gauge cleared route would be the preferred route.

3.4.13 These routeing assumptions were then used to calculate the number of paths per hour across all route sections within the Anglia Route Study area. The paths per hour assumptions were developed by taking the forecast demand in tonnes per annum[2], applying the routeing assumptions set out above, then demand was converted to paths per hour based on a number of assumptions set out in the Freight Market Study. For the purposes of the analysis, these have been rounded up within the Anglia Route Study to the next whole number, with the exact number used at boundaries, to ensure that as Route Studies take place across the country, cumulative rounding of freight flows does not take place.

The following diagram Figure 3.2 shows the assumed freight path requirements for the Anglia Route in 2043.

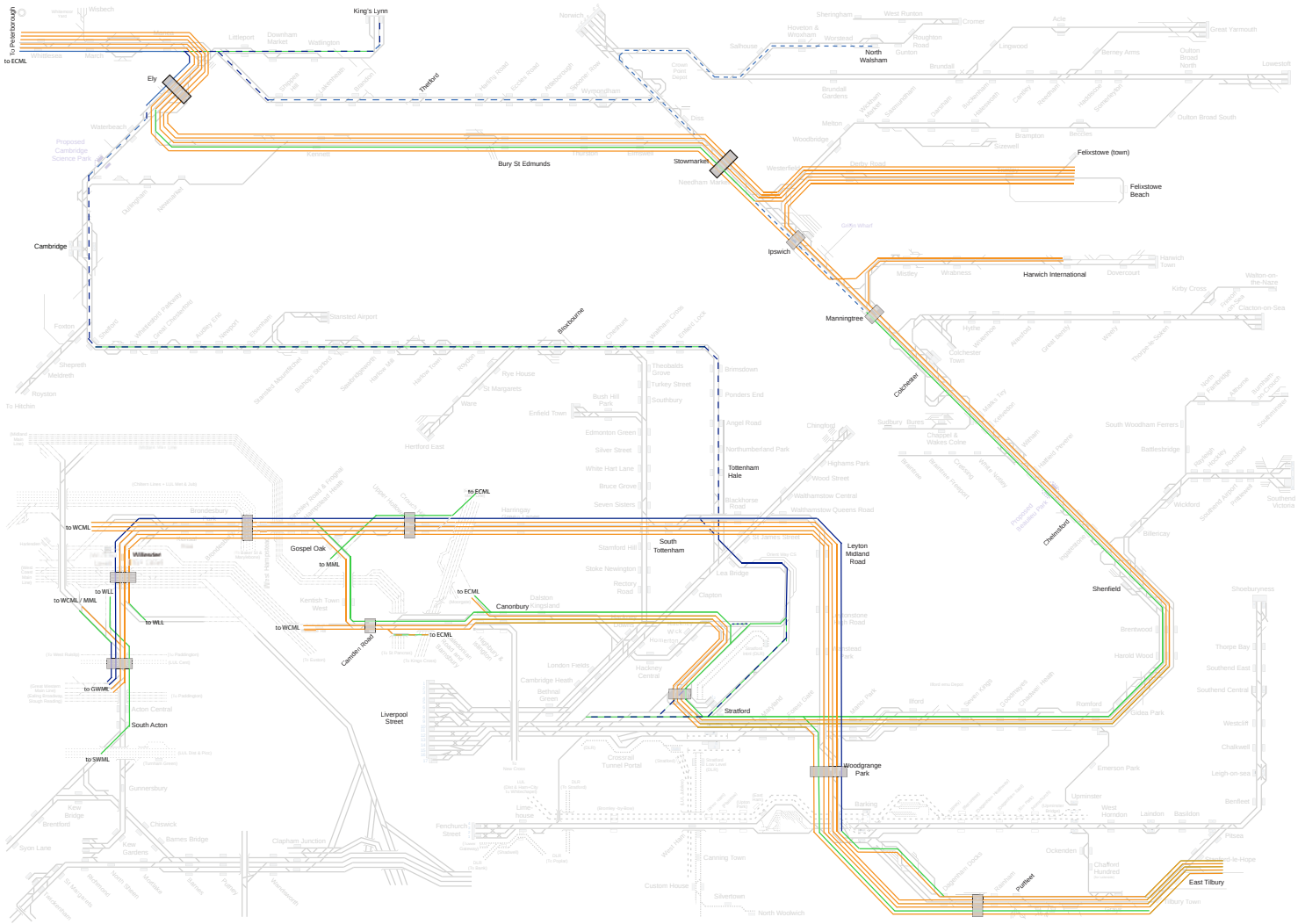
2 It should be noted that the Freight Market Study only mapped flows in the most loaded 'dominant' direction and that wagons returning in the opposite direction will equal those required in the dominant direction and therefore the number of paths required is the same.

Figure 3.2: 2043 Freight Path Requirements

- Paths taken from 2043 conditional outputs & stakeholder feedback
- Number of paths usually rounded up to nearest whole number
- Indicative linkages across sections shown, actual may vary (see key)
- Assume that hours of operation as required / as current (e.g.F2N cross-country paths operate all day, paths via Stratford do not operate in peaks)
- Less than hourly paths (typically with < 0.3 tph) indicated, proposal to test as sensitivies rather than base path
- Paths may appear inconsistent across sections due to rounding, 'worst case' in terms of number of paths shown.

Key:

- Hourly Class 4 Path
- Hourly Class 6 Path
- Hourly Path capable of running as Class 4 or 6
- Less than hourly (irregular) path
- Undefined connectivity (i.e. paths can join up across adjacent sections in different ways to give different journey opportunities)



Suburban connectivity to central London

3.4.14 The London and South East Market Study provides guidance on the conditional outputs related to the appropriate level of connectivity from suburban stations into central London.

3.4.15 For inner suburban stations to and from London, the Anglia Route Study should aim to provide three to four direct trains per hour on an even pattern and provide incremental journey time improvements.

3.4.16 London is a large city with many different clusters of employment accessed by an integrated public transport network that includes the London Underground and London buses. The Anglia Route Study should consider exploiting opportunities to connect to employment centres in London other than the natural terminus of the rail corridor. This could be achieved through connectivity into the tube network or through direct connectivity to other Central London locations.

Outer suburban and long distance connectivity to central London

3.4.17 For outer suburban and longer distance locations into London, the Anglia Route Study should aim to provide a total journey time (including waiting for a train and interchanging) of less than 100 minutes and as close to 40 minutes as possible.

Non-London connectivity within the route

3.4.18 The Anglia Route Study should exploit opportunities to improve connections between large non-London conurbations on the route that will not be improved as a result of improving direct connections to and from London.

Cross-boundary connectivity

3.4.19 The Market Studies recommend conditional outputs to improve connectivity between large towns and cities. The Cross-boundary work stream took these conditional outputs, and produced service planning assumptions for each Route Study to take as the services that will cross route study boundaries (see Chapter 4).

Airport connectivity

3.4.20 Good rail connectivity to airports is important in supporting economic growth, productivity and social mobility. It can play a key role in providing better access to markets, national and international destinations, business and leisure opportunities, and to jobs. New and improved rail services and their integration with other transport modes at major airports are key to providing more sustainable travel opportunities and improving overall connectivity, acting as a transport hub both for air passengers and for other rail users. Rail is a vital ingredient to improving the travel experience for air passengers and aviation employees, as well as in helping airports meet current and future travel demand.

3.4.21 Rail service provision should be able to meet growing demand for accessing the airports by rail. Fast, convenient and reliable rail access to central London is a priority for London's airports but direct access to non London core economic centres, both long-distance and within the London and South East, is increasingly important.

3.4.22 Airport passenger and employee travel demand is also quite different to commuting and leisure flows with peaks occurring at different periods of the day and night. Earlier morning and later evening rail services should therefore also be considered, subject to value for money and affordability. As with other services in this study, key metrics are capacity, frequency, journey time and ease of transfer.

3.4.23 The Airports Commission was set up in 2012 to take a fresh and independent look at the UK's future airport capacity needs and produced its interim report at the end of 2013. The Government will consider the Airports Commission's work following the publication of its Final Report in summer 2015. Should the Government decide to take forward any recommendations made by the Airports Commission then the Route Study will review the conditional outputs.

Suburban connectivity to non-London employment centres

3.4.24 The Regional Urban and London and South East Passenger Market Studies recommend aspirations for services around non-London employment centres. These need to be tailored depending on the demographics of the employment centre and the demographics of the population catchments of the stations served.

Access to higher education and social infrastructure

3.4.25 Access to further and higher education establishments and social infrastructure is an important use of rail services in addition to the commuting, business and leisure travel which are often a focus of attention when considering rail services. Many students now choose to study at local higher education establishments, and commute from home increasing the use of rail for this purpose. In the course of the Regional Urban Market Study, stakeholders had the opportunity to reflect the needs for this type of travel in the establishment of the connectivity conditional outputs.

Required connectivity and capacity for weekend and evening leisure travel

3.4.26 The connectivity and capacity conditional outputs listed in Section 3.3 relate principally to weekdays including providing sufficient capacity during the peaks. If sufficient rolling stock and infrastructure is available to provide a good peak weekday service then this will generally be enough to provide a good evening and weekend service. Another element of providing a good evening and weekend service is the planning of engineering work. Engineering possessions should be planned in such a way as to balance the desire to run good weekend and evening services with the efficient undertaking of necessary maintenance and renewal work.

Improved local access to the rail network to cater for demand

3.4.27 Improved access to the rail network includes the ability to interchange easily with other modes, in particular through good road access and car parking and good bus connections. This output also covers improved disabled access to the network, both to stations and trains. These issues are not specifically addressed through the route studies, but are better dealt with through the franchise specification and management.

Improving passenger satisfaction

3.4.28 Improved passenger satisfaction can only be delivered by successfully delivering all aspects of a good train service. Some of these outputs are already picked up though other conditional outputs including:

- improved connectivity (faster and more frequent trains)
- providing the required capacity to avoid crowding
- providing access to the network.

3.4.29 However, some aspects of a good train service are not picked up in the previous outputs. These include the reliability and punctuality of services, comfort, quality and cleanliness of rolling stock and the quality of the station environment. These outputs are principally a matter for franchise specification and management rather than for the Long Term Planning Process.

3.4.30 The following sections are an interpretation of the conditional outputs for each of the sub-routes within Anglia and how these conditional outputs have been converted into a service specification to test infrastructure and develop choices for funders.

3.4.31 The conditional outputs are also categorised into CP6 priorities and those for the longer term (2043). This prioritisation includes those conditional outputs that deliver the required capacity to the end of CP6 and conditional outputs that funders have an interest in delivering in CP6.

3.5 Interpretation of conditional outputs for the Great Eastern route

3.5.1 Crossrail will significantly improve the frequency and capacity of suburban routes into London and is expected to deliver sufficient capacity to meet demand for the end of CP6. There is expected to be a small capacity gap of around 2,000 passengers by the end of the 30 year planning period.

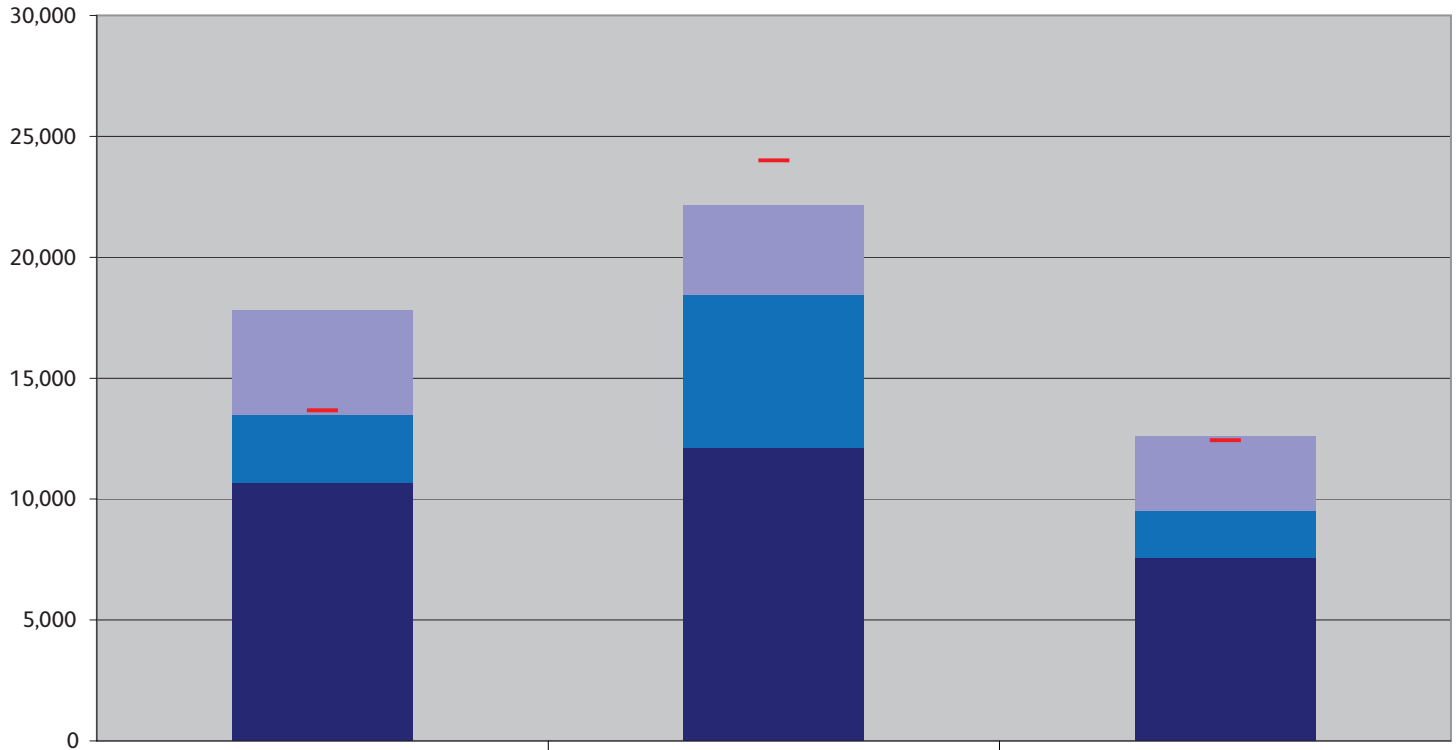
3.5.2 The Anglia Route Study should look at options to improve the frequency and journey times from Southend and Norwich to London to the equivalent of three or four trains per hour at 80mph and exploit any extra services to improve journey times/frequencies from Ipswich, Colchester and Chelmsford to London. Southend is served by two routes into Liverpool Street and also into Fenchurch Street. Both routes provide a frequent service but stop at relatively large suburban areas en-route.

3.5.3 Assuming a crowding standard of 0.45 passengers per square metre and that an average load factor to total capacity of 85 percent will result in a reasonable level of crowding over all peak hour services, then there will be a need to provide further capacity for approximately 2,200 passengers by 2023 and an additional 5,100 by 2043 in the peak hour on the Norwich and semi fast services via Chelmsford.

3.5.4 In CP5, two extra 12-car services are expected to run on the Wickford route in the peak hour into Liverpool Street, this will meet the required capacity by 2023 and reduce the 2043 gap to 2,400 passengers.

3.5.5 Figure 3.3 shows the current demand, demand in 2023 and 2043, current capacity and the capacity gap to 2023 and 2043.

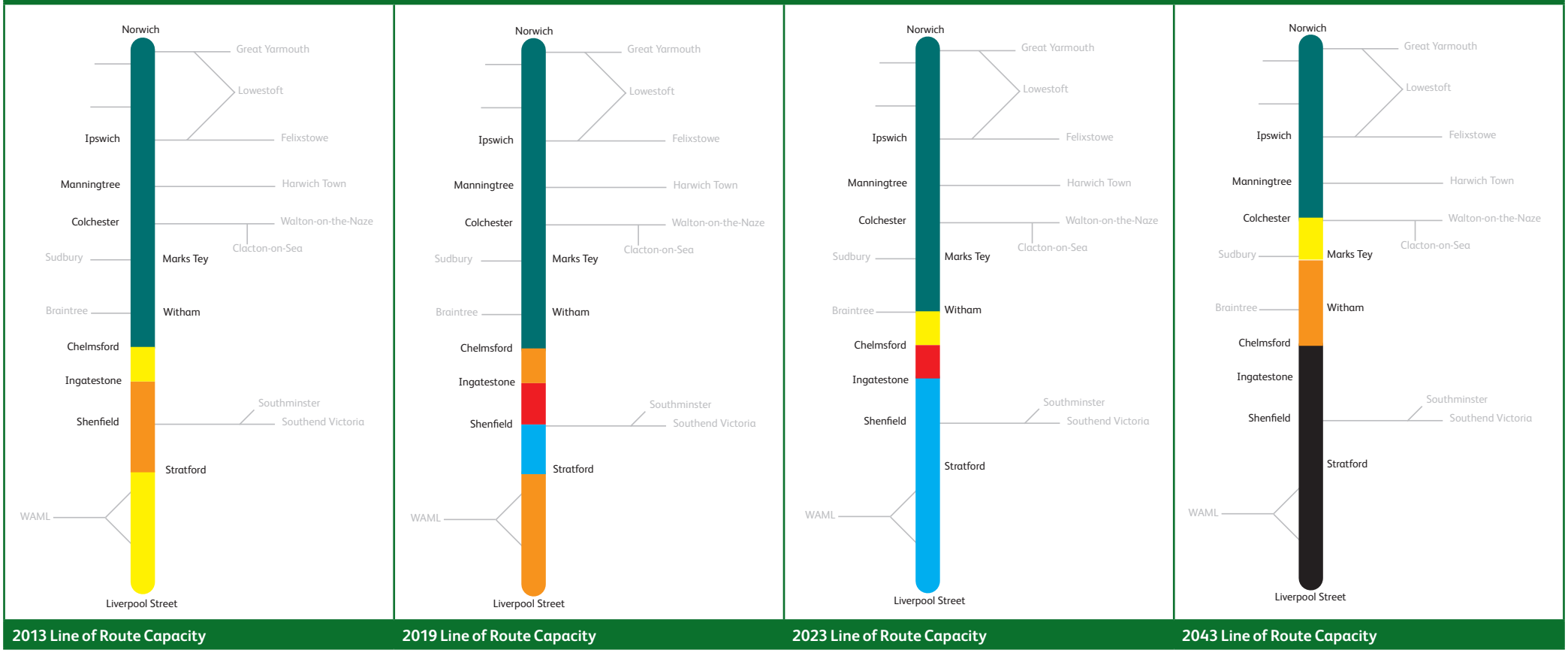
Figure 3.3: Current demand, demand in 2023 and 2043, current capacity and the capacity gap to 2023 and 2043 on the GEML



	GE Norwich	GE Suburban	GE via Wickford
2043 - Peak Arrivals	17,826	22,163	12,580
2023 - Peak Arrivals	13,446	18,409	9,489
2013 - Peak Arrivals	10,669	12,111	7,529
Total Capacity - end CP5	13,664	24,000	12,428
2023 Capacity Gap	2,175	0	0
2043 Capacity Gap	7,328	2,074	2,372

3.5.6 The following graph shows the build up of demand over and above the current capacity for all services on the route to London Liverpool Street via Chelmsford between 8 and 9 am. It shows that passengers on these services will be travelling in crowded conditions for a long time. Without intervention, services will be over seated capacity and between 40 per cent and 100 per cent of standing capacity taken up for well over 20 minutes. Services that start from Norwich, Stowmarket, Witham and Chelmsford tend to have the highest load factors and demand is at or exceeds seated capacity now.

Figure 3.4: Average load factor of all services on the main line between Norwich and London Liverpool Street via Chelmsford in 2013, 2019, 2023 and 2043



3.5.7 Norwich is a large employment centre with a suburban rail network offering low frequency service and slow journey times. The route study should look at opportunities to improve the frequency and journey times on the following corridors:

- the Sheringham and Cromer route to Norwich provides access to employment for a commuting market into Norwich and also serves a leisure market to Sheringham and Cromer. Currently, one train per hour serves stations on the route to and from Norwich.
- the Great Yarmouth and Lowestoft route to Norwich also provides access to employment for a commuting market into Norwich and a leisure market to seaside resorts. Approximately, one train per hour serves stations from Lowestoft to Norwich and one train per hour serves stations from Great Yarmouth to Norwich. Berney Arms station is served by two trains per day.

3.5.8 The Norwich to Cambridge market is served by one train per hour and there are opportunities to improve connections to Stansted Airport, Ely and destinations over route boundaries.

3.5.9 Witham, Marks Tey, Colchester, Manningtree and Ipswich are interchange points that could be used to improve connectivity to branch lines on the route. The Anglia Route Study should look at opportunities to improve services on the following branch lines:

- Braintree to Witham is currently served by 1 train per hour to London Liverpool Street
- Sudbury to Marks Tey is served by one train per hour on the branch line with no onward direct connections
- Clacton-on-Sea to Colchester is served by a frequent service to London in the peak, and one train per hour to London in the off peak
- Harwich Town to Manningtree is served by one train per hour on the branch line with peak services through to London.

3.5.10 The Cross-boundary work stream has provided assumptions on the service specification from the Anglia route to the East Midlands, West Midlands, Yorkshire and the Humber, the North West and Scotland (see Chapter 4).

3.5.11 Freight traffic on the Great Eastern Main Line and on the Felixstowe to Peterborough route is expected to grow as a result of growth in intermodal traffic from Felixstowe.

3.5.12 The conditional outputs for the GEML are summarised in the tables below. They are used in Chapters 5 and 6 to describe the outputs that different options deliver. They are coded according the route in question (GE – Great Eastern) and numbered to help with referencing throughout the document.

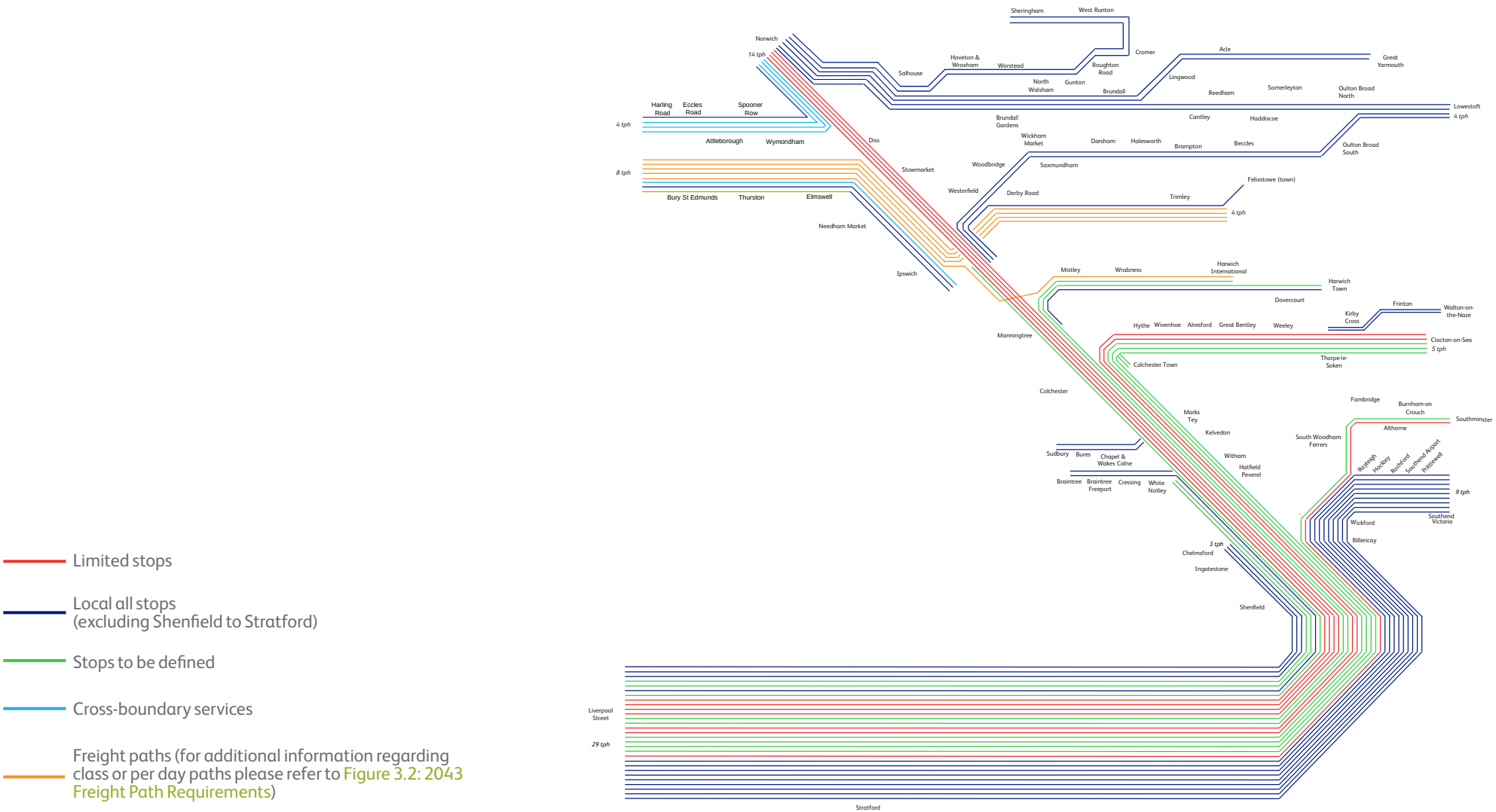
Table 3.2: 2023 Conditional Outputs for the GEML

CP6 Conditional Outputs	Description
GECO1	To provide sufficient capacity for passengers travelling into central London during peak hours, taking into account anticipated growth over the period to 2023 - Great Eastern Main Line services
GECO2	To provide sufficient capacity for cross-boundary and Cambridge passengers travelling to Norwich via Ely, taking into account anticipated growth to the end of Control Period 6 (2024) Cross-boundary services
GECO3	To produce journey time improvements on the route from Norwich to London - Great Eastern Main Line

Table 3.3: 2043 Conditional Outputs for the GEML	
2043 Conditional Outputs	**Description**
GECO4	To provide sufficient capacity for passengers travelling into central London during peak hours, taking into account anticipated growth over the period to 2043 - Great Eastern Main Line services
GECO5	To provide sufficient capacity for cross-boundary and Cambridge passengers travelling to Norwich via Ely, taking into account anticipated growth over the period to 2043 - Cross boundary services
GECO6	Increase in passenger service frequency between Norwich and Sheringham to 2 tph
GECO7	Increase in passenger service frequency between Great Yarmouth and Norwich (via Acle) to 2 tph
GECO8	Increase in passenger service frequency between Lowestoft and Norwich to 2 tph
GECO9	Increase in passenger service frequency between Lowestoft and Ipswich to 2 tph
GECO10	Increase in passenger service frequency between Felixstowe and Ipswich to 2 tph
GECO11	Increase in passenger service frequency between Harwich Town and Manningtree to 2 tph
GECO12	Increase in passenger service frequency between Walton-on-the -Naze and Colchester to 2 tph
GECO13	Increase in passenger service frequency between Clacton-on-Sea and Colchester to 2 tph
GECO14	Increase in passenger service frequency between Sudbury and Marks Tey to 2 tph
GECO15	Increase in passenger service frequency between Braintree and Witham to 2 tph
GECO16	Increase in passenger service frequency between Southminster and Wickford to 2 tph

3.5.13 The following diagrams interpret the conditional outputs into an assumed service specification for 2043 in the peak hours. The diagrams exclude Crossrail services. The diagrams do not show which trains stop where but do suggest which trains are expected to bypass stations and provide a fast service for passengers from large stations (limited stop) and those trains that are expected to stop at all stations. The diagram also includes passenger services that cross a route boundary. For more information on the cross-boundary services and how they feed into the route study please see Chapter 4.

Figure 3.5: 2043 assumed service specification for GE main lines, AM Peak Hours (0700-0959)



3.6 Interpretation of conditional outputs for the West Anglia route

3.6.1 On suburban routes into London, the West Anglia route should aim to provide:

- three to four trains per hour from all suburban stations to London
- sufficient capacity to cater for demand
- incremental journey time improvements.

3.6.2 Most stations have three to four trains per hour into London now.

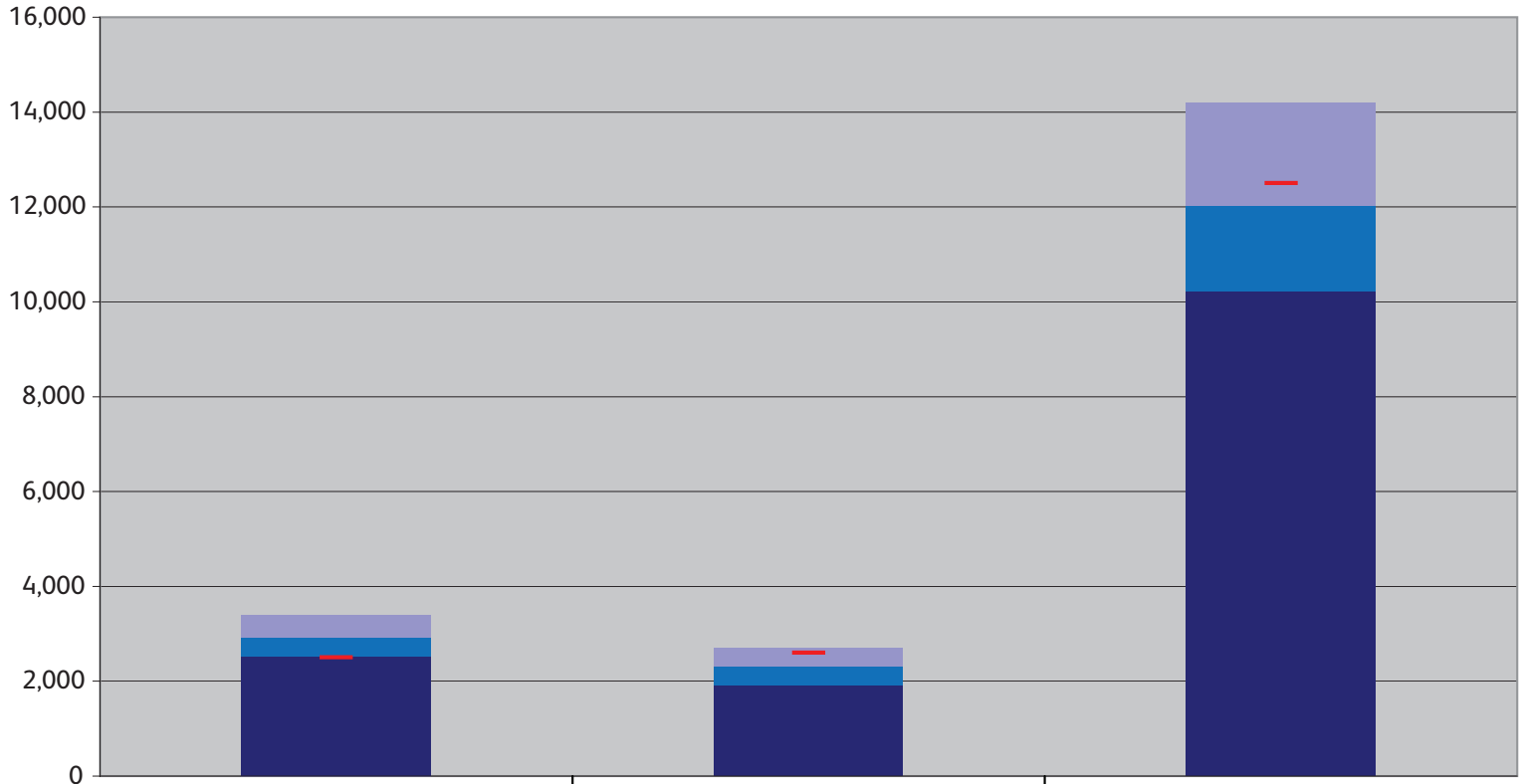
3.6.3 Stations on the Hertford East line currently have less than four trains per hour to Liverpool Street, Hertford is also served by the London North Eastern route into Kings Cross. Southbury, Turkey Street and Theobalds Grove currently have two trains per hour to Liverpool Street. Enfield Lock, Brimsdown, Ponders End, Angel Road and Northumberland Park currently have less than four trains per hour to Liverpool Street. Services from Angel Road to Stratford will be introduced in Control Period 5 (CP5).

3.6.4 Rolling stock capability tends to be a limiting factor to journey time improvements on suburban routes. Older suburban stock accelerates slowly and is less able to reach the maximum line speed before the next station. Rolling stock that accelerates faster can save time on departure from every station and can exploit improvements in line speed.

3.6.5 Assuming a crowding standard of 0.45 passengers per square metre and that an average load factor to total capacity of 85 per cent will result in a reasonable level of crowding over all peak hour services, then there will be a need to provide further capacity for approximately 1,000 passengers by 2023 and 2,100 by 2043 in the peak hour on the Cambridge and Stansted Airport services into Liverpool Street. On suburban services further capacity for 1,700 passengers by 2023 and 4,200 by 2043 will be required.

3.6.6 The following table shows the current demand, demand in 2023 and 2043, current capacity and the capacity gap to 2023 and 2043 on the West Anglia Main line into London Liverpool Street. Growth in peak passenger numbers on the West Anglia Main Line is expected to be largely driven by the expected increase in central London employment. Improvements in capacity, quality of rolling stock, population, and the impact of demand at Stansted Airport are among many factors that could influence these forecasts. Regular monitoring and updating these forecasts to take account of known changes in supply and demand should be undertaken.

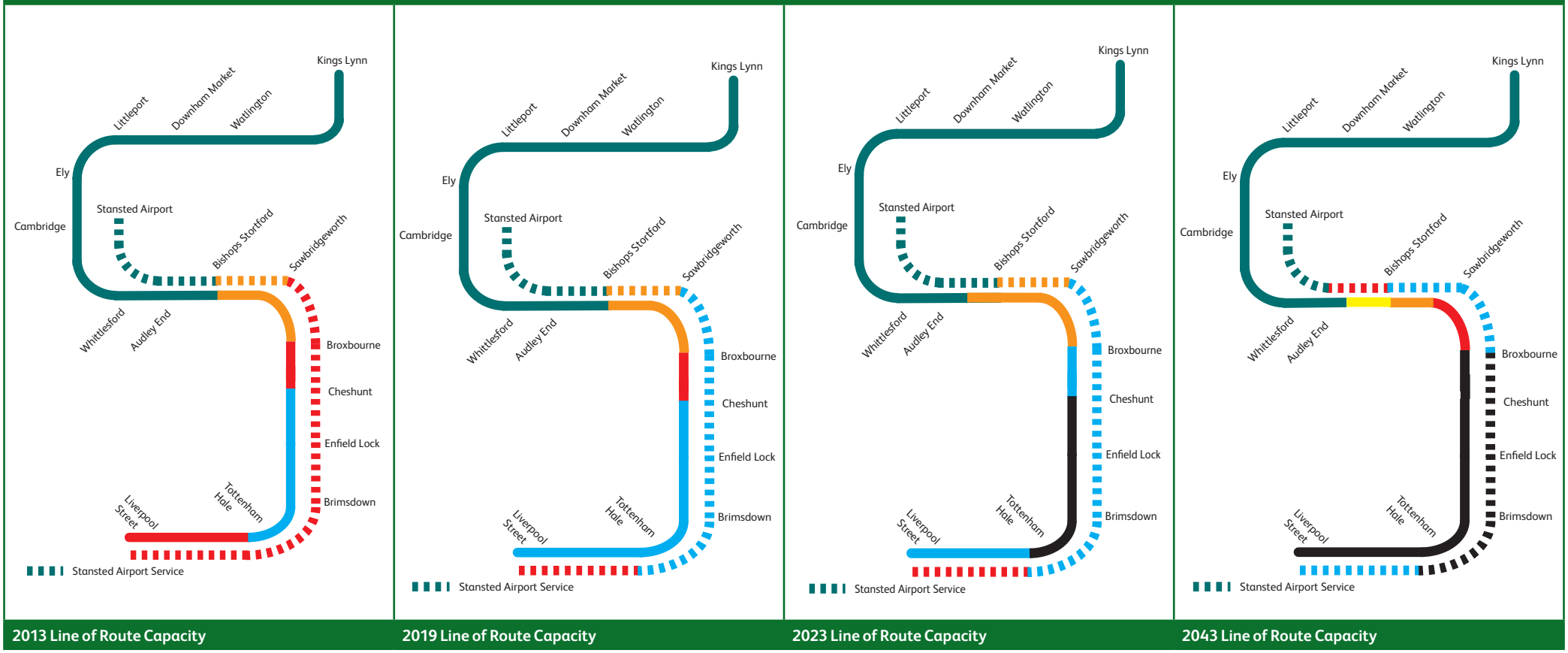
Figure 3.6: Current demand, demand in 2023 and 2043, current capacity and the capacity gap to 2023 and 2043 on the West Anglia Main Line



	WA Cambridge	WA Stansted Airport	WA Suburban
2043 - Peak Arrivals	3,400	2,700	14,200
2023 - Peak Arrivals	2,900	2,300	12,000
2013 - Peak Arrivals	2,500	1,900	10,200
Total Capacity - end CP5	2,500	2,600	12,500
2023 Capacity Gap	900	100	1,700
2043 Capacity Gap	1,500	600	4,200

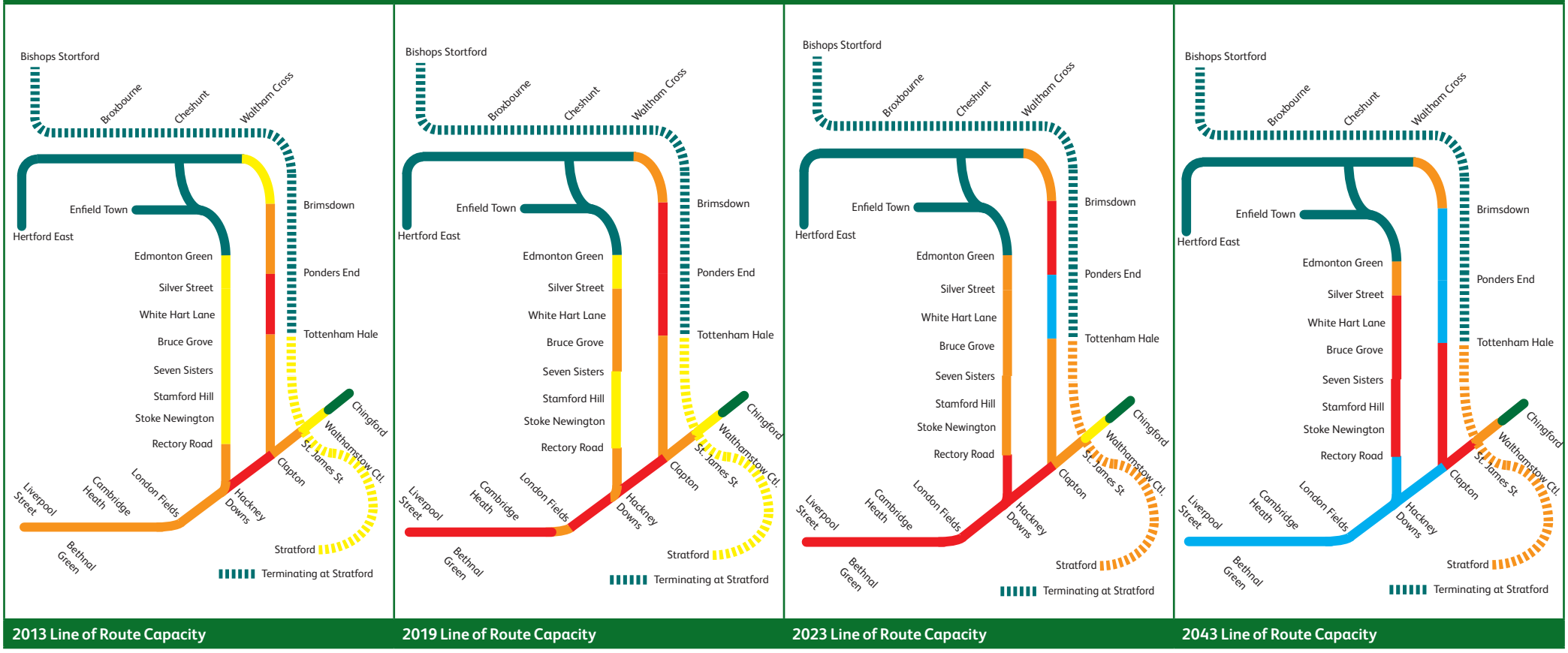
3.6.7 The following graph shows the build up of demand on the route. It shows that passengers will be travelling in crowded conditions for a long period of time on the Cambridge and Stansted Airport services.

Figure 3.7: Average load factor of the Cambridge and Stansted Airport services to Liverpool Street between 8 and 9 am in 2013, 2019, 2023 and 2043



3.6.8 The following graph shows crowding on the services from Hertford, Broxbourne, Cheshunt and Enfield into Liverpool Street and Stratford. It demonstrates that even to 2043, on average services will not be over standing capacity. However, of the suburban trains, the Hertford East services are the most overcrowded and passengers are in crowded conditions for a long period of time. Other services on the inner suburban routes tend to be crowded for shorter periods of time.

Figure 3.8: Average load factor of the West Anglia Suburban services to Liverpool Street and Strtaford between 8 and 9 am



3.6.9 The Route Study should assess opportunities to connect with employment centres in London other than the main terminus of the rail corridor. There are some opportunities to achieve this:

- connections to the London Underground network at Seven Sisters and Tottenham Hale
- connections to Stratford as a growing employment and commerce centre
- direct connections to central London employment centres via a new railway.

3.6.10 All of these would, to varying degrees, provide better access to employment for deprived communities in the Lea Valley and could have a significant impact on peak capacity and suburban frequency requirements on the line.

3.6.11 Stansted Airport is a key destination on the West Anglia route. Connections from the south are adequate, but there are opportunities to improve journey times to London and to provide improved connections from the north from Cambridge, Norwich, Peterborough and beyond.

3.6.12 The Anglia Route Study should seek to improve outer suburban and longer distance connections from Cambridge, and from stations between Stansted Airport and Cambridge to London, by improving the pattern of services, frequency and journey times. Trains to King's Cross also serve the Cambridge to London market with a fast and frequent service.

3.6.13 Cambridge is a large employment centre with constrained road infrastructure. The Route Study should look at opportunities to improve the frequency and journey time of services to Cambridge from the Peterborough, Norwich, Kings Lynn and Newmarket lines and to provide a reasonable suburban frequency from stations between Cambridge and Stansted Airport.

3.6.14 There is expected to be a shortfall in capacity on the route from Kings Lynn to Cambridge via Ely that will not be met by the provision of capacity on other routes. Services are crowded from Ely to Cambridge now. Between 07:00 and 08:00, some services are overcrowded, but this can be mitigated through additional Birmingham New Street to Stansted Airport services and changes to the timetable structure. Despite the provision of additional Birmingham New Street to Cambridge services from the Peterborough to Cambridge route, services in the peak hour are likely to be overcrowded. There is expected to be a shortfall of seated and standing capacity on the Kings Lynn to Cambridge services in the peak hour of 400 passengers by 2023 and 600 by 2043.

3.6.15 The Cross-boundary work stream has provided assumptions on the service specification from the Anglia Route to the East Midlands, West Midlands, Yorkshire and the Humber, the North West and Scotland (see Chapter 4).

3.6.16 The conditional outputs for the WAML are summarised in the tables below. They are used in Chapters 5 and 6 to describe the outputs that different options deliver. They are coded according the route in question (WA – West Anglia) and numbered to help with referencing throughout the document.

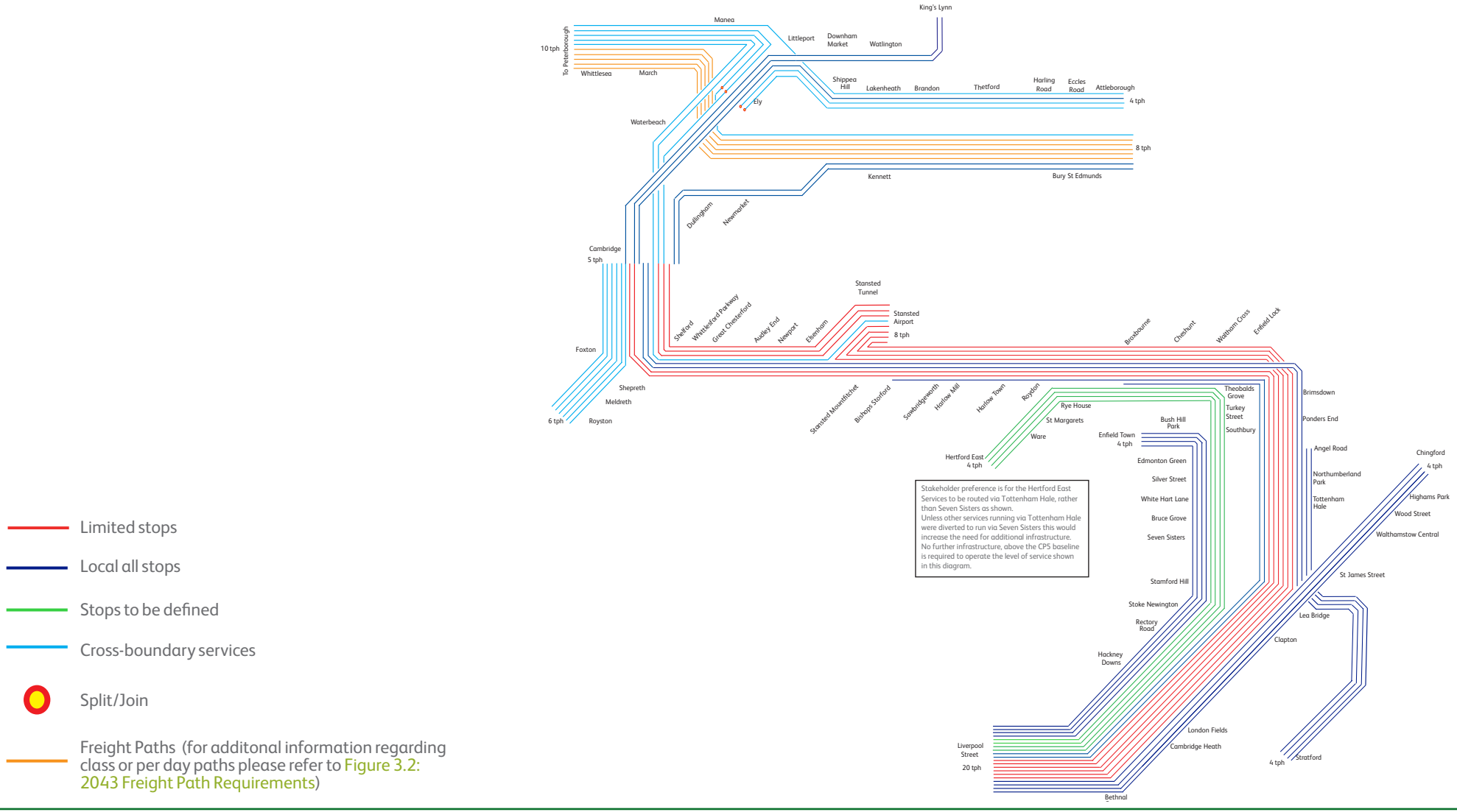
Table 3.4: 2023 Conditional Outputs for the West Anglia Main Line

CP6 Conditional Outputs	Description
WACO1	To provide sufficient capacity for passengers travelling into central London during peak hours, taking into account anticipated growth to the end of Control Period 6 (2024) - West Anglia Main Line services via the Southbury Loop, Lea Valley & Chingford Branch
WACO3	To improve journey times from Cambridge and Stansted Airport to London on the WAML route

Table 3.5: 2043 Conditional Outputs for the West Anglia Main Line	
2043 Conditional Outputs	**Description**
WACO2	To provide sufficient capacity for passengers travelling into central London during peak hours, taking into account anticipated growth over the period to 2043 - West Anglia Main Line services via the Southbury Loop, Lea Valley & Chingford Branch.
WACO4	Improve cross London connectivity, connecting South West and North East London
WACO5	To provide sufficient capacity for passengers travelling to Stansted Airport all day, taking into account anticipated growth over the period to 2043
WACO6	To provide sufficient capacity for cross-boundary and Cambridge passengers travelling to Ipswich/Norwich, taking into account anticipated growth over the period to 2043 – Cross-boundary services
WACO7	Increase in passenger service frequency between Kings Lynn and Cambridge to 2 tph
WACO8	Increase in passenger service frequency between Ipswich and Cambridge to 2 tph

3.6.17 The following diagram interprets the conditional outputs into an assumed service specification for 2043. The diagrams do not show which trains stop where but do suggest which trains are expected to bypass stations and provide a fast service for passengers from large stations (limited stop) and those trains that are expected to stop at all stations. The diagram also includes passenger services that cross a route boundary. For more information on the cross-boundary services and how they feed into the route study please see Chapter 4.

Figure 3.9: 2043 assumed service specification for West Anglia main lines Peak hours (0700-0959)



Limited stops

Local all stops

Stops to be defined

Cross-boundary services

Split/Join

Freight Paths (for additonal information regarding class or per day paths please refer to Figure 3.2: 2043 Freight Path Requirements)

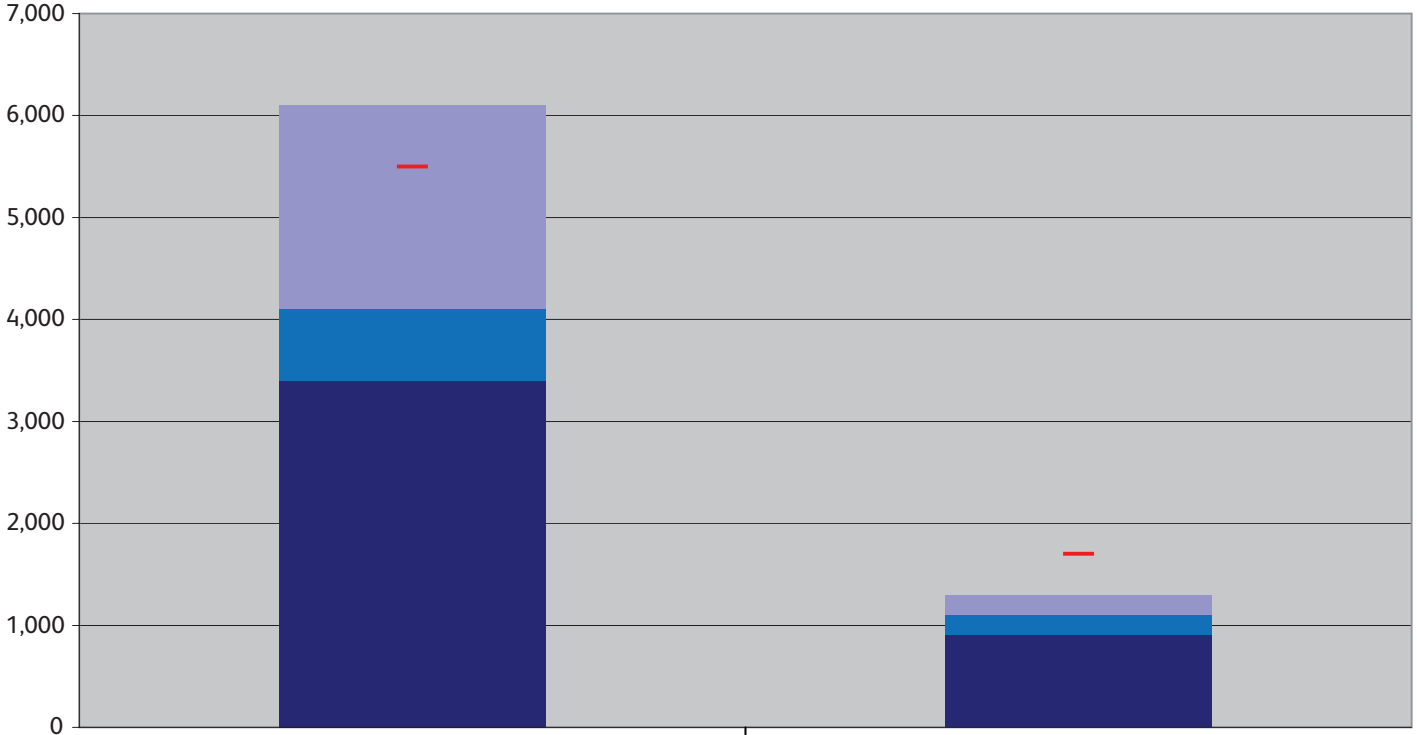
3.7 Interpretation of conditional outputs for the North London lines

3.7.1 The North London Line (NLL) and Gospel Oak to Barking (GOB) line provide frequent suburban services on the London Overground network with high-accelerating, high-capacity rolling stock.

3.7.2 The peak loading is in the westbound direction into Highbury and Islington in the morning peak on the NLL. Transport for London plan on providing additional capacity in CP5 and CP6 through the London Overground Capacity Improvement Programme (LOCIP) that will increase the length of services from four-car to five-car on the North London Line; and through running an additional two trains per hour in the peak. By the end of CP6, this will provide sufficient capacity to cater for demand. Assuming a crowding standard of 0.35 m^2 per passenger, and an average load factor over the peak hour of 85 per cent. There is expected to be a gap in capacity on the North London line to 2043 of around 1,500-2,000 passengers. On the Gospel Oak to Barking route, electrification and the introduction of 4-car EMUs on the route is expected to provide sufficient capacity over the planning period to 2043.

3.7.3 The following graph shows the current demand, demand in 2023 and 2043, current capacity and the capacity gap to 2023 and 2043.

Figure 3.10: Current demand, demand in 2023 and 2043, current capacity and the capacity gap to 2023 and 2043 on the North London Line & Gospel Oak to Barking Line



	NLL	GOB
2043 - Peak Arrivals	6,100	1,300
2023 - Peak Arrivals	4,100	1,100
2013 - Peak Arrivals	3,400	900
Total Capacity - end CP5	5,500	1,700
2023 Capacity Gap	0	0
2043 Capacity Gap	1,700	0

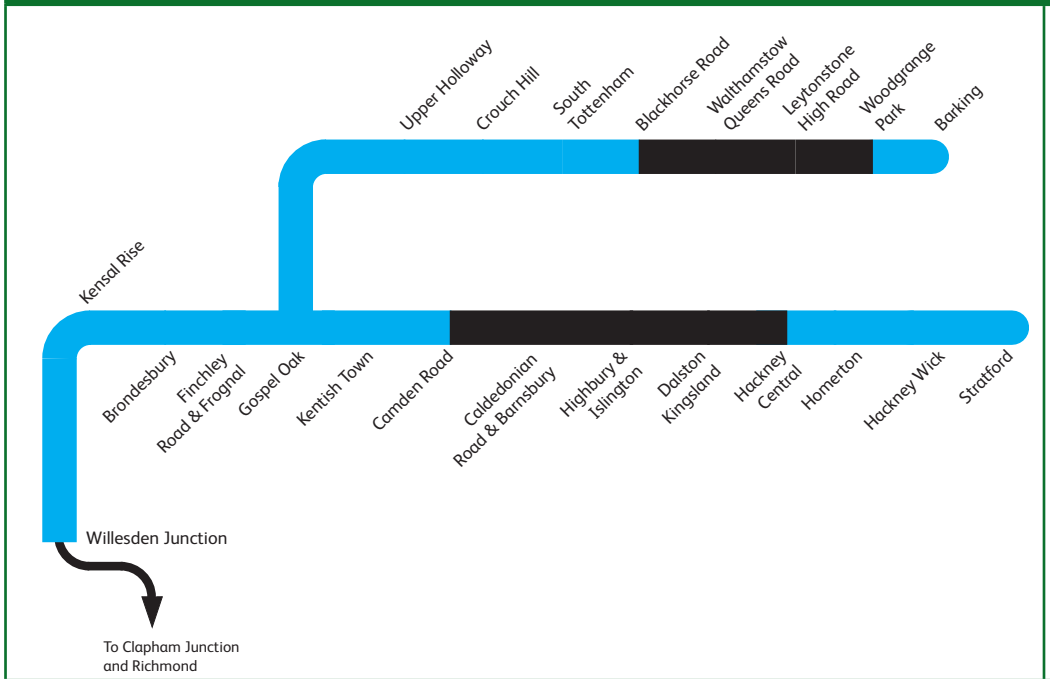
3.7.4 Analysis has focussed on the direction and time of the highest demand and it should be noted that there are also secondary locations where demand is also very high. Any solution to capacity issues should manage demand on the entire route.

3.7.5 Freight traffic on the route is expected to increase as a result of increased intermodal traffic, especially from London Gateway.

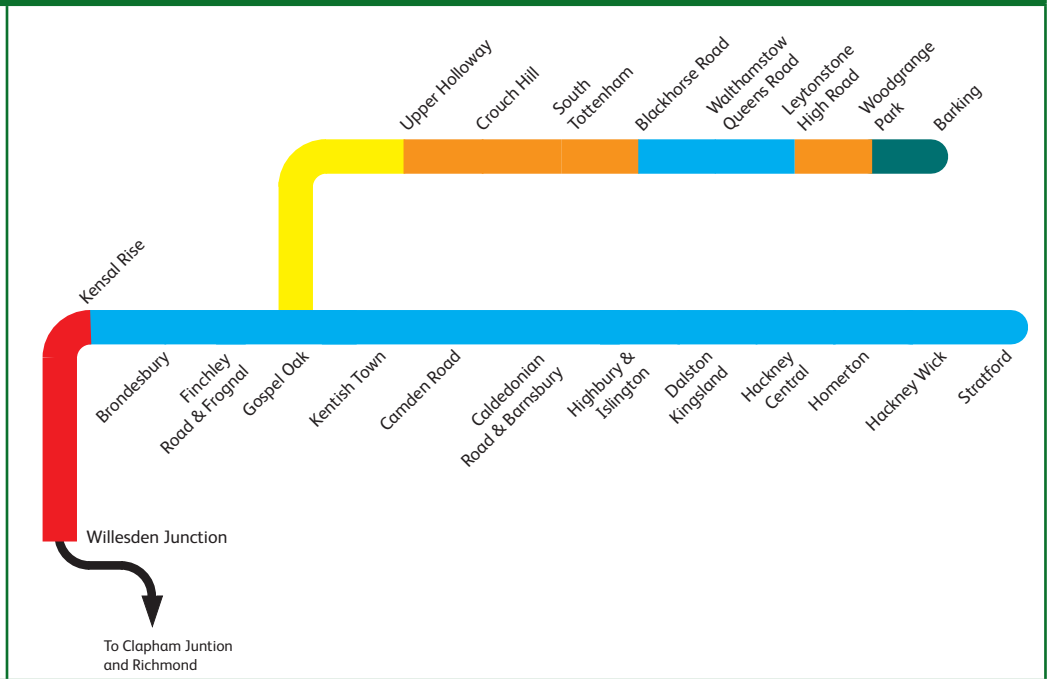
3.7.6 The conditional outputs for the North London lines are summarised in the Table 3.6 below. They are used in Chapters 5 and 6 to describe the outputs that different options deliver. They are coded according the route in question (CL – Cross London – North London Line and Gospel Oak to Barking) and numbered to help with referencing throughout the document.

3.7.7 Figures 3.11 and 3.12 show demand and crowding on the route. It shows that both routes are considerably busy now, and the introduction of additional capacity in CP5 will provide significant crowding relief, in the form longer and trains on the North London Line and on the Gospel Oak to Barking route. Unlike most suburban commuting lines that tend to pick up passengers on route to a termini for commuting, these routes tend to have many passengers boarding and alighting along the entire route, providing access to many employment centres in North London, and onward connections to the tube and bus network and passengers tend to travel on the route for short periods of time.

Figure 3.11: Average load factor on services in the Westbound direction (busiest) in the Am high peak hour on the North London line and in the Eastbound direction on the Gospel Oak to Barking route in 2013 and 2019



2013 Line of Route Capacity



2019 Line of Route Capacity

Figure 3.12: Average load factor on services in the Westbound direction (busiest) in the Am high peak hour on the North London line and in the Eastbound direction on the Gospel Oak to Barking route in 2023 and 2043

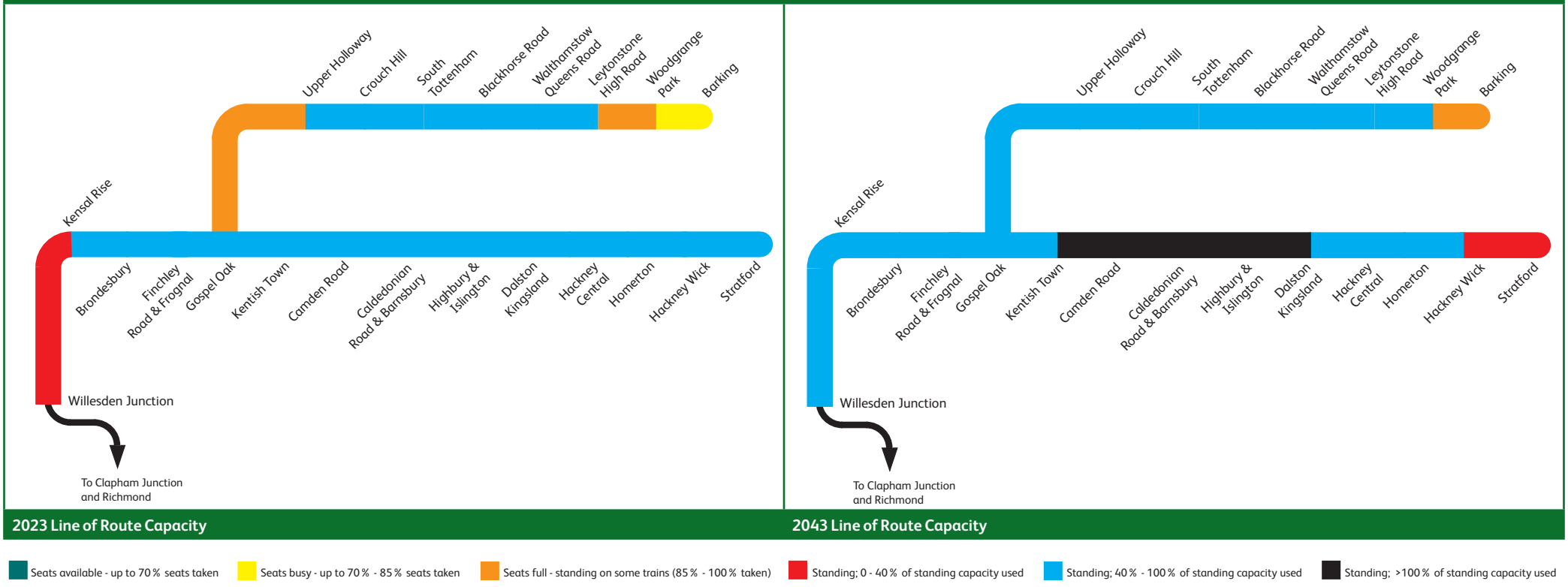


Table 3.6: 2043 Conditional Outputs for the North London lines	
2043 Conditional Outputs	**Description**
CLCO1	To provide sufficient capacity for passengers travelling across London during peak hours, taking into account anticipated growth over the period to 2043 - North London Line and Gospel Oak to Barking
CLFCO2	As identified to meet CLCO1, to provide sufficient capacity freight paths across London - Cross-boundary

3.7.8 An interpretation of the conditional outputs into an assumed service specification for 2043 is shown at the end of Section 3.8

3.8 Interpretation of conditional outputs for Essex Thameside route

3.8.1 The Essex Thameside route provides a high frequency service into London Fenchurch Street serving a suburban market from Southend, Basildon and other centres on the north of the Thames Estuary.

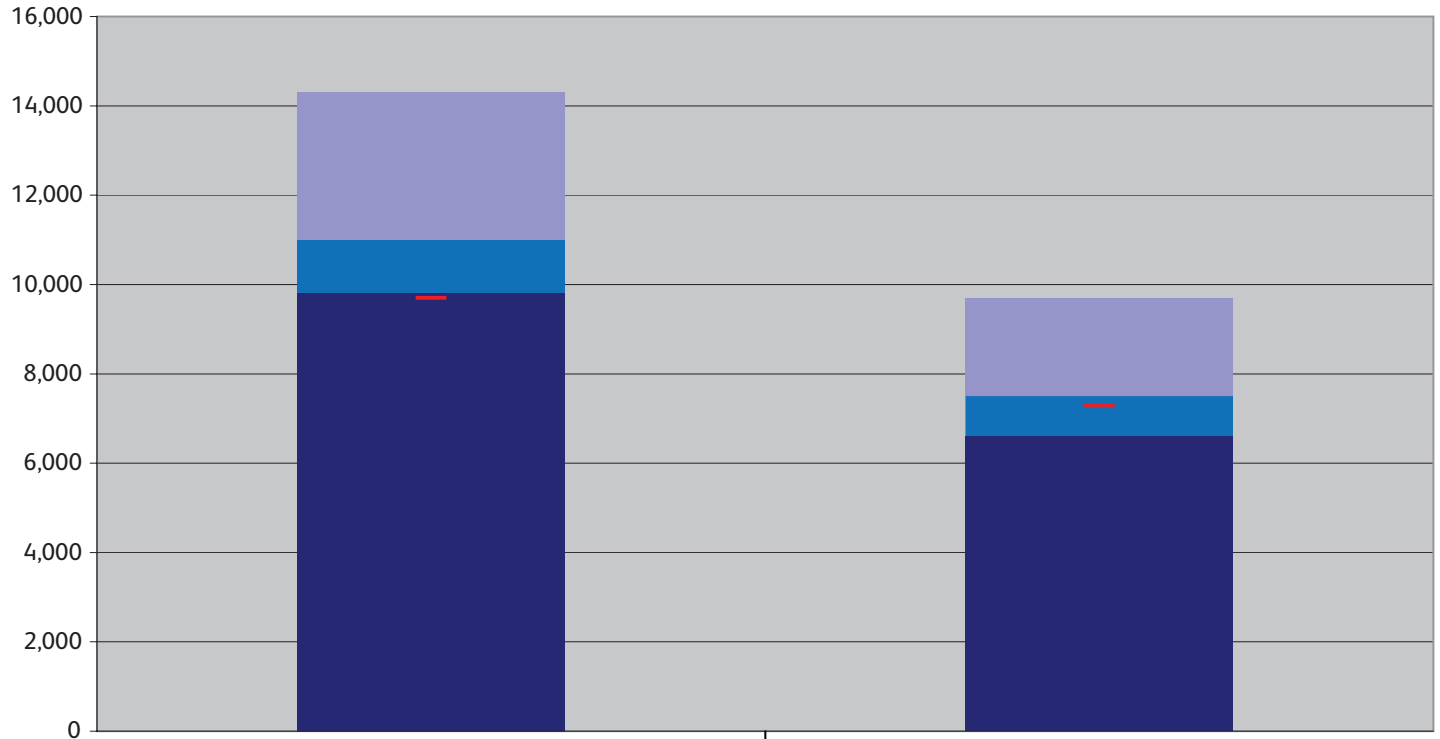
3.8.2 The Anglia Route Study should look at options to improve journey times from Southend to London and to exploit opportunities from running more trains in order to improve the frequency of services from intermediate stations into London. Commuting into Southend is well served as a result of providing for the London commuting market.

3.8.3 Freight traffic from London Gateway is expected to increase, therefore the Anglia Route Study should seek to provide sufficient capacity to accommodate this extra traffic.

3.8.4 Assuming a crowding standard of 0.45 passengers per square metre and that an average load factor to total capacity of 85 per cent will result in a reasonable level of crowding over all peak hour services, then there will be a need to provide further capacity for approximately 4,700 passengers by 2023 and 11,000 by 2043 in the peak hour into Fenchurch Street. There will also be a capacity gap in the first shoulder-peak hour.

3.8.5 Figure 3.13 shows the current demand, demand in 2023 and 2043, current capacity and the capacity gap to 2023 and 2043.

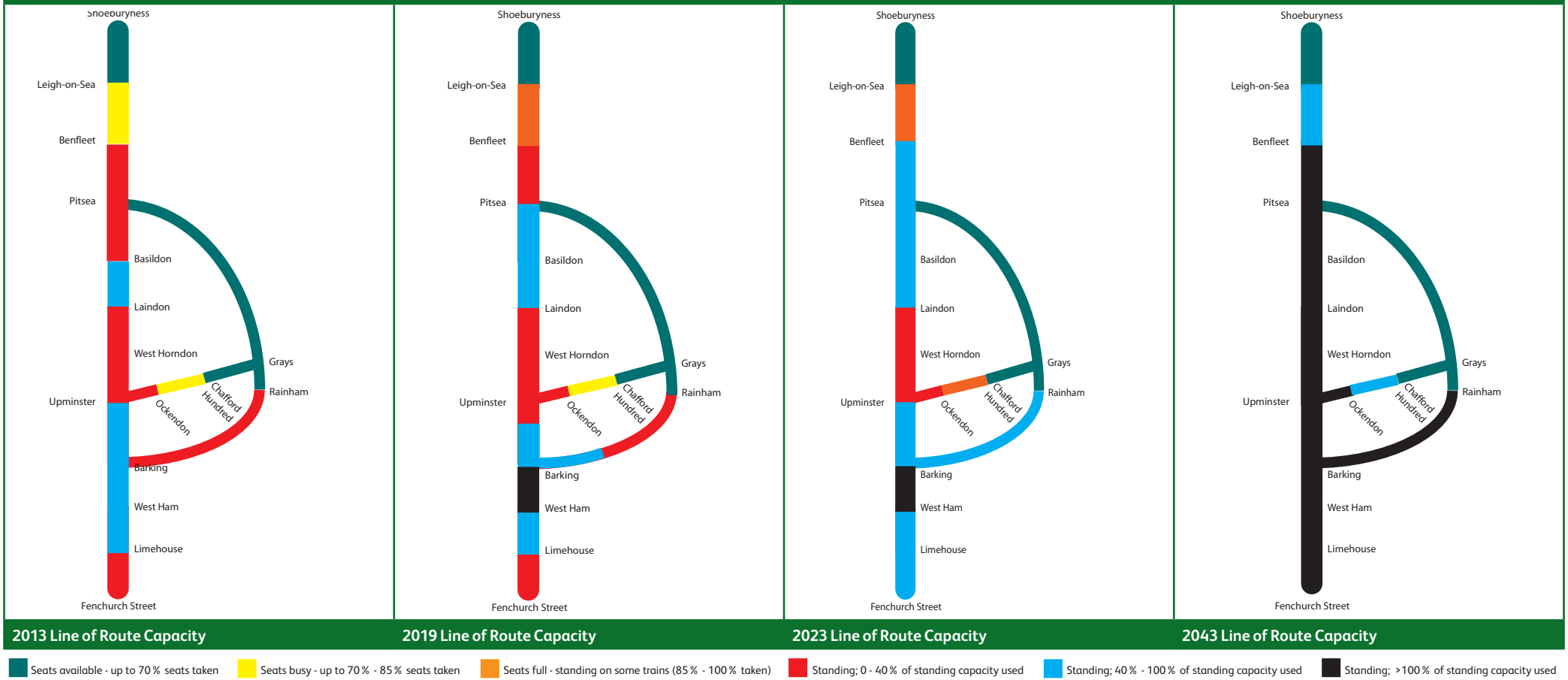
Figure 3.13: Current demand, demand in 2023 and 2043, current capacity and the capacity gap to 2023 and 2043 on the Essex Thameside route



	Inners	Outers
2043 - Peak Arrivals	14,300	9,700
2023 - Peak Arrivals	11,000	7,500
2013 - Peak Arrivals	9,800	6,600
Total Capacity - end CP5	9,700	7,300
2023 Capacity Gap	3,200	1,500
2043 Capacity Gap	7,000	4,100

3.8.6 The following graph, Figure 3.14 shows the build up of demand on the route. It shows that some trains are crowded for a long period of time. Passengers on services from Shoeburyness to Fenchurch Street are expected to travel in crowded conditions for the longest. Whilst crowding on inner/suburban services are high but for much shorter periods of time. There may be an argument for using a lower crowding standard on inner services to reflect on the short amount of time that passengers are travelling in crowded conditions.

Figure 3.14: Average load factor of Essex Thameside services to Fenchurch Street between 8 and 9 am in 2013, 2019, 2023 and 2043



3.8.7 The conditional outputs for Essex Thameside are summarised in the tables below. They are used in Chapters 5 and 6 to describe the outputs that different options deliver. They are coded according the route in question (ET – Essex Thameside) and numbered to help with referencing throughout the document.

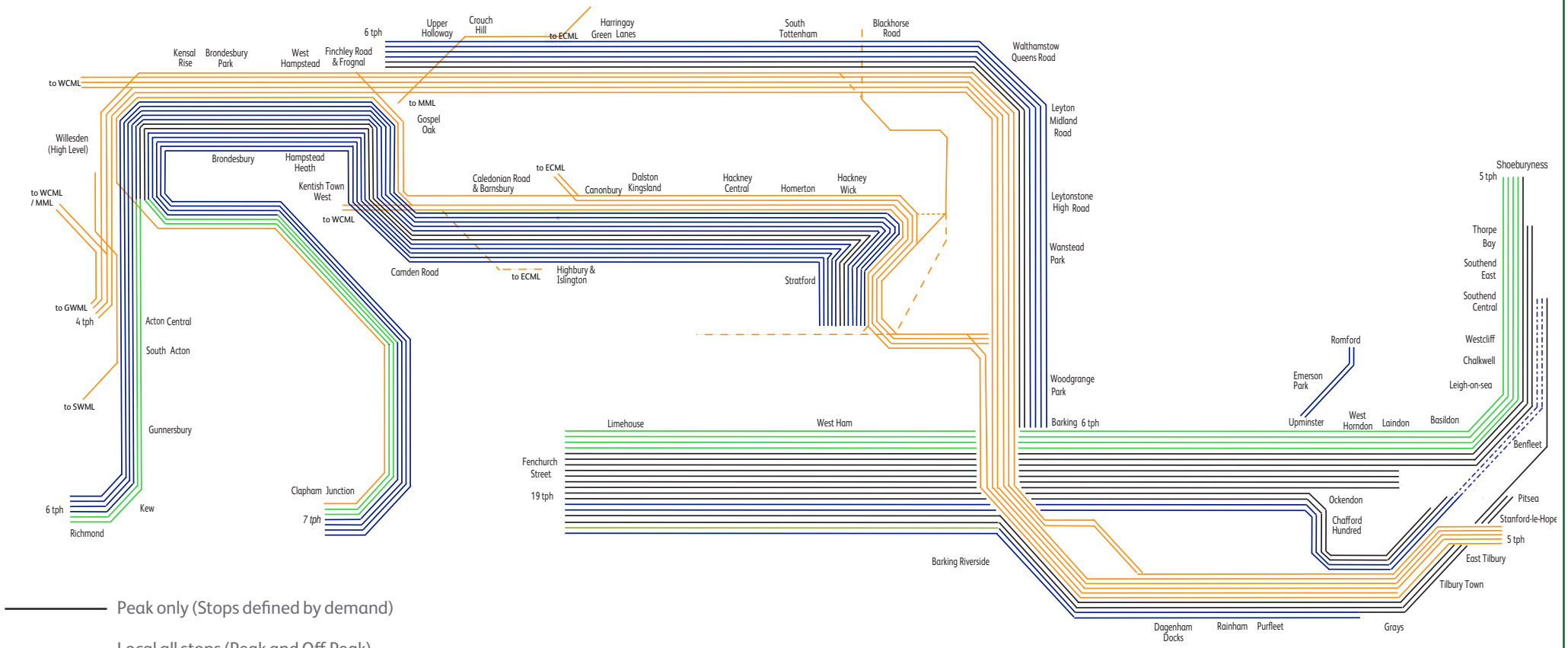
Table 3.7: 2023 Conditional Outputs for Essex Thameside

CP6 Conditional Outputs	Description
ETCO1	To provide sufficient capacity for passengers travelling into central London during peak hours, taking into account anticipated growth over the period to 2023 - Essex Thameside
ETCO2	To improve journey times on the Essex Thameside route

Table 3.8: 2043 Conditional Outputs for Essex Thameside

2043 Conditional Outputs	Description
ETCO3	To provide sufficient capacity for passengers travelling into central London during peak hours, taking into account anticipated growth over the period to 2043 - Essex Thameside
CLFCO1	To provide sufficient capacity for freight travelling from the London Gateway Port via the Tilbury loop, taking into account anticipated growth over the period to 2043 - Essex Thameside

Figure 3.15: 2043 assumed service specification for Essex Thameside and North London Lines



04: Cross-boundary Analysis

4.1 Introduction

4.1.1 This chapter outlines why it has been necessary to consider the approach to services (passenger and freight) which operate across the boundaries of the Route Study area. It details those services that operate in the baseline year of 2019 before going on to describe the process for developing the cross-boundary services which meet the conditional outputs for the longer term articulated in the established Market Studies, describing the assumptions that have been made. Finally it provides a number of examples of how the conditional outputs relevant to these services have been interpreted to assist in developing the 2043 Indicative Train Service Specification for the Anglia Route Study detailed in Chapter 3.

4.2 The Cross-boundary approach

4.2.1 By necessity, for the purposes of undertaking the Long Term Planning Process (LTPP), the Network Rail geography is divided into Route Study Areas; this is to make the process manageable. For this reason, the Route Studies do not run in parallel, but are phased over the available time period within the five-year planning cycle.

4.2.2 By working at the Route Study level, the Network Rail route teams and relevant local stakeholders, both within and outside the industry, can be involved in work relevant to them addressing their requirements.

4.2.3 The Route Study boundaries broadly follow those of the Network Rail devolved Routes, with some exceptions to break down into smaller, more manageable areas (from a Route Study perspective), and to reduce the number of interfaces where possible. Due to this division of the rail network geography, it is necessary to co-ordinate the treatment of passenger and freight trains which cross Route Study boundaries, hence the cross-boundary process.

4.3 The Route Study boundaries and the services that operate across them in 2019

4.3.1 For the purposes of the Long Term Planning Process passenger and freight services which traverse the study area boundary are referred to as cross boundary services. For the baseline year of 2019, these can be broadly summarised as follows:

Table 4.1: Cross-boundary freight and passenger services		
Boundaries between Anglia and other routes	**Route Boundary**	**Service Details**
LNE (East Coast)	Between Whittlesea and Peterborough	Inter-regional services connecting into Cambridge, Ipswich, Stansted Airport and Norwich via Ely Freight services
	Between Meldreth and Royston	Services between Kings Lynn, Ely, Cambridge and Kings Cross/Thameslink
	Between Camden Road and Finsbury Park	Freight services
	Between Canonbury and Finsbury Park	Freight services
	Between Crouch Hill and Harringay	Freight services
LNE (East Midlands)	Between Acton Wells and Hendon/Cricklewood	Freight services
	Between Upper Holloway and West Hamstead	Freight services
Western	Between Willesden Jn and Acton Main Line	Freight services
LNW (West Coast)	Between Camden Road and Queens Park	Freight services
	Between Kensal Rise and Wembley Central	Freight services
	Between Kensal Rise and Willesden Jn (LL)	ECS moves
	Between Acton Central and Shepherds Bush	Freight services
LNW (West Midlands)	Between Acton Central and Wembley Central	Freight services
	Between Acton Central and Wembley Stadium	Freight services
Wessex	Between South Acton and Brentford/Chiswick	Freight services
Sussex	Between Willesden Jn and Shepherds Bush	Freight and West London Line/North London Line services
Other	Between Barking and Ebbsfleet (HS1)	Freight services
	Between Stratford and Whitechapel (Crossrail)	12tph each way between Shenfield and Farringdon (all services continue beyond Farringdon)
	Between Canonbury and Dalston Junction (RfL)	East London Line services
	Between Gunnersbury and Turnham Green (LUL)	District Line services

4.4 Conditional outputs

4.4.1 Market Studies were undertaken for each of four identified markets: Long Distance passenger, London & South East passenger, Regional Urban passenger and Freight.

4.4.2 The passenger market studies generated conditional outputs, i.e. aspirations for the industry to meet, subject to affordability and value for money which are set out in detail in Chapter 3. These are guided by economic analysis of future demand, and where investment is likely to provide the greatest socio-economic return.

4.4.3 The conditional output for freight is to accommodate the forecast demand. The Freight Market Study produced forecasts for every point-to-point flow. The assumption was that existing flows would follow existing routeings. New flows were assumed to follow the shortest practical route taking into account such constraints as loading gauge.

4.4.4 Not all conditional outputs are contained within Route Study boundaries. Clearly, passenger and freight movements are not constrained to Route Study geographical areas, and the Cross boundary process has been designed to ensure that these are reflected in the analysis within the Anglia Route Study.

4.5 Development of the process

4.5.1 The cross-boundary process has been developed by a working group composed of Network Rail, passenger and freight train operating company representatives and the Department for Transport.

4.5.2 The group have developed a Cross-boundary Indicative Train Service Specification (ITSS) for passenger services which cross any route study boundary across the UK. This specification is an interpretation of how the connectivity conditional outputs articulated in the established Market Studies could be delivered. There are many ways in which the conditional outputs could be expressed and the Cross-boundary ITSS has as a start point sought to minimise the number of train movements over any given corridor by linking conditional outputs together and where possible having many conditional outputs delivered by the same train service. Given that the conditional outputs are conditional on a value for money business case being found it could be that the Cross-boundary ITSS may need to change in the future.

4.5.3 There are also a number of planning cycles to be undertaken between the time of writing and 2043 which may change priorities in the future. However, it is necessary to develop a set of service level assumptions in order to test the capability and capacity of infrastructure based on professional judgement of industry stakeholders. Using this approach allows a consistent methodology to be applied across Great Britain to ensure that opportunities can be identified and tested.

4.5.4 The services contained in the Cross-boundary ITSS have been included within the Anglia Route Study Indicative Train Service Specification detailed in Chapter 3.

4.5.5 For freight services, information for the Anglia Route Study has been derived from the Freight Market Study, including preferred routeing of services. These routeings have been disaggregated within the Anglia Route Study area and discussed with the Anglia Route Study Working Group. Similarly to passenger, there are a wide range of origins and destinations for freight. However, freight trains operate to a different timetable according to the needs of industry and are often irregular or operate on specific days of the week. This has been catered for within the forecasting approach by reviewing the exact disaggregated figure for intermodal (Class 4) and other, including aggregate (Class 6) freight services and discussing with the Working Group, particularly freight operators, to arrive at a consistent figure that allows analysis of forecast freight flows alongside passenger. The information has then been rounded within the route study area to the nearest whole number, but remains the precise figure at the Route Study boundary area. This ensures that adjacent Route Studies do not incrementally round up, and result in over provision of timetable slots for freight traffic.

4.5.6 The Cross-boundary Working Group continues to meet to receive and approve proposals from the Route Studies to amend the cross-boundary specification (for either passenger or freight trains), and to advise on resolving capacity issues affecting more than one Route Study.

4.5.7 The Route Studies do not all run in parallel so the cross-boundary process is a continuous one throughout the LTPP period.

4.6 Cross-boundary service assumptions for the longer term for the Anglia Route Study

4.6.1 To produce the Cross-boundary ITSS requires the conditional outputs from the four established Market Studies (both those that cross the route study boundary and those that don't) to be interpreted. Of most relevance are the passenger connectivity conditional outputs and the accommodating freight demand conditional outputs.

4.6.2 Any passenger conditional output crossing a Route Study boundary will require a train to 'carry' it. However one train may 'carry' many conditional outputs. Thus a long distance train travelling across the country from Liverpool to Norwich may carry conditional outputs between, for example, Nottingham, and many other places en-route, and from Peterborough to many other places en-route. It will also be seen that conditional outputs work in both directions, for example Nottingham to Norwich, and Norwich to Nottingham.

4.6.3 The conditional outputs are expressed as 'journey opportunities' per hour. This recognises the fact that it is impractical to provide direct trains between all origin-destination pairs due to the number of train services this would require, even taking into account the possibility of trains joining and dividing en-route.

4.6.4 However there is a general conditional output to provide broadly the same level of service as in the baseline. Thus the service specification would normally maintain a direct service where one already exists.

4.6.5 As well as describing connectivity conditional outputs between the major towns and cities of Great Britain, the passenger market studies also describe connectivity to and from international gateways such as large airports and HS2 stations. In practical terms cross-boundary services to large airports are most pertinent to the Anglia Route Study area for journeys to and from Stansted Airport.

4.6.6 One train may also carry passengers in more than one market, for example long distance and regional, or long distance and London & South East.

4.6.7 It should be noted that both the Cross-boundary and the Anglia ITSS are unconstrained for example by network capacity or considerations of rolling stock.

4.6.8 Splitting and joining of trains has been minimised due to the implications on journey time and performance. However where required, it is considered acceptable towards the end of a train's journey rather than mid-route.

4.6.9 Details of how the conditional output to accommodate freight demand for the longer term have been met are described in paragraph 4.3 above. It should be noted that freight demand in the longer term is subject to a degree of uncertainty and intermodal demand in particular is predicated on a number of terminals being provided.

4.7 Cross-boundary services within, and across, the Anglia Route Study for the longer term to 2043

4.7.1 The Anglia Route Study area is served by a number of 'cross-boundary' services which are included within the 2043 ITSS map. This includes broad groups of services serving Markets as set out below. At the end of this section a number of worked examples are provided to show how the conditional outputs have been interpreted in practice and how the subsequent train services shown in the 2043 ITSS to accommodate them have been derived and detailed in Chapter 6.

- services from Anglia to the East Midlands and beyond to Liverpool
- services from Anglia to Yorkshire and Scotland
- services to the West Midlands from the Anglia area.

4.7.2 Freight services are included within the 2043 ITSS and include the numbers of trains required to meet the forecast growth in demand for movement of freight by rail.

4.7.3 In summer 2014, the East West Rail Consortium published a report setting out, which conditional outputs the 'Central Section' of the East West Rail Link, between the western section and Cambridge, could potentially be used to deliver. This used a similar approach to the rail industry led Market Studies. The rail industry and the East West Rail Consortium are continuing to work together to take proposals forward. This could deliver conditional outputs either identified by the Consortium, or by a Market Study.

4.7.4 As development work progresses on the East West Rail - Central section, it may be the case that further understanding of the opportunities available for this section to carry passenger and freight services becomes available in time to inform the final Anglia Route Study.

4.8 Worked Examples

The indicative train service specification for cross-boundary flows includes one service each way between Ipswich/Norwich (joining/dividing at Ely) and Liverpool Lime Street via Nottingham and one service each way between Cambridge/Norwich (joining/dividing at Ely) and Derby via Nottingham. Options to address the cross-boundary services are detailed in Chapter 6.

Table 4.1: Cross-boundary freight and passenger services

Flow	Conditional Output	Indicative Train Service Specification
Cambridge – Nottingham	B/E (2-3,or 3-4 per hour, 100. or 60 mph)	1tph each way between Ipswich/Norwich (joining/dividing at Ely) and Liverpool Lime Street via Nottingham 1tph each way between Cambridge/Norwich (joining/dividing at Ely) and Derby via Nottingham. Interchange opportunities at Leicester 1tph each way between Norwich and Birmingham via Leicester. 1tph each way between Stansted Airport and Birmingham via Leicester.
Norwich – Nottingham	C (1 -2 per hour 80mph)	1tph each way between Ipswich/Norwich (joining/dividing at Ely) and Liverpool Lime Street via Nottingham 1tph each way between Cambridge/Norwich (joining/dividing at Ely) and Derby via Nottingham. Interchange opportunities at Leicester 1tph each way between Norwich and Birmingham via Leicester.

Cambridge and Nottingham

4.8.1 Even taking into account the simplifications which connections (rather than direct trains) allow, it is still necessary to include more trains than today to allow the conditional outputs to be met. For example between Cambridge and Nottingham the Long Distance Market Study conditional output is 'B/E' which is defined as two to three trains per hour (tph) with an average speed of 100mph, or three to four tph at 60mph.

4.8.2 The base train service operating at the end of Control Period 5, has no direct train between Cambridge and Nottingham. There is the opportunity to travel to Nottingham once per hour and interchange at Ely.

4.8.3 Thus to fully meet the conditional output requires at least the addition of a direct travel opportunity of one or more trains and/or increased opportunities to interchange (potentially with a significant acceleration of the services).

4.8.4 Note that the conditional outputs are a guide to the overall Generalised Journey Time (GJT) desired. The GJT is composed of in-vehicle time, waiting time and interchange penalty. Thus GJT may be improved by combinations of faster trains, more trains or better connections.

4.8.5 It is also necessary to make further assumptions in order to keep the specification manageable.

Norwich–Nottingham

4.8.6 Alongside the Cambridge - Nottingham conditional output there is a conditional output for Norwich - Nottingham at level C (one to two tph at 80mph), but only one train per hour in the 2019 base year. This implies at least one to two additional Norwich-Nottingham train required each hour.

4.8.7 Assuming for a moment that Nottingham – Cambridge and Nottingham – Norwich cannot be served by the same trains, this would equate to between five and eight trains to serve the markets. The extra three to four trains per hour would clearly be impractical and uneconomic from a service provision perspective, even before network capacity constraints are taken into account.

4.8.8 Therefore, combination of the conditional outputs onto a number of services allows the diverse markets to be met by a lower net number of trains, overall.

4.8.9 Ely has been identified as an appropriate location to undertake splitting and joining of trains allowing a single train to meet multiple conditional outputs for the Nottingham market.

4.9 Routeing Options

4.9.1 For the Anglia Routeing, there are no alternative routeing options available for cross-boundary services entering via Peterborough, Should proposals for the extension of the East West Rail route between Oxford and Bedford to Cambridge come to fruition then this new section of route presents an opportunity for some rerouting of cross-boundary services.

4.10 Ongoing Process

4.10.1 The 2043 ITSS for Anglia is unconstrained and is provided as an input to the Route Studies, which seek to accommodate it alongside trains which run purely within the Route Study area.

4.10.2 Where it is not possible to accommodate all trains on the baseline infrastructure using the baseline rolling stock assumptions then Route Studies can:

- reroute
- use different rolling stock assumptions
- consider the case for additional infrastructure.

4.10.3 Where these affect cross-boundary trains (passenger or freight) then it is important to work with all the other Route Studies to ensure that assumptions are consistent on routeing, rolling stock type and length (in the case of accommodating demand).

4.10.4 Where a business case is being made for infrastructure to accommodate cross-boundary trains, then it is important to work with other Route Studies to ensure that all costs are captured on the line of route.

4.10.5 This is managed by the Cross-Boundary Working Group which meets throughout the Route Study process.

4.11 Summary

4.11.1 This Chapter has outlined how the cross-boundary process has been developed for both passenger and freight services, how it has been applied in the Anglia Route Study, as well as the broad range of services which are included within it, which are set out in detail in the 2043 ITSS, and a small number of worked examples to set out how the approach has worked.

05: Control Period 6 Priorities

5.1 Introduction

5.1.1 In this chapter the Anglia Route Study highlights the priorities which have been identified for Network Rail's next control period for funding (CP6, commencing April 2019), and seeks to inform funders of the implications in terms of interventions, industry outputs, value for money, and affordability.

5.1.2 The Rail Value for Money Study[3] highlighted the need to make best use of the existing capacity of the network, before considering further investment-based strategies to accommodate the rising demand from passengers and freight users. This theme is consistent with the way the rail industry currently plans the use and development of capacity through the following broad hierarchy of responses:

- First, by making tactical adjustments to the timetable and train plan in order to better match the available capacity with demand. This sometimes includes creating extra capacity by making informed trade offs against other rail outputs (for example, journey times). These changes are typically planned and delivered through the 'day-to-day' planning of the railway and the franchising process, although the Long Term Planning Process (LTPP) also identifies trade-offs through consideration of a 'making best use' scenario
- Next, delivering extra capacity by deploying additional operational resources (such as rolling stock), where this can be done within the existing capability of the rail network. These opportunities are typically identified through the LTPP and franchising processes
- Finally, by investing in the capability of the network to allow more or longer trains to be operated. These interventions are typically identified through the LTPP, and delivered by aligning the franchising and Periodic Review processes in a back-to-back manner. Investment in the network might be 'incremental' in nature (that is, sequentially unlocking network constraints until train operators are able to run the maximum number of trains at their maximum length), or, where this is no longer possible or does not offer value for money, this may be a 'step change' (for example, building new lines or cross-city links), which typically provides sufficient capacity to accommodate demand growth over a much longer period.

5.1.3 The Anglia Route Study identifies a number of investment priorities for CP6. All of the CP6 investment choices identified for the Anglia Route meet one (or more) of the following criteria:

- Investments which are required to provide sufficient capacity for the anticipated level of passenger and freight demand at the end of CP6 (where this investment is also consistent with the longer-term capacity strategy identified by the Route Study)
- 'Once in a generation' opportunities where conditional outputs (or some part of the capital works necessary to enable conditional outputs over a longer period of time) can be delivered efficiently during CP6, for example, in conjunction with the planned renewal of life-expired assets
- Outputs that funders have expressed an interest in prioritising for CP6.

5.1.4 This chapter sets out the CP6 choices for funders by sub route and then finishes with a section on station capacity issues on all routes within Anglia.

3 "Realising the Potential of GB Rail", Sir Roy McNulty, May 2011

5.2 Summary of CP6 conditional outputs

5.2.1 This section of the Route Study highlights the priorities for CP6 that exist to meet the conditional outputs set out in the Market Studies to 2023 and re-iterated in Chapter 3. In each case the approach has been to establish the long term challenges in meeting the conditional outputs and ensure that the CP6 options are consistent with the potential longer term solutions set out in Chapter 6.

5.2.2 The below table is a summary of Conditional Outputs identified as CP6 priority options covered in this Chapter.

Table 5.1: Control Period 6 conditional outputs

CP6 Conditional Outputs	Description
GECO1	To provide sufficient capacity for passengers travelling into central London during peak hours, taking into account anticipated growth over the period to the end of Control Period 6 (2023/2024) - Great Eastern Main Line services
GECO2	To provide sufficient capacity for cross-boundary services between Peterborough / Norwich and Cambridge via Ely, taking into account anticipated growth over the period to the end of Control Period 6 (2023/2024) – Cross-boundary services
GECO3	To provide journey time improvement for services on the route from Norwich to London – Great Eastern Main Line
F2NCO1	To provide sufficient capacity for freight travelling via the Felixstowe to Nuneaton route, taking into account anticipated growth over the period to the end of Control Period 6 (2023/2024) - Cross-boundary services
WACO1	To provide sufficient capacity for passengers travelling into central London and other employment centres during peak hours, taking into account anticipated growth over the period to the end of Control Period 6 (2023/2024) - West Anglia services
WACO3	To provide journey time improvement for services from both Cambridge and Stansted Airport to London Liverpool Street - West Anglia services
CLCO1	To provide sufficient capacity for passengers travelling across London during peak hours, taking into account anticipated growth over the period to the end of Control Period 6 (2023/2024) – North London Line and Gospel Oak to Barking
CLFCO2	As identified to meet CLCO1, to provide sufficient capacity freight paths across London – Cross-boundary to the end of Control Period 6 (2023/2024)
ETCO1	To provide sufficient capacity for passengers travelling into central London during peak hours, taking into account anticipated growth over the period to the end of Control Period 6 (2023/2024) - Essex Thameside
ETFCO1	To provide sufficient capacity for freight travelling from the London Gateway Port via the Tilbury loop, taking into account anticipated growth over the period to the end of Control Period 6 (2023/2024) – Essex Thameside

5.3 Great Eastern Main Line

5.3.1 The relevant conditional outputs considered by the Anglia Route Study are listed below:

Table 5.2: Control Period 6 GEML conditional outputs

Conditional Output	Description
GECO1	To provide sufficient capacity for passengers travelling into central London during peak hours, taking into account anticipated growth over the period to the end of Control Period 6 (2023/2024) – Great Eastern Main Line services
GECO2	To provide sufficient capacity for cross-boundary services between Peterborough / Norwich and Cambridge via Ely, taking into account anticipated growth over the period to the end of Control Period 6 (2023/2024) – Cross-boundary services.
GECO3	To provide journey time improvement for services on the route from Norwich to London – Great Eastern Main Line
F2NCO1	To provide sufficient capacity for freight travelling via the Felixstowe to Nuneaton route, taking into account anticipated growth over the period to the end of Control Period 6 (2023/2024) – Cross-boundary services

Great Eastern Main Line Outer Services

5.3.2 As stated in Chapter 3, by the end of CP6 there will be a capacity gap on services from Norwich and outer services serving Ipswich, Colchester and Chelmsford into London Liverpool Street of around 2,200 passengers.

5.3.3 Apart from some services that start at Witham, all services currently run as 12-car EMUs or as 10-car loco-hauled stock. Lengthening to more than 12-car is expected to be prohibitively expensive because of short platform lengths at nearly all stations including London Liverpool Street.

5.3.4 Lengthening the remaining Witham services to 12-car, and increasing the frequency of services will cater for the additional capacity requirements. An additional service from Norwich, and two services starting from Ipswich, Colchester or earlier and providing capacity at key stations such as Witham and Chelmsford will best meet the crowding issue on the busiest services.

5.3.5 In order to provide sufficient capacity for these additional trains the following combination of infrastructure interventions is required:

- Option 1 and 2: Additional platforms at London Liverpool Street or the redirection of West Anglia Main line services to additional platforms at Stratford
- Options 3 and 4: Improved signalling between Chelmsford and Stratford
- Option 5: Doubling of Trowse swing bridge (near Norwich)
- Option 7: Provision of a loop line near Haughley Junction or changes to the signalling on the Bury St Edmunds line Option 8

Table 5.3: Infrastructure interventions to meet GECO1				
Great Eastern Main Line Service Specification (GECO1)	Platform capacity at London Liverpool Street	Signalling headway reduction between Chelmsford and Stratford	Passing loop at Haughley Junction	Doubling of Trowse Swing Bridge
CP5 Baseline: 24tph into London Liverpool Street				
CP6 requirement: 27tph into London Liverpool Street	✓	✓	✓	✓

Table 5.4: Infrastructure interventions to meet GECO2				
Peterborough/Cambridge to Ipswich/Norwich via Ely Service Specification (GECO2)	Doubling of Trowse swing bridge	Passing loop at Haughley Junction	Signalling headway reduction at Bury St Edmunds	Ely level crossings closures
CP5 Baseline: 3tph (1tph Nottingham to Norwich, 1tph Cambridge to Norwich, 1tph Ipswich to Cambridge)				
CP6 Forecast: 5tph (2tph Norwich to Cambridge, 1tph Ipswich to Cambridge, 1tph Ipswich to Ely, 1tph Nottingham to Norwich)	✓	✓	✓	✓

5.3.6 Doubling Trowse swing bridge not only supports the capacity required on the Great Eastern Main Line but also provides the necessary capacity to cater for an additional Norwich to Ely / Cambridge Service. Infrastructure work to double Ely North Junction and upgrade the Queen Adelaide Crossings would also be required to support services travelling via Ely.

5.3.7 The appraisal of this scheme compares the benefit of additional peak capacity provided by one extra 8-car Norwich train and two additional 12-car semi fast services (including the operating cost of running these services in the peak hour) with the capital cost of the options listed above:

5.3.8 Assuming the highest cost of all options, this set of options has a low value for money socio-economic case (BCR from 1 – 1.5). If the costs of improved signalling could be avoided through ETCS and ATO (removing the cost of options 3 & 4) this set of options has a high value for money socio-economic case, this scenario will require further investigation during the consultation period. Further detail of this appraisal is set out in Appendix A.

5.3.9 The option to relocate West Anglia services to Stratford and provide additional platforms at Stratford (to free up capacity at London Liverpool Street) is expected to have a worse value for money case because the scope of works required is expected to be more expensive than additional platforms at London Liverpool Street. The anticipated final cost of additional platforms at Stratford has not been completed and this conclusion will require review during the consultation period of this study.

Felixstowe to Nuneaton Services

5.3.10 On the Felixstowe to Ely route, there is a capacity shortfall for 2024 with the requirement of 60 freight paths per day. Over the CP5 baseline infrastructure, the following interventions are required to cater for this capacity.

- Option 6: Further doubling of the Felixstowe Branch
- Option 7: Provision of a loop line near Haughley Junction or changes to the signalling on the Bury St Edmunds line Option 8
- Option 9: Further doubling of Ely to Soham
- Option 10: Ely Level Crossing Closures.

5.3.11 In CP6, the first constraint to delivering any increase in freight and passenger capacity over the route is Ely level crossings (Queen Adelaide crossing and Kiln Lane). Without this, no further increase incapacity is possible over and above today's paths. This constraint applies to the entire Felixstowe to Nuneaton route. Having resolved that constraint, there are further interventions that are required to deliver freight capacity regardless of passenger capacity requirements, and some that are required to deliver both freight and passenger capacity requirements.

5.3.12 An incremental scheme at Ely that upgrades the level crossings in the Ely area will safely permit an increase in freight capacity up to 48 trains per day from Felixstowe and an assumed increase in passenger capacity.

5.3.13 To deliver the full freight conditional outputs for CP6 of 60 tpd in each direction, a more comprehensive scheme at Ely to address the Queen Adelaide level crossings is required that avoids the constraints and provide sufficient capacity between Ely and Soham, a further doubling of the Felixstowe Branch, and loop facilities at Haughley and Witham. Such a scheme would be expensive due to the necessary works in the Ely area.

5.3.14 The business case for doubling of the Felixstowe branch line is predicated on the ability to accommodate growth in freight paths from Felixstowe to Nuneaton including routes that are outside the boundaries of this study. Therefore, a full appraisal of benefits and costs cannot be made. If the growth in freight demand to the end of CP6 were fully accommodated between Felixstowe and Nuneaton, the benefit associated with the reduction in lorry miles on Britain's roads would have significant benefit, in the order of PV £2bn.

5.3.15 The Freight RUS work stream will seek to understand further the capacity and infrastructure requirements on the entire Felixstowe to Nuneaton route and put together a strategic case for investment.

Table 5.5: Infrastructure interventions to meet F2NCO1

Felixstowe to Nuneaton Service Specification (F2NCO1)	Felixstowe branch further doubling	Ely to Soham line further doubling	Passing loop at Haughley Junction or Signalling headway reduction at Bury St Edmunds	Ely level crossings closures
CP5 Baseline: 48tpd				
CP6 Forecast: 60tpd	✓	✓	✓	✓

London to Norwich Journey Time Improvements

5.3.16 To improve journey times between Norwich and London Liverpool Street, there are a number of operating, timetable and infrastructure options. The existing two services from Norwich also stop at Diss, Stowmarket, Ipswich and other stations on the route to London Liverpool Street. Skipping these stops would enable the introduction of a new faster service from Norwich but at the detriment to passengers from other stations. The additional services required to provide sufficient capacity into London Liverpool Street could be used to provide a fast service from Norwich only stopping at a few key stations on the route. This would go some way to providing the journey time improvements from Norwich.

5.3.17 Over and above the journey time improvements provided by the additional service, rolling stock and line speed improvement options should also be considered. Currently services between Norwich and London Liverpool Street are run using class 90 electric locomotives and carriages. These trains tend to have poor acceleration characteristics compared to some newer electric locomotives or Electric Multiple Units (EMUs). For example the introduction of new build EMUs with fast acceleration characteristics could beat the existing journey time by 2-4 minutes (depending on stopping pattern). Improving the line speed on the route to 110mph could further improve the journey time between Norwich and London by between 3-7 minutes (depending on stopping pattern) with journey time improvements spread over the route allowing other services on the route to also achieve journey time improvements.

5.3.18 The case for implementing 110 mph line speed improvements between Shenfield and Norwich (option 11) has been appraised incrementally to the business case set out to provide sufficient passenger capacity in CP6. A journey time improvement of around 6-7 minutes would be expected to be delivered in each direction, spread across the route from Shenfield to Norwich and affecting all passenger services on the route not just passengers on the London to Norwich trains. There is a high value for money case for delivering these journey time improvements. Further detail of this appraisal is set out in Appendix A.

5.3.19 The following tables describe the infrastructure required to implement the options to meet the GEML conditional outputs in CP6 and give an estimate of the capital cost estimates where available:

- Options 3 and 4: Improved signalling between Chelmsford and Stratford
- Option 5: Doubling of Trowse swing bridge (near Norwich)
- Option 9: Provision of loops north of Witham
- Option 11: 110mph line speed improvements between Shenfield and Norwich.

Table 5.6: Infrastructure interventions to meet GECO3

Great Eastern Main Line Service Specification (GECO3)	Signalling headway reduction between Chelmsford and Stratford	Doubling of Trowse Swing Bridge	Passing loop at north of Witham	110 mph line speed improvements between Shenfield and Norwich
CP5 Baseline: 24tph into London Liverpool Street				
CP6 requirement: 27tph into London Liverpool Street	✓	✓	✓	✓

Table 5.7: Assessment of Option 1: Additional platforms at London Liverpool Street (GECO1, GECO3)

Summary of intervention:

This option is to provide additional platforms at London Liverpool Street to support the increase in services from the GEML.

Options for potential additional platform locations

- new platform 0 located within the shopping area to the west side of London Liverpool Street Station, but potentially requiring platform 1 to be shortened
- three new platforms between the existing platforms 10 and 11, one adjacent to platform 10 and two within the taxi rank area
- remodelling of the existing platforms 1-10 within the western most train shed to allow provision of an additional three 12-car length platforms or an additional two 12-car and two 10-car platforms
- creation of an additional terminus station to the north of London Liverpool Street within the area of Network Rail owned land adjacent to Shoreditch High Street station on the East London Line. This would potentially be utilised by services from the West Anglia route.

Output assessment:

Current feasible capacity at London Liverpool Street is 24 passenger services from the GE Main Line in the high peak hour; beyond this an additional platform is required. Multiple platforms would allow for increased capacity requirements for the end of CP6 and up to 2043.

This goes towards meeting requirements of GECO1, but in isolation would not allow for additional paths into the station. Option 3 would also be required. Option 2 is an alternative to providing additional platforms.

Increased platform capacity will also help to improve performance.

Affordability assessment:

The Anticipated Final Cost (AFC) of additional platforms at London Liverpool Street is between £15m and £35m in 2023 prices.

Table 5.8: Assessment of Option 2: Additional services to Stratford (GECO1, GECO3)
Summary of intervention: The option to relocate some services originating from the West Anglia Main Line from London Liverpool Street to Stratford could be accommodated through two additional 12-car bay platforms at Stratford located between Platforms 10a and 11. Thus releasing platform capacity at London Liverpool Street for Great Eastern Main Line services.
Output assessment: Any additional services beyond 4tph to Stratford from the West Anglia route will require additional platforms. Any trains beyond 4tph will seriously impact on the ability to use Orient Way Sidings.
Value for money assessment: This option is an alternative to providing extra platforms at London Liverpool Street to meet capacity requirements on the Great Eastern Main Line.
Affordability assessment: The cost of this scheme is yet to be estimated, but given the scope of works required is likely to cost more than additional platforms at London Liverpool Street.

Table 5.9: Assessment of Option 3: Signalling alterations between Shenfield and London Liverpool Street (GECO1, GECO3)
Summary of intervention and output assessment: Current feasible capacity at London Liverpool Street is 24 passenger service arrivals in the high peak hour due to the signalling only being able to path a train 90 seconds behind another (technical headway), and less then optimal signalling around Stratford. ***Conventional – 75 second headway*** A technical headway of 75 seconds would allow for the required 2023 capacity, potentially a further buffer would be required to robustly cater for 2043 capacity ***Conventional – 60 second headway*** A technical headway of 60 seconds would allow for the required 2043 capacity and associated performance buffer. This would meet the peak capacity requirements to the end of CP6 (GECO1) and the longer term (GECO4) ***European Train Control System (ETCS)*** There are options to accelerate the roll out of European Train Control System (ETCS) / Automatic Train Operation (ATO) which delivers in cab signalling capable of allowing trains to run at significantly shorter headways. A study between Shenfield and Stratford has shown that ETCS and ATO would meet the requirements of GECO1 and the longer term GECO4, but in isolation would not allow for additional paths. Option 1 would also be required. Reduction in headways enables more effective timetabling of trains through Stratford.
Value for money assessment: The Anticipated Final Cost (AFC) of conventional signalling improvements to 75 second headway is between £175m and £375m in 2023 prices. The cost of 60 second headway and ETCS with automatic train operation will be estimated in time for the publication of the final Route Study

Table 5.10: Assessment of Option 4: Chelmsford headway reduction to meet demand (GECO1, GECO3)
Summary of intervention: Signalling headway reduction would be required between Chelmsford and Shenfield would be necessary to provide sufficient capacity for the following service assumptions: ***Peak:*** 4 x Norwich, 2 x Clacton, 6 x Stopping passenger services (2 x Clacton, 1 x Harwich Town, 1 x Harwich Int, 1 x Colchester Town, 1 x Ipswich), 2 x Witham, 1 x Braintree, 3 x Chelmsford ***Off peak:*** 4 x Norwich, 1 x Clacton, 3 x Stop Passenger (1 x Clacton, 1 x Ipswich, 1 x Colchester Town), 1 x Braintree, 3 x Freight This would meet the peak train capacity requirement for 2023 and 2043 (GECO1 and GECO4), but in isolation would not allow for additional paths. Option 1 and Option 3 would also be required.
Affordability assessment: The cost of this scheme has not been estimated, and will be required for the final publication of this document.

Table 5.11: Assessment of Option 5: Doubling of Trowse Swing Bridge (GECO1, GECO2, GECO3)

Summary of intervention:

To facilitate additional paths from Norwich it is necessary to double the single track section over Trowse Swing Bridge and Trowse Lower Junction.

Trowse Swing Bridge was originally built in 1845 as a single track structure then reconstructed as a twin track structure in 1905. Overhead electrification was introduced in 1986 and it reverted back to a single line structure. The structure is lifted by hydraulic jacks and swings open. There have been frequent problems reported with navigation access caused due to its unreliability leaving it unable to open. There is a 40mph speed limit across the bridge.

The following options have the potential to provide the additional capacity over constrained single line sections at Trowse Swing Bridge:

- new fixed structure adjacent to existing. Existing structure swing mechanism fully disabled along with all power and mechanical equipment decommissioned. (This option is dependent on the 1985 British Railways Act regarding the requirement to open the bridge being rescinded)
- new fixed single structure to accommodate twin tracks. Existing structure to be demolished along with all power and mechanical equipment decommissioned. (This option is dependent on the 1985 British Railways Act regarding the requirement to open the bridge being rescinded)
- new swing bridge adjacent to the existing along with the existing structure made fully operable
- new single structure to accommodate twin tracks with moveable lift function. Existing structure to be demolished along with all power and mechanical equipment decommissioned
- new single fixed structure to accommodate twin tracks. Existing structure to be demolished along with all power and mechanical equipment decommissioned
- new fixed structure adjacent to existing at higher level along with the swing function made operable on the existing structure.

The following options have the potential to provide the additional capacity over constrained single line sections at Trowse Lower Junction:

- new 25mph double junction from up and down main line to up and down Thetford line
- new 25mph double junction from up and down main line to up and down Thetford line with a facing 25mph crossover on Thetford branch.

Output assessment:

Current feasible capacity over Trowse swing bridge would allow for the 2023 service levels in isolation, however it would cause timetabling constraints elsewhere on both the Great Eastern Main Line and the Ely area that would be highly detrimental to both passenger and freight growth and would not provide an even and robust service.

All options meet the requirements to allow for peak capacity requirements in 2023 (GECO1) and capacity up to the requirements of 2043 meeting GECO4 and GECO5

Reduction of the timetabling constraints would also aid the ability to provide improved journey times and the ability to run additional trains between Norwich and Cambridge (GECO2 and GECO3).

Affordability assessment:

The Anticipated Final Cost (AFC) is between £35m and £75m in 2023 prices.

Table 5.12: Assessment of Option 6: Further doubling of Felixstowe Branch Line (beyond CP5 works) (F2NCO1)
Summary of intervention: The single line sections on the Felixstowe Branch Line provide a constraint to delivering the capacity required for forecast growth in intermodal freight traffic to and from the Port of Felixstowe. To provide the necessary capacity to cater for a robust 60 freight trains per day it would be necessary to double further sections of the single line sections of the Felixstowe Branch Line.
Output assessment: The feasible capacity over the Felixstowe Branch Line at the end of CP5 will be 48 freight trains per day, plus an hourly passenger service. Further doubling of the Felixstowe Branch is necessary to cater for the forecast of 60 freight trains per day allowing for the current service in isolation; however it would also be necessary to implement Options 7 or 8 as well as Option 10 to meet freight capacity requirements (F2NCO1 and GECO2)
Affordability assessment: The Anticipated Final Cost (AFC) is between £75m and £175m in 2023 prices.

Table 5.13: Assessment of Option 7: Haughley Junction Loop facility (F2NCO1, GECO2)
Summary of intervention: A passing loop facility allows fast Norwich to London services to pass freight services on the Great Eastern Main line and hold freight paths requiring access to the Bury St Edmunds line. The loop is designed to cater for the additional freight and passenger requirements at the end of CP6.
Output assessment: Current speed differential issues between passenger and freight results in insufficient capacity for both Felixstowe to Nuneaton freight and passenger conditional outputs. This can be resolved through changing the freight on the Great Eastern Main Line, but this requires the ability to path freight at intervals of 4 minutes on to the Bury St Edmunds line. The loop facility will provide sufficient capacity for freight paths in the Ipswich and Haughley Jn area to the end of CP6 (F2NCO1 and GECO2) when implemented in conjunction with options 6 and 9. Increased robustness and flexibility of freight paths aids the provision of improved journey times on the Great Eastern (GECO3) for services from Norwich to London.
Affordability assessment: The Anticipated Final Cost (AFC) is between £35m and £75m in 2023 prices..

Table 5.14: Assessment of Option 8: Bury St Edmunds headway reduction (F2NCO1, GECO2)
Summary of intervention: This option is an alternative to loops at Haughley Junction. This option requires line speed improvements for both passenger and freight services to provide the necessary headway reduction. This requires infrastructure upgrades to facilitate the line speed increase and removal of differential speeds.
Output assessment: Current speed differential issues between passenger and freight, results in insufficient capacity for both Felixstowe to Nuneaton freight and passenger conditional outputs. This can be resolved through changing the pattern of freight on the Great Eastern Main Line, but this requires the ability to path freight at intervals of 4 minutes on to the Bury St Edmunds line. This option provides capacity for freight trains in the Ipswich and Haughley Jn area (F2NCO1) when implemented with options 6 and 9. Increased robustness and flexibility of freight paths aids towards providing improved journey times on the Great Eastern (GECO3) for services from Norwich to London.
Affordability assessment: The Anticipated Final Cost (AFC) of this scheme is yet to be estimated.

Table 5.15: Assessment of Option 9: Full doubling of Soham to Ely (beyond CP5 works) (F2NCO1)
Summary of intervention:
The single line sections between Ely and Soham (beyond the CP5 works) provide a constraint to delivering the capacity required for forecast growth in intermodal freight traffic to and from the Port of Felixstowe.
With freight level of 60 freight paths per day between Soham and Ely this area would need full double tracking.
Output assessment:
Current feasible capacity through the Soham to Ely single line section would allow for the current service in isolation, however it would cause fixation of both the Great Eastern Main Line and the Ely area that would be highly detrimental to both passenger and freight and would not provide an even and robust service.
This achieves GECO6 when implemented with Option 8 and either 9 or 10.
Increased robustness and flexibility of freight paths aids towards GECO7 for services from Norwich to London.
Affordability assessment:
The Anticipated Final Cost (AFC) is between £50m and £100m in 2023 prices.

Table 5.16: Assessment of Option 10: Ely infrastructure works including level crossing works and potential further double tracking and avoiding lines. (F2NCO1, GECO2)
Summary of intervention:
Options range from level crossing works in the Ely area to building of avoiding lines and double track sections.
Level crossing works will allow for 48 freight paths per day between Ely and Soham (which would need full double tracking). Further work in conjunction with options, 6 and either7 or 8 will allow for 60 freight paths per day and cater for additional freight demand in the long term
Output assessment:
This achieves freight capacity requirements F2NCO1 and GECO2 with implementation of Option 6 and either 7 or 8.
Affordability assessment:
The Anticipated Final Cost (AFC) of Level crossing works in the Ely area is between £100m and £250m. The AFC of full bypass of Ely station is between £375m and £875m in 2023 prices.

Table 5.17: Assessment of Option 11: Loop facility north of Witham (GECO3)
Summary of intervention:
To provide robust capacity for the addition of a third London to Norwich service all day alongside the existing and future freight services levels there would be a requirement for 1 freight path per hour to be overtaken between Witham and Colchester. To do this, new looping facilities would be necessary between Witham and Colchester.
Output assessment:
Current speed differential issues (potential further detriment by achieving GECO3) between passenger and freight, results in insufficient capacity for both Felixstowe to London freight and passenger conditional outputs. The loop facility allows for holding of Class 4/6 freight to allow for overtaking by faster passenger services; this achieves GECO3 when implemented with Options 5 and 7. During peak hours when fewer freight services operate in the London region, this loop allows for slower passenger trains to be overtaken achieving reduced journey times for fast passenger services. Increased robustness and flexibility of freight paths aids towards GECO3 for services from Norwich to London. In order to maximise the benefits, a dynamic loop is required (for example, extension of the current Witham loops towards Kelvedon).
Affordability assessment:
The Anticipated Final Cost (AFC) is between £35m and £75m in 2023 prices.

Table 5.18: Assessment of Option 12: 110mph Line Speed Improvements between Shenfield and Norwich (GECO3)
Summary of intervention:
This option to increase line speed between Shenfield and Norwich to 110mph, would involve significant infrastructure upgrades to Track, Signalling, Overhead Line Equipment and Structures. This option would also provide further benefit with the introduction of new modern type EMUs, where the braking and acceleration profiles makes best use of 110mph infrastructure.
Output assessment:
Sub-option 12a
Line Speed improvements to 110mph and using the current Class 90 rolling stock between Norwich and London would mean that trains would not be capable of taking full advantage of 110mph line speeds because of relatively poor acceleration characteristics
Sub-option 12b
Line Speed improvements to 110mph with new modern type EMUs with improved braking and acceleration profiles makes best use of 110mph infrastructure meeting the journey time conditional output (GECO3) requirements.
Consideration of stopping patterns may also be necessary
Options 1, 3, 5, and 7 or 8 have positive implications in being able to improve journey times (GECO3) alongside this option.
Affordability assessment:
The Anticipated Final Cost (AFC) is between £175m and £375m in 2023 prices..

5.4 West Anglia Main Line

5.4.1 The relevant conditional outputs considered by the Anglia Route Study are listed below.

Table 5.19: Control Period 6 WAML conditional outputs

CP6 conditional outputs	Description
WACO1	To provide sufficient capacity for passengers travelling into central London and other employment centres during peak hours, taking into account anticipated growth over the period to the end of CP6 (2023/2024) – West Anglia services.
WACO3	To provide journey time improvement for services from both Cambridge and Stansted Airport to London Liverpool Street - West Anglia services.

5.4.2 There is expected to be a capacity gap on services from Stansted Airport and Cambridge and on suburban services arriving into London Liverpool Street between 08:00 and 09:00 by the end of CP6. The shortfall is approximately 1,000 passengers on the Cambridge and Stansted Airport services and 1,700 passengers on the suburban services. This capacity gap can be met without changing the routeing of existing services or additional services but through train lengthening.

5.4.3 The forecast increase in peak passenger demand is limited in that it doesn't fully take into account the latest understanding of housing growth potential on the route. In particular the methodology for estimating background passenger growth does not take into account the circular effect of improved services on the viability of additional housing, economic regeneration, and the resultant increase in passenger demand and requirement for improved connectivity. The conclusions of this section (5.4.11 below) and relevant conclusions in Chapter 6 take account of the particular potential for population growth on this corridor – over and above the current demand forecasts.

5.4.4 Cambridge and Stansted Airport services arriving into London Liverpool Street between 08:00 and 09:00 are all 8 carriages in length. The Stansted Airport services and one of the Cambridge services are run using rolling stock that tends to have a low number of seats per carriage. This is appropriate to meet the market for travel to and from the airport because passengers value comfort and space for luggage. Higher density rolling stock could mitigate the capacity gap into London in the peak, but will impact adversely on the airport passengers. Lengthening two of the services from 8 carriages to 12 carriages in length between 08:00 and 09:00 would meet the capacity gap by the end of CP6 and is likely to be the best option.

5.4.5 On the route via Tottenham Hale, services from Hertford East to London Liverpool Street are expected to be over capacity by the end of CP6. Lengthening the two existing peak hour services into London Liverpool Street between 08:00 and 09:00 from 8 carriages to 12 carriages in length will deliver sufficient capacity. Choosing not to lengthen the services would mean passengers are travelling in increasingly crowded conditions and would impact negatively on passenger satisfaction.

5.4.6 An appraisal has been carried out that demonstrates that providing four additional 4 car units to lengthen Cambridge, Stansted and Hertford East services in the AM peak would have a high value for money case (BCR>2) for investment in CP6 excluding the cost of any necessary platform extensions. Further detail of this appraisal is included in Appendix A.

5.4.7 On services from Enfield Town to London Liverpool Street, and from Chingford to London Liverpool Street, any capacity shortfall for 2024 will be met by the introduction of high density rolling stock. This will be implemented by Transport for London when they take over the responsibility for these services in 2015.

5.4.8 There is expected to be a capacity gap on the services into Cambridge from the Kings Lynn line via Ely by the end of CP6. Trains are crowded from Ely to Cambridge and passengers primarily use services to commute to Cambridge and London. Crowding on services arriving into Cambridge between 07:00 and 08:00 can be mitigated through timetable changes and the additional service from Birmingham New Street to Stansted Airport via Cambridge expected to run in CP5 subject to the implementation of the necessary infrastructure works to upgrade level crossings and double Ely North Junction. Crowding on services arriving into Cambridge between 08:00 and 09:00 cannot be mitigated in the same way. Lengthening of one of the Kings Lynn to London King's Cross services from 4 carriages to 8 carriages in length would provide sufficient capacity by the end of CP6 and lengthening the service that only stops at Downham Market and Ely would avoid the need to lengthen platforms. However, this would mean that the 8-car service would probably join with a 4-car service at Cambridge and continue to London King's Cross as a 12 car service. This option would require consideration in the East Coast Main Line Route Study. Other options to mitigate this capacity issue include increasing the density of standing space of rolling stock into Cambridge. However, these services also provide capacity for passengers from Cambridge to London King's Cross and higher seated density rolling stock is more appropriate for this market.

Table 5.20: Infrastructure interventions to meet WACO1

West Anglia Service Specification	Platform Extensions
CP5 Baseline: 26tph 22tph to London Liverpool St 4tph Stratford	
CP6 Forecast: 26tph 22tph to London Liverpool St 4tph Stratford	✓

5.4.9 To improve journey times from Cambridge and Stansted Airport to London Liverpool Street, line speed improvements on their own will not improve journey times because fast trains are restricted by the mix of fast and slow trains on the same line. Some small incremental journey times could be made through changes to the pattern of services but this is likely to be detrimental to some passenger journeys in favour of others. Further work will be examined before the final document to assess the journey time benefit which can be achieved through both line speed improvements and alterations to the timetable. Realising the full journey time improvements without detriment to other services can only be made through a combination of West Anglia Main Line capacity improvements and journey time improvements by providing additional tracks to segregate the fast and stopping services.

5.4.10 Additional capacity to provide more frequent services is currently included as part of the longer term strategy in Chapter 6. Given the scope and cost of infrastructure required to significantly improve the frequency and connectivity on the route, investment should be considered in the context of providing a significant improvement in direct access to employment in Central London as well as significant improvements in the connectivity to and from Stansted Airport. During the consultation period, specific comments on the service outputs that rail on the West Anglia Main Line should seek to achieve in CP6, and how this might affect the viability of additional housing and regeneration would be welcome.

5.4.11 For CP6 on the West Anglia Main Line inwards of Broxbourne, it is proposed that a number of enabling works are focused on to support the longer term plan set out in Chapter 6 which supports demand well above that currently forecast

- land acquisition for four tracking
- level Crossing closures between Tottenham Hale and Broxbourne.

In additional to these depots and stabling and any power supply enhancements to support the additional rolling stock requirements set out for train lengthening in CP6 will also need to be delivered.

5.4.12 The following tables describe the infrastructure options for CP6.

Table 5.21: Assessment of Option 13: Train lengthening to provide capacity West Anglia Main Line to meet forecast demand to the end of CP6 (WACO1)

Summary of intervention:

Extend all Lea Valley line services in the high peak to 12-car in length by the end of CP6.

The following platforms are currently less than 12 car in length:

- Shelford
- Great Chesterford
- Newport
- Elsenham
- Roydon
- Harlow Mill
- Hertford East (platforms 1 & 2)
- Ware (platform 1)
- St Margarets (platforms 1 & 2)
- Rye House (platforms 1 & 2)
- Broxbourne (platforms 1 & 4)
- Cheshunt (platforms 2 & 3)
- Waltham Cross (platforms 1 & 2)
- Enfield Lock (platforms 1 & 2)
- Brimsdown (platforms 1 & 2)
- Ponders End (platforms 1 & 2)
- Angel Road (platforms 1 & 2)
- Northumberland Park (platforms 1 & 2).

Output assessment:

The service pattern remains unchanged.

One way of meeting the capacity requirements is to lengthen trains as follows:

- the procurement of two additional 4 car units to lengthen peak Hertford East to London Liverpool Street services from 8 to 12-car
- the procurement of two additional 4-car units lengthening peak Stansted Airport and Cambridge to London Liverpool Street services from 8 to 12-car.

This would provide approximately an additional 16 vehicle arrivals in the peak hour to London Liverpool Street by the end of CP6, meeting the required passenger capacity for CP6 (conditional output WACO1a) on the outer suburban services into London Liverpool Street.

Additionally, the following options should be considered:

- providing rolling stock with more seats on the Kings Lynn / Cambridge to London Liverpool Street services and the Stansted Airport to London Liverpool Street services. This will need to be considered by the franchise specification process in the context of capacity provision into Cambridge where more standing capacity may be more appropriate.

Train lengthening alone provides no journey time improvements and therefore does not meet conditional outputs to improve journey times on the route (WACO3).

Affordability assessment:

An estimate of the AFC of platform lengthening has yet to be completed and will be included in the final Route Study document.

Table 5.22: Assessment of Option 14: Journey time improvements on services from Cambridge and Stansted Airport to London Liverpool Street (WACO3)
Summary of intervention:
This option improves the line speed on the route to enable 100mph running. However, journey times to London from both Stansted Airport and Cambridge cannot be improved without capacity interventions or alterations to the service structure on the West Anglia Main Line.
Output assessment:
The service pattern remains unchanged, which meets connectivity requires as detailed in the conditional outputs. Line speed improvements do not result in journey time improvements for all services because of timetabling constraints. Current even service patterning for Stansted Airport services may be unable to maintained if journey time benefits are to be realised. Line speed improvements could provide up to 3 to 5 minutes journey time benefit to some services dependent on timetable structure. To provide the best journey time benefits for services from Cambridge and Stansted Airport without further infrastructure enhancements would be at detriment to other services on the West Anglia Main Line. This only partially meets the requirements of WACO3. Options 29 and 30 detailed in Chapter 6 would provide the necessary infrastructure to fully meet the requirements of WACO3.
Affordability assessment:
Journey time improvements through small timetable improvements should be considered through the franchise specification process. The value of the implementation of line speed improvements will be assessed before the final document following more detailed analysis.

5.5 North London Line and Gospel Oak to Barking Line

5.5.1 The relevant conditional outputs considered by the Anglia Route Study are listed below.

Table 5.23: Control Period 6 North London Line and Gospel Oak to Barking Line conditional outputs

Conditional Output	Description
CLCO1	To provide sufficient capacity for passengers travelling across London during peak hours, taking into account anticipated growth over the period to the end of Control Period 6 (2023/2024) – North London Line and Gospel Oak to Barking
CLFCO1	As identified to meet CLCO1, to provide sufficient capacity freight paths across London to the end of Control Period 6 (2023/2024) – Cross-boundary

5.5.2 On the North London Line route, the route study's assessment is that extra capacity planned for CP5 (see Chapter 2) will be sufficient to accommodate the anticipated demand for the North London Line up to the end of CP6.

5.5.3 On the Gospel Oak to Barking route, the route study's assessment is that extra capacity planned for CP5 (see Chapter 2) will be sufficient to accommodate the anticipated demand for the Gospel Oak to Barking Line up to the end of CP6.

5.5.4 As a result (CLCO1) and (CLFCO1) will be met for the route up to the end of CP6 . Options for longer term capacity intervention are featured in Chapter 6.

5.5.5 For freight there is adequate capacity on this route to accommodate the forecast traffic to 2023

5.6 Essex Thameside

5.6.1 The relevant conditional outputs considered by the Anglia Route Study are listed below:

Table 5.24: Control Period 6 Essex Thameside conditional outputs

Conditional Outputs	Description
ETCO1	To provide sufficient capacity for passengers travelling into central London during peak hours, taking into account anticipated growth over the period to the end of CP6 (2023/2024) – Essex Thameside.
ETFCO1	To provide sufficient capacity for freight travelling from the London Gateway Port via the Tilbury loop, taking into account anticipated growth over the period to the end of CP6 (2023/2024) – Essex Thameside

5.6.2 The refranchising for Essex Thameside was undertaken in parallel with the Route Study development, therefore the proposed December 2015 timetable is not assumed as the baseline service specification.

5.6.3 Over and above the current capacity on trains into London Fenchurch Street there will be a need to provide capacity for approximately 4,700 passengers by 2023 between 08:00 and 09:00 and 2,200 passengers between 07:00 and 08:00. The services into London Fenchurch Street are split by 'outer services' that serve stations further from London and 'inner services' that tend to serve stations closer to London. Passengers on outer services will be travelling in crowded conditions for a long time, and the loss of welfare caused by crowding is worse than for passengers on inner services who are forced to stand for relatively short periods of time. Services are a mix of 8 carriages and 12 carriages in length. Lengthening six outer services from 8 carriages to 12 carriages in length will meet the capacity requirement and requires no further infrastructure work. Lengthening two of the inner services by four carriages will alleviate crowding but not meet the same crowding standard as for the outer services. A new franchisee has recently been put into place to serve this route, and some of this additional required capacity is expected to be delivered in CP5.

5.6.4 In order to meet the capacity requirements, passenger circulation at London Fenchurch Street Station is a growing concern, and options should be considered to provide more capacity for passengers using the station in peak times.

5.6.5 An assessment of the operational case for delivering extra capacity has been completed. Lengthening of six trains by 4 cars is required to deliver the required capacity in the peak into London Fenchurch Street on the outer services, three arriving between 07:00 and 08:00 and three arriving between 08:00 and 09:00.

5.6.6 Lengthening of two trains by 4 cars is also required to provide the required capacity by the end of CP6 on the inner services into London Fenchurch street.

5.6.7 There is a high value for money case to provide this additional capacity, this does not include the cost of providing additional capacity at London Fenchurch Street. Further detail of the appraisal of this option can be found in Appendix A.

5.6.8 There is adequate capacity to meet the forecast freight services for CP6 (ETFCO1).

5.7 Station capacity – all routes

Background

5.7.1 It is recognised that station capacity is an important factor to be considered as part of the Long Term Planning Process on the Anglia route. Stations form an integral part of a passenger's journey, and if sufficient capacity is not provided then not only can safety be compromised, but walk times and inconvenience can be increased owing to congestion. Providing sufficient space at stations is a crucial enabler to achieving higher frequency services, maintaining dwell times and running longer or higher capacity rolling stock.

5.7.2 Many of the rail stations on the Anglia Route date from Victorian times, and in terms of overall footprint and layout have not changed substantially for many decades. As a result of this and growth in the market, some stations on the Anglia Route are congested during peak hours, making movement through the station to and from the platforms slow and potentially difficult.

Objective

5.7.3 The overall objective of the exercise was to identify which stations on the Anglia route need to be assessed for potential future passenger capacity issues that will require some level of intervention during CP6 (up to 2024) and before 2043. The station capacity review covers safety concerns and passenger discomfort caused by overcrowding, as well as factors that cause delays to passenger journeys. Station maintenance e.g. outdated facilities, improvement to station façades, station ambience etc are generally not included under the station capacity umbrella. Whilst it may be beneficial to spend money on these, they are not taken into direct consideration in this review unless there is an opportunity to increase capacity as part of a 'Renewal', 'NSIP – National Station Improvement Programme' or 'AfA - Access for All' scheme for example.

5.7.4 In order to generate a station capacity base scenario a review of current station operations was undertaken across the route. A shortlist of stations was developed and agreed, following which a programme of site visits was undertaken to review station congestion first hand. This information was then used as a starting point to identify potential future capacity issues, based on forecast passenger demand and potential infrastructure and operational enhancements. High level station capacity enhancement opportunities were then identified, which will be analysed as part of a more detailed station capacity assessment if required.

5.7.5 This analysis is by no means a replacement for a full station capacity assessment. This exercise should be seen as an enabler for the second phase in which shortlisted stations will be assessed according to Network Rail's Station Capacity Assessment Guidance.

Station Selection

5.7.6 Due to the large number of stations on the Anglia Route it was not feasible to carry out capacity assessments involving passenger surveys, site visits etc for all stations. An overall station shortlist was generated by employing a two-stage methodology.

1. MOIRA data analysis
2. Train Operator consultation

5.7.7 An exercise was carried out using data from the industry's demand allocation tool – (MOIRA) to identify the stations with the highest boarding/alighting numbers for individual train services during peak times of the day. Station capacity analysis is predominantly based on the busiest 15 minute periods of the day, the heaviest train boarding and alighting loads. If a station has sufficient capacity to handle the busiest periods then this should be more than enough for all other times of day. For the purposes of this assessment a total boarding/alighting figure of 200 for the busiest train service at each particular station was selected. Stations with a lower maximum churn were discounted and a shortlist of those with a maximum churn greater than 200 was created.

5.7.8 Consultation was held with c2c, Abellio Greater Anglia and TfL in order to incorporate their first-hand knowledge gained from operating the stations on a day-to-day basis. Some station site visits were also undertaken.

5.7.9 The shortlists developed through these two different processes were then combined to create one overall list. Overlaps were identified between the two lists, with a high proportion of stations appearing on both.

5.7.10 The Route Study anticipates that some of the busiest stations on the Anglia route will be improved via planned or on-going station improvement projects, this includes the following:

Table 5.25: CP4/5 Interventions

Station	Scheme
Barking	Further development work being carried out as part of the Barking Riverside proposals. As part of their franchise bid c2c have agreed to make improvements to the operation of Barking station.
Finchley Road & Frognal	Existing ticket office removed and new enlarged space with extended gateline.
Hackney Central	Existing waiting room and booking hall to be removed to allow greater throughput. New gateline and new booking hall in existing car park.
Hackney Wick	Opening up of route through embankment to improve access.
West Hampstead	New high level concourse and footbridge.
Willesden Junction	Further development work being carried out as part of the QPR development.
Walthamstow Central	New entrance and gateline.
Chelmsford	NSIP works widened gateline and booking hall along with second entrance. Potentially AfA - bid submitted for access from new housing development to station.
Colchester	NSIP & Colchester subway enhancement, potential AfA.
Ipswich	NSIP scheme will improve passenger flows.
Billericay	NSIP, AfA to Platform 2.
Tottenham Hale	WAML capacity enhancement will provide additional platform, AfA proposal and a LU proposal to enhance booking hall.
Bishops Stortford	NSIP, widened gateline and enhanced booking hall.
Seven Sisters	AfA proposals to provide step free access, via installation of lifts behind subway to platforms 1 & 2, with connecting walkways.
Cheshunt	AfA proposals to provide 2 lifts onto existing footbridge, to reduce usage of level crossing.
Romford	To cater for predicted demand.
Ilford	To cater for predicted demand.
Forest Gate	To cater for predicted demand.
Harold Wood	To cater for predicted demand.
Brentwood	AfA proposal to provide step free access to all platforms, and to cater for predicted demand.
Grays	AfA proposals to provide new subway and lifts.
Dalston Kingsland	Proposal to increase the size of the booking hall and widen platforms.

5.7.11 As a result, the Anglia Route Study has not considered these stations for further investment during CP6. Should capacity at any of these stations not be addressed in CP5 by these projects or should the project not qualify for funding, then they will become a priority for investment during CP6, where they are not already.

5.7.12 The review has also highlighted a small number of stations that are recommended for interventions during CP5:

5.7.13 If the below stations do not receive investment during CP5, then they will become priorities for investment during CP6.

Table 5.26: CP5 Station Recommendations

Station	Issue	Possible intervention
Barking	Congestion on Platform 1.	Platforms need to be de-cluttered.
Blackhorse Road	Access to overground platforms is restricted by a narrow footbridge and narrow stairs that lead into the LU ticket hall but access to the ticket hall is also restricted by a narrow entrance	There are plans for an AfA scheme. The scheme should solve congestion issues too and therefore needs to contain a wider footbridge with wider stairs leading onto the platforms. In addition access to the LU ticket hall needs to be improved.
Canonbury	The entrance to the station is too small. There are only two standard gates and a wide aisle gate. There is a lot of queuing in the peaks. The Customer Information Systems (CIS) is also in the small ticket hall and there is the potential risk of blocking the gates while reading it.	Requirement to widen the booking hall including additional gates and relocation of CIS.
Dalston Kingsland	Potential congestion issue on staircases.	Staircase may need widening depending on level of capacity being provided as part of the current proposal.
Homerton	Access to the station is congested.	The station requires a second entrance.
Kensal Rise	Access to/ from westbound platform is congested. Access is via a ramp into the car park.	Current station access to car park requires improvement to provide sufficient capacity.
Brondesbury	Booking hall area is congested	Expansion and remodelling of booking hall is recommended.

5.7.14 Elsewhere on the Anglia Route, it is anticipated that investment will be required at a number of other stations to meet the relevant conditional output during during CP6.

5.7.16 The Route Study recommends that further development is taken forward to determine the level of investment required to provide the necessary station capacity.

Table 5.27: CP6 Station Recommendations

Station	Conditional Output	Possible intervention
Liverpool Street	GECO1	Increase capacity for passengers exiting/ entering platforms, vertical circulation from the concourse is also very constrained.
Fenchurch Street	ETCO1	Increase capacity for passengers exiting from all platforms to Tower Gateway exit so as to avoid restricting the passenger flow to the main concourse.
Limehouse	ETCO1	Potential increase in capacity for passengers exiting from all platforms required.
West Ham	ETCO1	Potential increase in capacity for passengers exiting the platforms and interchanging between National Rail and London Underground services required.
Seven Sisters	WACO1	Increase width of overground platforms and subway capacity for passengers interchanging and exiting at the station.

5.7.15 Other stations may require smaller interventions during CP6. These stations are:

Table 5.28: CP6 Station Recommendations (smaller interventions)

Station	Conditional Output	Possible intervention
Kentish Town West	N/A	Congestion on stairs - Wider stairs
Crouch Hill	N/A	Congestion on stairs - Wider stairs
Chafford Hundred	ETCO1	Congestion when exiting - Wider exit
Laindon	ETCO1	Congestion in front of gateline when exiting - Improvements to allow better access to gateline
Upminster	ETCO1	Congestion at access to platform 1 - Widening of entrance
Benfleet	ETCO1	Congestion when exiting on top of stairs - Improvements to vertical circulation.

06: Accommodating the Conditional Outputs in 2043

6.1 Introduction

6.1.1 This section of the Route Study highlights the longer term choices for funders that exist to meet the conditional outputs set out in the Market Studies up to 2043. In each case the approach has been to establish the long term challenges in meeting the conditional outputs and ensure that the Control Period 6 choices for funders set out in Chapter 5 are consistent with the potential longer term solutions set out in this Chapter.

6.1.2 In some cases there is no one intervention to meet the conditional output, and therefore the choices should be seen as the building blocks for accommodating the conditional outputs to 2043 in an affordable and deliverable way.

6.1.3 The conditional outputs required by 2043 can be broadly categorised as either (morning peak) capacity or (off-peak) connectivity. In the following sections this study will detail choices for funders that meet these capacity and connectivity conditional outputs; where appropriate, cost information will be supplied.

6.2 The capacity challenge in 2043

6.2.1 The London and South East Market Study identified conditional outputs to accommodate forecast growth during the morning peak hours (07:00 to 09:59 arrivals) into London on the Anglia Route. For the purposes of this study the high peak hour is defined as services arriving at the London Termini between 08:00 and 09:00.

6.2.2 Table 6.1 below is a summary of conditional outputs for the longer term options covered in this Chapter.

Table 6.1: Longer term conditional outputs	
Conditional Output	**Description**
GECO4	To provide sufficient capacity for passengers travelling into central London during peak hours, taking into account anticipated growth over the period to 2043 - Great Eastern Main Line services
GECO5	To provide sufficient capacity for cross-boundary (via Peterborough) and Cambridge passengers travelling to Norwich via Ely, taking into account anticipated growth over the period to 2043 – Cross-boundary services
F2NCO2	To provide sufficient capacity for freight travelling via the Felixstowe to Nuneaton route, taking into account anticipated growth over the period to 2043 – Cross-boundary services
WACO2	To provide sufficient capacity for passengers travelling into central London during peak hours, taking into account anticipated growth over the period to 2043 - West Anglia Main Line services via the Southbury Loop, Harlow Town & the Chingford branch.
WACO5	To provide sufficient capacity for passengers travelling to Stansted Airport all day, taking into account anticipated growth over the period to 2043
CLCO2	To provide sufficient capacity for passengers travelling across London during peak hours, taking into account anticipated growth over the period to 2043 - North London Line and Gospel Oak to Barking
CLFCO2	As identified to meet CLCO1, to provide sufficient capacity for freight across London – Cross-boundary
ETFCO2	To provide sufficient capacity for freight travelling from the London Gateway Port via the Tilbury loop and from HS1, taking into account anticipated growth over the period to 2043 - Essex Thameside
ETCO3	To provide sufficient capacity for passengers travelling into central London during peak hours, taking into account anticipated growth over the period to 2043 - Essex Thameside

6.3 Great Eastern Main Line and branches

6.3.1 The relevant conditional outputs considered by the Anglia Route Study are listed in Table 6.2 below.

Table 6.2: Longer term conditional outputs on the GEML

Conditional Output	Description
GECO4	To provide sufficient capacity for passengers travelling into central London during peak hours, taking into account anticipated growth over the period to 2043 - Great Eastern Main Line services
GECO5	To provide sufficient capacity for cross-boundary (via Peterborough) and Cambridge passengers travelling to Norwich via Ely, taking into account anticipated growth over the period to 2043 – Cross-boundary services
F2NCO2	To provide sufficient capacity for freight travelling via the Felixstowe to Nuneaton route, taking into account anticipated growth over the period to 2043 – Cross-boundary services

6.3.2 Up to 2043 there will be a capacity gap on services from Norwich and outer services serving Ipswich, Colchester and Chelmsford into London Liverpool Street of around 5,100 passengers over and above the capacity gap to 2023.

6.3.3 Up to 2043 on services from the Wickford route, there is expected to be a capacity gap of around 2,100 passengers, over and above the capacity provided in Control Period 5 (CP5, 2014-2019).

6.3.4 All services are assumed to be 12-car Electric Multiple Units or as 10-car loco-hauled stock. Lengthening to 16-car or beyond is expected to be prohibitively expensive because of the extent of remodelling required to achieve longer platform lengths and signalling constraints across the network. Increasing the frequency of services will cater for the additional capacity requirements. An additional service from Norwich, and two services starting from Ipswich or Colchester to meet the crowding issue on the busiest services. These additional main line services are above those specified in Chapter 5 to meet the CP6 capacity conditional outputs.

6.3.5 Up to 2043 on the Great Eastern Suburban and Crossrail routes, the introduction of Crossrail services is expected to meet the required capacity to around Control Period 8 (2029-2034) /CP9 (2034-2039). There is expected to be a capacity gap of around 2,000 passengers by the end of the control period 10. This could be met by lengthening of Crossrail services to 10-car (23m vehicles).

6.3.6 The forecast demand up to 2043 of 5 tph for freight and 7 tph passenger services passing through Haughley Junction is unable to be accommodated as part of the capacity interventions set out to meet the CP6 conditional outputs. Due to the speed differential between passenger and freight trains, further interventions above those listed are required at Haughley Junction to enable freight services to be passed by the faster passenger services to achieve the required number of trains. Therefore the requirement of four-tracking or grade separation at Haughley Jn would be necessary to meet the longer term demand.

6.3.7 The forecast demand up to 2043 of 5tph for freight and 9tph passenger services crossing Ely North Jn is unable to be accommodated as part of the capacity interventions set out to meet the CP6 conditional output. The speed differentials of a mix of both passenger and freight would require further interventions such as three to four tracking between Ely Station and Ely North Jn, grade separation at both Ely Dock Jn and Ely North Jn, and works at Ely Station to remove the constraints of crossing moves, platform usage and line utilisation.

6.3.8 All interventions assessed to meet the capacity required to 2043 build on the priorities for CP6 identified in Chapter 5. The following tables show how the infrastructure proposed delivers the capacity required to 2043.

Table 6.3: Infrastructure interventions to meet GEC04 & GEC03

Great Eastern Main Line Service Specification (GECO4 & GECO3	Platform capacity at London Liverpool Street	Signalling headway reduction between Chelmsford and London Liverpool Street	Passing loop at north of Witham	Passing loop at Haughley Junction	Doubling of Trowse Swing Bridge	Four tracking or grade separation at Haughley Junction
CP5 Baseline: 24tph into London Liverpool Street						
CP6 requirement: 27tph into London Liverpool Street	✓	✓	✓	✓	✓	
CP7 and beyond: 32tph into London Liverpool Street (alongside a 5tph cross country Freight forecast)	✓	✓	✓	✓	✓	✓

Table 6.4: Infrastructure interventions to meet GEC05

Peterborough/ Cambridge to Ipswich/ Norwich via Ely Service Specification(GEC05)	Doubling of Trowse swing bridge	Passing loop at Haughley Junction	Signalling headway reduction at Bury St Edmunds	Ely level crossings closures	Four tracking or grade separation at Haughley Junction	Ely area Improvements
CP5 Baseline: 3tph (1tph Nottingham to Norwich, 1tph Cambridge to Norwich, 1tph Ipswich to Cambridge)						
CP6 Forecast: 5tph(2tph Norwich to Cambridge, 1tph Ipswich to Cambridge, 1tph Ipswich to Ely, 1tph Nottingham to Norwich)	✓	✓	✓	✓		
CP7 and beyond Forecast: 7tph(1tph Norwich to Cambridge, 3tph Norwich via Ely to Peterborough/ cross-boundary, 2tph Ipswich to Cambridge, 1tph Ipswich via Ely to Peterborough/ cross-boundary)	✓	✓	✓	✓	✓	✓

Table 6.5: Infrastructure interventions to meet F2NC02						
Felixstowe to Nuneaton Service Specification (F2NCO2)	Felixstowe branch doubling	Passing loop at Haughley Junction	Signalling headway reduction at Bury St Edmunds	Ely level crossings closures	Four tracking or grade separation at Haughley Junction	Ely area improvements
CP5 Baseline: 48tpd						
CP6 Forecast: 60tpd	✓	✓	✓	✓		
CP7 and beyond Forecast: 90tpd	✓	✓	✓	✓	✓	✓

6.3.9 The following tables describe the options examined (beyond that needed in CP6) to meet conditional outputs up to 2043.

Table 6.6: Assessment of Option 16: Haughley Jn four tracking to meet conditional outputs GECO4, GECO5 and F2NCO2
Summary of intervention:
Four tracking between Ipswich and Haughley Junction would be necessary to provide sufficient capacity for the following service assumptions in each direction:
4tph Norwich, 4tph Freight, 1tph Ipswich to Cambridge, 1tph Ipswich to Peterborough, 1tph Ipswich to Liverpool Lime Street
Output assessment:
Current speed differential issues (combined with achieving GECO3 faster journeys from Norwich to London) between passenger and freight result in insufficient capacity for both Felixstowe to Nuneaton freight and passenger conditional outputs.
The challenge is achieving conflicting movements between the key freight flow (Felixstowe to Ely direction) and passenger flows from Norwich at Haughley Jn. To achieve the level of service for 2043 a portion of four tracking (or grade separation as detailed in Option 17) will be required on the approach to Haughley Jn to allow for the segregation of flows. This achieves conditional output F2NCO2 when implemented with Option 9 and 11 detailed in Chapter 5.

Table 6.7: Assessment of Option 17: Haughley Jn grade separation to meet conditional outputs GECO4, GECO5 and F2NCO2
Summary of intervention: Grade separation at Haughley Jn would be necessary to provide sufficient capacity for the following service assumptions in each direction: 4tph Norwich to/from London, 4tph Freight, 1tph Ipswich to/from Cambridge, 1tph Ipswich to/from Peterborough, 1tph Ipswich to/from Liverpool Lime Street.
Output assessment: Current speed differential issues between passenger and freight result in insufficient capacity for both Felixstowe to Nuneaton freight and passenger conditional outputs. Haughley Junction is where freight flows to and from Felixstowe need to cross passenger services on the main line between Norwich and London. Both service flows are forecast to grow and running additional services results in the need to grade separate the junction (or partial four tracking as detailed in Option 16) to remove the flat junction movement. This achieves conditional output F2NCO2 when implemented with Option 9 and 11 detailed in Chapter 5.

Table 6.8: Assessment of Option 32: Ely area improvements to meet conditional outputs GECO5 and F2NCO2

Summary of intervention:

The Ely area is considered operationally to be at capacity by the end of CP6. Conditional outputs from 2024 through to 2043 require the testing of a further growth scenario for passenger and freight services through the Ely area to Felixstowe, Cambridge, Norwich, Peterborough and beyond.

These flows introduce four primary constraints into the area:

- crossing moves at Ely North Jn
- crossing moves at Ely Dock Jn
- platform utilisation at Ely (especially if splitting/joining of trains is required)
- line utilisation Ely to Ely North Jn.

It is considered that the following interventions would be required to remove these constraints:

- Ely 3 / 4 tracking between Ely Station and Ely North Jn
- Ely platform works
- Ely North Jn Grade Separation
- Ely Dock Jn Grade Separation.

Previous work undertaken has highlighted the significant difficulties in achieving the above interventions in this area, some examples of which are:

- additional span on Stuntney Bridge Road under bridge
- additional double-track span on Cutter Bridge over Great Ouse, consent required from East Anglia Navigation authority
- hydrology issues with new bridges—drainage and scour
- land take
- embankment widening

Output assessment:

In order to accommodate all 2043 outputs with performance robustness, either Option 32 or 33 would be required. This would meet conditional outputs GECO5 and F2NCO2 alongside options 11 and 19 detailed in Chapter 5.

Ely North Junction and Ely Dock Junction grade separations are primarily driven by Felixstowe to Nuneaton freight traffic and their interaction with passenger services. Ely Platform works and 3 / 4 tracking between Ely Station and Ely North Junction are primarily driven by passenger aspirations for additional services from Peterborough (and beyond) and the split/join requirements at Ely.

Some infrastructure investment would be avoided by only partly meeting aspirations. Interventions would be necessary when demand requirements are triggered, which would allow for an incremental build.

Table 6.9: Assessment of Option 33: Ely Avoiding Line to meet conditional outputs WAC06, F2NCO1 and F2NCO2
Summary of intervention: The Ely area is considered operationally at capacity with the requirements of end CP6. Conditional outputs from 2024 through to 2043 require the testing of a higher traffic scenario. The first element being passenger routes through the Ely area from Peterborough and beyond to both Cambridge and Norwich. The second being the continued freight growth via the Felixstowe to Nuneaton route. These flows introduce four primary constraints into the area: • crossing moves Ely North Jn • crossing moves Ely Dock Jn • platform utilisation Ely (split/join location for the region) • line utilisation Ely to Ely North Jn. It is considered that the following intervention in place of option 32, would also relieve these constraints. An option has been assessed which considers the installation of a new railway link on the west side of Ely. This would remove the interaction between freight and passenger services in the Ely area and therefore reduce the required infrastructure work at junctions, level crossings and platforms as defined in Option 32.
Output assessment: In order to accommodate all 2043 outputs with performance robustness either Option 32 or 33 would be required. With this option for the long term rather than Option 32 no additional works Ely to Ely North Jn would be required beyond Ely North Jn doubling. This will meet conditional outputs F2NCO1 and F2NCO2 along side options 11 and 19 as specified in Chapter 5. The Felixstowe to Nuneaton CP5 scheme to reduce freight headway between Ely and Ely North Jn would be unnecessary and dependent on passenger aspirations level crossing works at the Queen Adelaide and Kiln Lane crossings could be avoided.

Great Eastern Main Line and branches: Conclusions

6.3.10 The high cost of infrastructure to meet the 2043 as opposed to the end CP6 specification is predominately driven by connectivity driven cross-boundary services and freight growth from Felixstowe over and above the 48 paths per day CP6 specification.

6.3.11 The value of connectivity driven cross-boundary services will need to be assessed to understand whether they provide sufficient revenue or wider economic benefit to make the case for large scale infrastructure investment at Haughley Jn and Ely.

6.3.12 The scale of the infrastructure interventions presented in this section are unlikely to present value for money solutions due to their size and complexity.

6.3.13 It is recommended that any investment beyond CP6 should be reviewed alongside emerging freight growth figures, and the output of cross-boundary analysis on connectivity services between route studies. This should also take account of the latest developments of schemes such as East West Rail.

6.4 West Anglia Main Line and branches: Capacity Conditional Outputs

6.4.1 The relevant conditional outputs considered by the Anglia Route Study are listed in Table 6.10 below.

Table 6.10: Longer term conditional outputs on the WAML

Conditional Output	Description
WACO2	To provide sufficient capacity for passengers travelling into central London during peak hours, taking into account anticipated growth over the period to 2043 - West Anglia Main Line services via Southbury Loop, Harlow Town & Chingford Branch.
WACO5	To provide sufficient capacity for passengers travelling to Stansted Airport all day, taking into account anticipated growth over the period to 2043
F2NCO3	To provide sufficient capacity for freight travelling via Ely on to the Felixstowe to Nuneaton route, taking into account anticipated growth over the period to 2043 – Cross-boundary services

6.4.2 There is expected to be a capacity gap on services from Stansted Airport and Cambridge and on suburban services arriving into London Liverpool Street between 08:00 and 09:00 by 2043. The shortfall is approximately 1,500 passengers on the Cambridge and Stansted Airport services and 2,500 passengers on the suburban services over and above the capacity gap to 2023.

6.4.3 On services from Enfield Town to London Liverpool Street, and from Chingford to London Liverpool Street, the introduction of high density rolling stock planned by Transport for London when they take over the responsibility for these services in 2015 is expected to cater for the forecast demand up to 2043.

6.4.4 On the route via Tottenham Hale, services from Hertford East to Liverpool Street are expected to be over capacity and require the lengthening of all services in the peak hour into Liverpool Street between 08:00 and 09:00 from 8 carriages to 12 carriages. Choosing not to lengthen the services would mean passengers are travelling in increasingly crowded conditions and would impact negatively on passenger satisfaction.

6.4.5 The above interventions would meet demand growth to 2043 as the forecasts currently stand.

6.4.6 Significant housing growth above that forecast as part of the Market Studies could take place along the West Anglia Main Line. In part this could be contingent on greater investment in the route. With this possibility in mind, options for further capacity enhancements to cater for additional services and providing significant journey time improvement for services from Cambridge and Stansted Airport are included within this chapter.

6.4.7 In order to provide capacity over and beyond the forecast demand up to 2043 taking into account stakeholder feedback on demand numbers, the following options for infrastructure interventions should be considered:

- four tracking of the West Anglia Main Line
- doubling of Stansted Tunnel.

Interventions to meet the forecast demand at Ely are discussed under the Great Eastern Main Line in Section 6.3.

6.4.8 Network Rail is currently working closely with Transport for London on the development and feasibility of Crossrail 2. The project would connect South West London with North London via a new tunnel. The northern section of the project is proposed to connect to both the East Coast Main Line (by interchanging at New Southgate) and West Anglia Main Line. The project is still being developed therefore the exact locations of the tunnel, portals and final origin and destinations of service is as yet unknown. The West Anglia connection is likely to be in the Tottenham area and allow for services from the West Anglia route to connect to both central

London and South West London via the new tunnel, providing direct connectivity to Euston, St Pancras and the West End.

6.4.9 The Route Study has examined a conventional four-tracking option on the West Anglia Main Line and a Crossrail 2 four tracking option. Both options would support delivery of the capacity conditional outputs to 2043, though as noted below the four tracking only option is particularly challenging south of Tottenham and has limited outputs. The Crossrail 2 option also supports delivery of improved cross London connectivity and supports an increased train frequency with the aim to achieve a minimum of 4tph at all stations on the Crossrail 2 route. The increase in train frequency allowed by the Crossrail 2 option would support the potential growth on this corridor- over and above the current demand forecast.

6.4.10 Without a Crossrail 2 connection to central London the capacity at both Liverpool Street and Stratford will constrain the number of additional services which any 'four-tracking only project' can deliver. The feasibility of four tracking the route south of Tottenham through to Bethnal Green is very challenging due to the structures and high density population of surrounding areas.

6.4.11 In Chapter 5 it is recommended that work starts on enabling workstreams for four tracking such as land take and level crossing closures within CP6. The Route Study recognises that the demand forecasting methodology used does not fully reflect potential housing growth projections in the Upper Lea Valley and outside London, and the wider impacts on economic growth that improved services to Stansted Airport and Cambridge could have. Prior to publication of the final Route Study, more detailed work with stakeholders will be undertaken to better understand the benefits that early four-tracking of the Lea Valley could bring. This work will examine incrementally increasing the train service to both Liverpool Street and Stratford to understand whether early infrastructure work can be undertaken prior to the full four tracking or Crossrail 2 scheme to support improved frequencies and journey time on the route. This will need to be aligned with the long term footprint required for Crossrail 2 to limit any abortive work and informed by a clear statement of the number of paths that could be released by such a scheme in isolation.

6.4.12 The following tables describe the further infrastructure beyond train lengthening that would exceed the conditional outputs up to 2043, by allowing for the potential for greater housing growth on the route.

Table 6.11: Assessment of Option 29: Four Tracking of the West Anglia Main Line to exceed conditional outputs WACO2 and WACO5

Summary of intervention:

This option provides improved connectivity along the Lea Valley and improved journey times for faster services such as services from Cambridge and Stansted Airport. This requires additional tracks from Broxbourne Jn through to Bethnal Green along with passing loops between Cambridge and Stansted Airport to enable segregation of fast and slow services.

This option also requires additional platforms at stations between Cheshunt and Tottenham Hale along the Lea Valley Line.

Output assessment:

The provision of four tracks between Broxbourne and Bethnal Green would allow for segregation of services calling at stations between Cheshunt and Tottenham Hale with faster non-stop services.

This would allow journey time improvements to be realised for Cambridge, Hertford East and Stansted Airport services and an improved frequency of calls at the stations south of Cheshunt on the Lea Valley.

The station capacity at Liverpool Street and Stratford will still constrain the number of services that can be operated to/from West Anglia.

Table 6.12: Assessment of Option 30: Four-tracking of the West Anglia Main Line with a Crossrail 2 type scenario to meet cross London connectivity – condition output WACO4
Summary of intervention: This option provides improved connectivity along the Lea Valley through the introduction of services from Lea Valley to central and south west London. Four tracking is required to allow for the level of service to/from Crossrail 2 alongside faster services to Cambridge and Stansted Airport for example; although it is not proposed that Crossrail 2 is extended to Stansted. The additional tracks would be required between Broxbourne Junction and the Tottenham Area to the location of a tunnel portal. This has the potential to free up capacity at London Liverpool Street to provide additional services on this route; but will depend on the number of services diverted to the portal to provide cross-London connectivity. This would also require lengthening of existing and provision of additional platforms at stations located on the Hertford East Branch and additional platforms at stations between Cheshunt and Tottenham Hale along the Lea Valley Line, as well as turnback facilities and additional stabling.
Output assessment: Improved cross-London connectivity is achieved. The service pattern can remain unchanged; alternatively the additional infrastructure will provide flexibility for routeing and additional services beyond the requirements for conditional outputs for 2043 meeting conditional outputs WACO1, WACO2 and WACO3. Journey time improvements are able to be realised owing to the segregation of fast and slow services meeting conditional output WACO2.

Table 6.13: Assessment of Option 31: Airport demand to meet conditional output WACO5
Summary of intervention: Current feasible capacity of the single line to Stansted Airport is 6tph. Doubling of the Stansted Airport line is required to achieve greater connectivity above the 6 tph.
Output assessment: Best use of current infrastructure limits access to Stansted Airport to 6 tph due to the single line section. Double tracking removes this constraint allowing additional paths into Stansted Airport, therefore meeting conditional output WACO5. Capacity beyond 8tph would require additional platforms at Stansted Airport.

West Anglia Main Line and branches: Conclusions

6.4.13 Analysis based on the growth forecasts from the Market Studies shows that lengthening of services on the route will support capacity on the route to 2043.

6.4.14 The Route Study recognises that the demand forecasting methodology used does not fully reflect potential housing growth projections in the Upper Lea Valley, and the wider impacts on economic growth that improved services to Stansted Airport and Cambridge could have.

6.4.15 Prior to publication of the final Route Study, more detailed work with stakeholders will be undertaken to better understand the benefits and potential funding sources in relation to any early four-tracking to the Lea Valley. This will need to be aligned with the long term footprint required for Crossrail 2 to limit any abortive work.

6.5 North London Line (including Gospel Oak to Barking): Capacity Conditional Outputs

6.5.1 The relevant capacity conditional outputs considered by the Anglia Route Study are listed in Table 6.14 below.

Table 6.14: Longer term conditional outputs on the North London Line (including Gospel Oak to Barking)

Conditional Output Reference	Conditional Output
CLCO2	To provide sufficient capacity for passengers travelling across London during peak hours, taking into account anticipated growth over the period to 2043 - North London Line and Gospel Oak to Barking
CLFCO2	As identified to meet CLCO1, to provide sufficient capacity for freight paths across London – Cross-boundary

6.5.2 On the North London Line route, there is expected to be a gap in capacity on the North London line to 2043 of around 1,800 - 2,000 passengers, or the equivalent of three to four extra 5-car trains.

6.5.3 On the Gospel Oak to Barking Line route, the proposals for electrification and longer services planned for CP5, are expected to provide capacity towards the 2043 target demand.

6.5.4 Freight Growth particularly from Thames Gateway Port will drive the need for more paths on the Gospel Oak to Barking line up to 2043. Up to five freight paths an hour are required by 2043 which will be very challenging to deliver alongside the passenger services.

6.5.5 One of the key challenges for both the North London Line and Gospel Oak to Barking line is continuing to support growth for both passenger and freight services whilst maintaining performance. Options have been developed for this route to support any increase in passenger or freight services on the route and to maintain adequate performance levels.

6.5.6 In order to provide sufficient capacity and maintain performance for the forecast demand up to 2043 the following options for infrastructure interventions should be considered:

- signalling headway reduction on North London Line
- signalling headway reduction between Gospel Oak and Barking
- additional platforms at either Gospel Oak or Barking (or adequate provision at Barking Riverside if this scheme comes to fruition)
- freight regulation point at Gospel Oak
- freight regulation point at Kensal Rise
- train Lengthening on the North London Line to 8-car (please also refer to the South East Route: Sussex Area Route Study, which discusses the need for 8-car trains on the West London Line).

6.5.7 The following tables describe the infrastructure options required to meet conditional outputs up to 2043.

Table 6.15: Assessment of Option 36: Increase in passenger services on North London Line to meet conditional outputs CLCO2 and CLFCO2
Current capability of the signalling limits the North London Line to 12tph. The Hampstead Heath tunnel area is the most constrained. To prevent trains coming to a stand at a red signal inside Hampstead Heath tunnel, a 'double block' control system is applied. This effectively increases headways through the tunnel itself, and across, the whole of the North London Line. Removing the control could reduce headways by up to 1½ minutes. To meet conditional output CLCO2 and CLFCO2, 16tph are required. A planning headway of 3 minutes will allow for both conditional outputs to be met. A step change approach would be to address the Hampstead Heath tunnel area initially as discussed above through modification of the tunnel controls.

Table 6.16: Assessment of Option 37: Increase in passenger services between Gospel Oak and Barking to meet conditional outputs CLCO2 and CLFCO2
To provide a robust service level consisting of 6tph passenger 4tph freight along the whole route would require a reduction in signalling headways, and potentially an additional platform at either Gospel Oak or Barking station. If the proposed extension of the Gospel Oak to Barking line to Barking Riverside is implemented, additional platform(s) would not be necessary unless the additional services are to terminate at Barking Station. Current capability of the signalling limits the Gospel Oak to Barking Line to 8tph. Barking to Leyton Midland Road requires the most utilisation due to passenger and Thames Gateway freight to both the Great Eastern Main Line (via Forest Gate Junction) and the Gospel Oak to Barking Line. To meet conditional outputs CLCO2 and CLFCO2, 12tph are required on the Gospel Oak to Barking Line and 13tph Barking to Leyton Midland Road. A planning headway of 3 minutes will allow for both conditional outputs to be met.

Table 6.17: Assessment of Option 38: Freight Regulation on the Gospel Oak to Barking Line to meet conditional outputs CLCO2 and CLFCO2
A third track at Gospel Oak would help to regulate freight services and provide robust capacity for the following service forecast: 6 tph Passenger 4tph Freight with even service pattern. Current timetabling of the Gospel Oak to Barking Line allows for multiple standard paths per hour for freight, although current utilisation is low-medium as Thames Gateway is not yet operating at full capacity. Path uptake is anticipated to increase significantly from CP5 onwards. In order to allow for high utilisation of paths on both the Gospel Oak to Barking Line and North London Line without serious performance implications freight regulation points will be required. This intervention is relevant to an increase in passenger traffic on the North London Line as well as on the Gospel Oak – Barking route as increases in passenger services heading to/from Camden Road through Gospel Oak will lead to more instances of freights being held awaiting a path onto the North London Line. Location of a regulation point at Gospel Oak will allow freight services waiting their path onto the North London Line to be held without trailing back over the Barking – Gospel Oak platform connection, therefore reducing the risk of knock on delays to that service group. This would improve performance robustness for conditional outputs CLCO2 and CLFCO2.

Table 6.18: Assessment of Option 39: Freight Regulation on the North London Line to meet conditional outputs CLCO2 and CLFCO2
The South East Route: Sussex Area Route Study assesses the likely infrastructure requirements, such as an additional platform at Clapham, for the increase in service frequency on the West London Line. The South East Route: Sussex Area Route Study sets out some possible options for the North London Line to support the requirement for 8-car services from the West London Line to meet the capacity gap; options include providing an 8 car turnback between Willesden Junction and Kensal Rise to allow for the termination of West London Line Services or platform lengthening on the North London Line to allow for the continuation of 8-car services from the West London Line on to the North London Line. This option examines a third track at Kensal Rise to support both the regulation of freight services at Kensal Green Junction and a turnback facility for the WLL service. Current timetabling of the North London Line allows for multiple standard paths per hour for freight, although current utilisation is low-medium as Thames Gateway is not yet operating at full capacity. Path uptake is anticipated to increase significantly from CP5 onwards. In order to allow for high utilisation of paths on both the Gospel Oak to Barking Line and North London Line without serious performance implications freight regulation points will be required. Location of regulation points by Kensal Rise will allow for services to be held on the North London Line in order to await an appropriate path on to the West Coast Main Line and onwards running on the North London Line, therefore allowing for mitigation of performance issues. This would improve performance robustness for conditional outputs CLCO2 and CLFCO2

Table 6.19: Assessment of Option 40: Train lengthening on the North London Line to meet conditional output CLCO2
There is expected to be a gap in capacity on the North London line of around 1,800 - 2,000 passengers, or the equivalent of three to four extra 5-car trains. An alternative to additional train paths (referred to in option 36), is to lengthen services to 8-car. The South East Route: Sussex Area Route Study assesses the likely infrastructure requirements, such as an additional platform at Clapham for the increase in service frequency. The South East Route: Sussex Area Route Study sets out some possible options for the North London Line to support the requirement for 8-car services from the West London Line to meet the capacity gap; options include providing an 8-car turnback between Willesden Junction and Kensal Rise to allow for the termination of West London Line Services, or platform lengthening on the North London Line to allow for the continuation of 8-car services from the West London Line on to the North London Line. Option 39 has the potential to provide both a regulating point and turnback facility.

North London Line (including Gospel Oak to Barking): Conclusions

6.5.8 In order to provide sufficient capacity and maintain performance for the forecast demand for both passenger and freight up to 2043 there are a number of infrastructure options that have been developed for this route.

6.5.9 It is recommended that headway reductions and provision of regulation points are considered as a priority to support capacity and performance on this route.

6.6 Essex Thameside

6.6.1 The relevant capacity conditional outputs considered by the Anglia Route Study are listed in Table 6.21 below.

Table 6.20: Longer term conditional outputs on Essex Thameside

Conditional Output	Description
ETFCO2	To provide sufficient capacity for freight travelling from the London Gateway Port via the Tilbury loop and from HS1, taking into account anticipated growth over the period to 2043 - Essex Thameside
ETCO2	To provide sufficient capacity for passengers travelling into central London during peak hours, taking into account anticipated growth over the period to 2043 - Essex Thameside

6.6.2 Assuming a crowding standard of 0.45 m^2 per passenger and that an average load factor to total capacity of 85 per cent will result in a reasonable level of crowding over all peak hour services, then there will be a need to provide further capacity for approximately 4,700 passengers by 2023 and 11,000 by 2043 in the peak hour into London Fenchurch Street. There will also be a capacity gap in the first shoulder peak hour. The capacity gap in both hours can be met through lengthening of trains to 2023.

6.6.3 The services into London Fenchurch Street are split by 'outer services' that serve stations further from London and 'inner services' that tend to serve stations closer to London. Passengers on outer services will be travelling in crowded conditions for a long time, and the loss of welfare caused by crowding is worse than for passengers on inner services who are forced to stand for relatively short periods of time. This is evidence that a lower crowding standard could be appropriate for inner services. Assuming 0.25 m^2 per passenger reduces the capacity gap to 2,000 by 2023 and to 6,400 by 2043 in the peak hour with some crowding between 07:00 and 07:59.

6.6.4 The refranchising for Essex Thameside was undertaken in parallel with the Route Study development, therefore the proposed December 2015 timetable is not assumed as the baseline service specification.

6.6.5 Options have been developed for lengthening services to 12 car to meet the capacity required to 2043. This assumes the lower crowding standard of 0.25m^2 for inner services.

6.6.6 For freight, there is adequate capacity to meet conditional output ETFCO2, to provide sufficient capacity for freight paths across London up to 2043.

Table 6.21: Assessment of Option 41: Forest Gate Grade Separation to meet conditional output ETFCO2

To meet conditional output ETFCO2, 2tph are required to cross from Woodgrange Park to the GEML in order to access Stratford and the North London Line. In order to make this move freight services must cross the GE Electric Lines with high intensity Crossrail services and have an appropriate path on the GE Main Lines. Due to service levels in the region an option would be to remove the conflict by providing complete separation of services.

Grade separation would also allow for future growth of passenger services.

Table 6.22: Assessment of Option 42: Train lengthening to 12-car to meet conditional output ETCO2
Summary of intervention:
No infrastructure intervention above those identified in Chapter 5 (Fenchurch Street Station Passenger Congestion) the only requirement would be for the provision of additional rolling stock to facilitate the lengthening of the remaining 8-car services to 12-car.

Essex Thameside: Conclusions

6.6.7 Analysis based on the growth forecasts from the Market Studies shows that lengthening of services on the route will support capacity on the route to 2043.

6.6.8 Grade separation of Forest Gate Jn is unlikely to present value for money solution due to its size and complexity. It is recommended that any investment in this area is reviewed alongside emerging freight growth figures from London Gateway.

6.7 The connectivity challenge in 2043

6.7.1 The London and South East Market Study identified conditional outputs to improve the level of rail connectivity between large towns and cities across the country (by for example, the frequency of train services, shorter journey times, and the provision of direct journeys which do not require an interchange). These outputs were developed as target frequencies and in each case are subject to value for money analysis.

6.7.2 Table 6.23 below is a summary of conditional outputs for the longer term options covered in this Chapter.

Table 6.23: Longer term conditional outputs

Conditional Output Reference	Conditional Output
GECO6	Increase in passenger service frequency between Norwich and Sheringham to 2tph
GECO7	Increase in passenger service frequency between Great Yarmouth and Norwich (via Acle) to 2tph
GECO8	Increase in passenger service frequency between Lowestoft and Norwich to 2tph
GECO9	Increase in passenger service frequency between Lowestoft and Ipswich to 2tph
GECO10	Increase in passenger service frequency between Felixstowe and Ipswich to 2tph
GECO11	Increase in passenger service frequency between Harwich Town and Manningtree to 2tph
GECO12	Increase in passenger service frequency between Walton-on-the-Naze and Colchester to 2tph
GECO13	Increase in passenger service frequency between Clacton and Colchester to 2tph
GECO14	Increase in passenger service frequency between Sudbury and Marks Tey to 2tph
GECO15	Increase in passenger service frequency between Braintree and Witham to 2tph
GECO16	Increase in passenger service frequency between Southminster and Wickford to 2tph
WACO4	Improve cross London connectivity, connecting South West and North East London
WACO6	Increase in passenger service frequency between Kings Lynn and Cambridge to 2tph
WACO7	Increase in passenger service frequency between Ipswich and Cambridge to 2tph

6.7.3 The options to address connectivity have been assessed to understand whether the existing infrastructure can support the conditional outputs. This has been assessed through development of a 2043 indicative service specification to achieve a minimum of 2tph on branch lines[4].

6.7.4 The following section details the options which have been examined. No appraisals have been undertaken for these options.

6.7.5 Where additional services can be achieved on the existing infrastructure, there will be an operational cost to run this service, and the value for money of this should be considered though the franchise process.

6.7.6 Where additional infrastructure is required to meet these connectivity conditional outputs, it is very unlikely that there will be a positive business case for these options and therefore are not deemed value for money as standalone schemes.

4 No connectivity conditional outputs were presented in the Market Studies for North London Line, Gospel Oak to Barking line and Essex Thameside

Great Eastern Main Line: Connectivity Conditional Outputs

Table 6.24: Assessment of Option 18: Increase in passenger service frequency between Norwich and Sheringham to meet conditional output GECO6
To provide up to 2tph allowing for a half hourly pattern between Cromer/Sheringham and Norwich would require doubling of the line at either Cromer or between Walsham and Gunton, along with an additional platform at Norwich.

Table 6.25: Assessment of Option 19: Increase in passenger service frequency between Great Yarmouth and Norwich (via Acle) to meet conditional output GECO7
To provide up to 2tph allowing for a half hourly pattern between Great Yarmouth and Norwich (via Acle) would require further doubling of the line between Great Yarmouth and Brundall Junction along with an additional platform at Norwich.

Table 6.26: Assessment of Option 20: Increase in passenger service frequency between Lowestoft and Norwich to meet conditional output GECO8
No track infrastructure intervention would be needed to provide up to 2tph allowing for a half hourly pattern between Lowestoft and Norwich. Platforming at Norwich would be fixed, allowing less flexibility, therefore an additional platform at Norwich would be recommended.

Table 6.27: Assessment of Option 21: Increase in passenger service frequency between Lowestoft and Ipswich to meet conditional output GECO9
Summary of intervention: To provide up to 2tph allowing for a half hourly pattern between Lowestoft and Ipswich would require full doubling of the single track sections or additional looping facilities south of Wickham Market, south of Saxmundham, north of Halesworth, midway between Brampton & Beccles and south of Oulton Broad South. Additional platforms at Ipswich would be required to enable the increase in service frequency. The Sizewell C power station project with Network Rail is carrying out feasibility works to provide an extension/loop between Woodbridge and Saxmundham to provide sufficient capacity for freight traffic during the construction of Sizewell C. The proposed infrastructure would support the requirements for increasing the passenger service.

Table 6.28: Assessment of Option 22: Increase in passenger service frequency between Felixstowe and Ipswich to meet conditional output GECO10
The infrastructure highlighted in option 5 of Chapter 5 (further doubling of the Felixstowe branch line), will also provide sufficient capacity to provide up to 2tph allowing for a half hourly pattern between Felixstowe and Ipswich.

Table 6.29: Assessment of Option 23: Increase in passenger service frequency between Harwich Town and Manningtree to meet conditional output GECO11
No infrastructure intervention is needed to provide up to 2tph allowing for a half hourly pattern between Harwich Town to Manningtree.

Table 6.30: Assessment of Option 24: Increase in passenger service frequency between Walton-on-the-Naze and Colchester to meet conditional output GECO12
No infrastructure intervention is needed to provide up to 2tph allowing for a half hourly pattern between Walton-on-the-Naze and Colchester/Colchester Town..

Table 6.31: Assessment of Option 25: Increase in passenger service frequency between Clacton and Colchester to meet conditional output GECO13
No infrastructure intervention is needed to provide up to 2tph allowing for a half hourly pattern between Clacton and Colchester/ Colchester Town.

Table 6.32: Assessment of Option 26: Increase in passenger service frequency between Sudbury and Marks Tey to meet conditional output GECO14
To provide up to 2tph allowing for a half hourly pattern between Sudbury and Marks Tey would require looping facilities between Bures and Chappel & Wakes Colne.

Table 6.33: Assessment of Option 27: Increase in passenger service frequency between Braintree and Witham to meet conditional output GECO15
To provide up to 2tph allowing for a half hourly pattern between Braintree and Witham would require looping facilities between Cressing and White Notley.

Table 6.34: Assessment of Option 28: Increase in passenger service frequency between Southminster and Wickford to meet conditional output GECO16
To provide up to 2tph allowing for a half hourly pattern between Southminster and Wickford would require an extra platform at Southminster to deliver one fast (calling at Southminster, Fambridge, Wickford) and one slow (all stations) service. In order to provide for 2tph calling at all stations, additional 12-car capable looping facilities would be required between Fambridge and Southminster, and between Fambridge and Wickford.

West Anglia Main Line: Connectivity Conditional Outputs

See Section 6.4 for WACO4 where the option for Crossrail 2 would improve cross London connectivity.

Table 6.35: Assessment of Option 34: Increase in passenger service frequency between Kings Lynn and Cambridge to meet conditional output WACO6
To provide a regular half hourly passenger service to Kings Lynn alongside the freight requirement, the single line between Littleport and Downham Market or Watlington and Kings Lynn would require doubling. Previous studies have been undertaken on this option and a half hourly passenger service would require the CP5 baseline infrastructure at Ely North Junction along with level crossing works

Table 6.36: Assessment of Option 35: Increase in passenger service frequency between Ipswich and Cambridge to meet conditional output WACO7
To provide a half-hourly service frequency from Ipswich to Cambridge, without triggering the need for additional infrastructure, a line speed increase to 75mph would be necessary, allowing trains to pass at Dullingham.

07: Consultation and Next Steps

7.1 Introduction

7.1.1 This section of the document sets out how the Anglia Route Study has been managed, how stakeholders have been consulted to date, and how interested parties can respond to this Draft for Consultation.

7.2 Management and consultation process

7.2.1 Network Rail has taken an open and consultative approach to the development of the Long Term Planning Process. The process is a new way of planning the future of the rail network, and the Anglia Route Study is a key part of the new process. Development of the Route Studies follows publications of the four market studies at the end of 2013 which set out the direction of travel for demand on the rail network in Great Britain over the next 30 years. The suite of Route Studies is a key next step in the process to develop the case for investment in the rail network in Control Period 6 and beyond.

7.2.2 Close involvement of a wide range of stakeholders from within and outside the industry has meant that the work has been subject to comment and guidance to ensure that as options have been developed, they have been challenged. However, we welcome comment on this document from any interested party who may wish to respond.

7.3 Stakeholder groups

7.3.1 The Long Term Planning Process is driven by four key groups:

- Rail Industry Planning Group
- Industry Board Groups, established as appropriate, for the Anglia Route Study
- Industry Working Groups
- 'Regional' Groups.

7.3.2 These groups have been complemented by one to one discussions with individual members of the above groups, with other interested parties and individuals, as required, during the development of this Route Study.

7.3.3 However, formal comment on this document is welcomed from any interested party who may wish to respond, whether or not they have been involved in the work to date. The Anglia Route Study Working Group will take into account responses in developing the final Anglia Route Study documentation.

7.4 How you can contribute

7.4.1 A wide range of views will help to develop and take forward the process through to completion of the Anglia Route Study. If you wish to respond to any of the ideas and interventions set out within this Draft for Consultation document, please e-mail your comments to the following e-mail address:

AngliaRouteStudy@networkrail.co.uk

Or by post to the address below:

Anglia Route Study Consultation
Network Rail (Group Strategy)
2nd Floor
Cottons Centre
Cottons Lane
London
SE1 2QG

7.4.2 This Route Study is only being published on the Network Rail website. If you would like a printed copy please contact the address above.

7.4.3 Respondents should indicate clearly if they wish all or part of their response to remain confidential. Otherwise, it is expected that the responses will be published on the Network Rail website and may be quoted in future. Where a response is made in confidence, it should be accompanied by a copy excluding the confidential information that can be treated as above. The names of respondents may be published in future documents or on the website, unless a respondent indicates that they wish their name to be withheld.

7.4.4 The Anglia Route Study will have a formal consultation period of 90 days, and the deadline for receiving responses is the 3rd February 2015. Earlier responses would be very much appreciated in order to maximise the time available for considering them.

7.4.5 After the conclusion of the formal consultation phase, the Anglia Route Study Working Group will consider further work that may be required to conclude the study, prior to publication of the final document in the summer of 2015.

7.4.6 Further details of the Long Term Planning Process, including an overview of the work, frequently asked questions and contact details for preceding work, including Market Studies, and other Route Studies can be found on the Network Rail website, via the following link: http://www.networkrail.co.uk/ltpp.

08: Appendix A: Appraisal Tables

8.1 Appraisal tables

8.1.1 The choices identified for the next Control Period (CP6, commencing April 2019) have been categorised from a financial and socio-economic perspective.

In the context of the financial perspective, CP6 choices have been categorised into those that:

- worsen the rail industry's net operating position (in other words, the additional operating costs exceed the value of revenue generated); or
- choices which improve the industry's net operating position. For these schemes, the Route Study also indicates the extent to which this improvement is able to cover the capital cost of the initial investment.

8.1.2 The choices have also been appraised from a wider 'socio-economic' perspective, which compares the value of benefits to users and non-users to the net financial cost to funders. The appraisals have been conducted in line with funders' guidelines, in particular WebTag; the Department for Transport's appraisal guidelines.

Table 8.1: Option S1i: Lengthening the remaining 8-car services to 12-car, and increasing the frequency of services by 3 trains in the peak will cater for the additional capacity requirements. For 2023.		
Conditional Output	GECO1	To provide sufficient capacity for passengers travelling into central London and other employment centres during peak hours, taking into account anticipated growth over the period to the end of Control Period 6 (2024) – Great Eastern Main Line services
	GECO2	To provide sufficient capacity for cross boundary services between Peterborough / Norwich and Cambridge via Ely, taking into account anticipated growth over the period to the end of Control Period 6 (2024) – Cross-boundary services.
Timeframe	Sufficient capacity to end of CP6 and also providing for 2043 capacity gap	
Objectives/purpose	To provide sufficient peak capacity on the Great Eastern Outer service via Chelmsford for 2023 and moving towards providing sufficient infrastructure to provide capacity for the long term.	
Description	An additional service from Norwich, and two services starting from a station where they are able to serve the majority of key stations on the route will best meet the crowding issue on the busiest services.	
Infrastructure requirement	In order to provide sufficient capacity for these additional trains the following infrastructure interventions are required: • Option 1 and 2: Additional platforms at London Liverpool Street or the redirection of West Anglia Main line services to additional platforms at Stratford • Options 3 and 4: Improved signalling between Chelmsford and Stratford • Option 5: Doubling of Trowse swing bridge (near Norwich) • Provision of a loop line near Haughley Junction or changes to the signalling on the Bury St Edmunds line • Option 9: loops north of Witham.	
Operational requirement	New train diagrams to lengthen one Witham to Liverpool street service, 2 12 car services from outer Great eastern, and one additional 8 car service from Norwich.	
Passenger impact	Provides an additional 36 vehicle arrivals in the high peak hour into Liverpool street by 2023, provides increased peak frequency of services.	
Freight impact	Haughley infrastructure is also required to provide sufficient capacity for freight to 2023.	
Relates to other options	Relates to options to provide sufficient freight capacity for the F2N route and provision of increased frequency between Ely and Norwich (Trowse Swing Bridge)	
Socio-economic Value for money categorisation	Low	
Rail Industry financial categorisation	Increases operating subsidies	
Note	• performance and wider socio-economic benefits have yet been included in the business case. Network Rail will revise the business case at a later date to reflect this • the cost of upgrading the power supply to accommodate the extra services has not been included. Network Rail will undertake power supply analysis and examine any depot and stabling implications later in the development process • the cost estimates that inform the business case are based on initial engineering feasibility assessments but are pre: GRIP. Significant contingencies have been added but as always in these cases Network Rail will need to complete considerable further engineering feasibility work before a reasonable degree of certainty can be reached both on costs and outputs.	

Table 8.2: Option S1i: Financial and socio-economic categorisation

Rail industry financial impact (Categorisation of Revenue, Operating costs & Capital costs over appraisal period)			**Socio-economic impact** (WebTAG VfM category, see summary TEE table for further details)
Scheme increases operating subsidies (i.e. R – O < 0)		✓	Low
Scheme decreases operating subsidies (i.e. R – O > 0)	Low capital cost coverage (i.e. (R – O) / C <33%)		
	Medium capital cost coverage (33-66%)	N/A	
	High capital cost coverage (66-100%)	N/A	
	Positive financial case (> 100%)		

Table 8.3: Option S1i Appraisal Results

60 year appraisal	**Option S1i PV £m**
Benefits (Present Value)	
Rail user benefits	241.7
Non user benefits	77.7
Rail user & non user disruption disbenefits	-18.0
Current TOCs revenue	0.0
Current TOCs/ NR opex	0.0
Other Government Impacts (indirect taxation)	-31.8
Total Quantified Benefits	**269.5**
Costs (Present Value)	
Investment Cost	239.7
Operating Cost	160.73
Revenue	-171.0
Other Government Impacts (road infrastructure costs)	-0.18
Total costs	**229.2**
NPV	**40.4**
BCR	**1.18**
Note: All figures are presented in 2010 market prices	

A sensitivity test has been carried out that removes the infrastructure costs associated with Signalling headway improvements.

Table 8.4: Option S1i sensitivity reduced capital cost of headway improvements: Financial and socio-economic categorisation

Rail industry financial impact (Categorisation of Revenue, Operating costs & Capital costs over appraisal period)			Socio-economic impact (WebTAG VfM category, see summary TEE table for further details)
Scheme increases operating subsidies (i.e. R – O < 0)		N/A	Very high
Scheme decreases operating subsidies (i.e. R – O > 0)	Low capital cost coverage (i.e. (R – O) / C <33%)	✓	
	Medium capital cost coverage (33-66%)	N/A	
	High capital cost coverage (66-100%)	N/A	
	Positive financial case (> 100%)		

Table 8.5: Option S1i Appraisal Results

60 year appraisal	Option S1i PV £m
Benefits (Present Value)	
Rail user benefits	241.7
Non user benefits	77.7
Rail user & non user disruption disbenefits	-4.7
Current TOCs revenue	0.0
Current TOCs/ NR opex	0.0
Other Government Impacts (indirect taxation)	-31.8
Total Quantified Benefits	**282.9**
Costs (Present Value)	
Investment Cost	62.6
Operating Cost	160.7
Revenue	-171.0
Other Government Impacts (road infrastructure costs)	-0.18
Total costs	**52.1**
NPV	**230.8**
BCR	**5.4**
Note: All figures are presented in 2010 market prices	

Table 8.6: Option 11: 110 mph line speed between Norwich and Chelmsford		
Conditional Output	GECO3	As identified to meet GECO1, to provide sufficient capacity for passengers travelling into central London and other employment centres during peak hours, and providing journey time improvement for services from Norwich taking into account anticipated growth to the end of Control Period 6 (2024) – Great Eastern Main Line
Timeframe	CP6 priority	
Objectives/purpose	To improve the journey times between Norwich and London Liverpool Street.	
Description	110mph Line speeds between Chelmsford and Norwich.	
Infrastructure requirement	This option to increase line speed between Shenfield and Norwich to 110mph, would involve significant infrastructure upgrades to Track, Signalling, Overhead Line Equipment and Structures. Also, the infrastructure is incremental to infrastructure required to deliver additional capacity on the route.	
Operational requirement	This option would also require the introduction of new modern type EMUs, where the braking and acceleration profiles makes best use of 110mph infrastructure.	
Passenger impact	A journey time improvement of around 6-7 minutes would be expected to be delivered in each direction, spread across the route from Shenfield to Norwich and affecting all passenger services on the route not just the London to Norwich trains.	
Freight impact	Haughley infrastructure is also required to provide sufficient capacity for freight to 2023.	
Relates to other options	Incremental to capacity options,	
Socio-economic Value for money categorisation	Very High	
Rail Industry financial categorisation	Reduced operating subsidies	
Note	Further work should be undertaken to manage the value of this scheme, this appraisal looks at LSI improvements on the entire rout, some sections may be more expensive and deliver less than others.	

Table 8.7: Option 11: Financial and socio-economic categorisation

Rail industry financial impact (Categorisation of Revenue, Operating costs & Capital costs over appraisal period)			**Socio-economic impact** (WebTAG VfM category, see summary TEE table for further details)
Scheme increases operating subsidies (i.e. R – O < 0)		N/A	Very High
Scheme decreases operating subsidies (i.e. R – O > 0)	Low capital cost coverage (i.e. (R – O) / C <33%)	N/A	
	Medium capital cost coverage (33-66%)	N/A	
	High capital cost coverage (66-100%)	✓	
	Positive financial case (> 100%)		

Table 8.8: Option 11 Appraisal Results

Summary results of socio-economic appraisal (60 year appraisal)	**Option 11 PV £m**
Benefits (net benefits to consumers & private sector plus tax impacts)	
Rail user benefits	554.4
Non user benefits	213.6
Rail user & non user disruption disbenefits	-25.1
Current TOCs revenue	0.0
Current TOCs/ NR opex	0.0
Indirect taxation impacts	-52.7
Total benefits (a)	**690.1**
Costs (costs to government - broad transport budget)	
Capital costs	333.5
Operating costs	0.00
Revenue	-293.6
Other government Impacts	-0.76
Total costs (b)	**39.2**
Net Present Value (NPV) (a-b)	**650.9**
Benefit Cost Ratio (BCR) (a/b)	**>5**

Notes: Present Values (PVs) are in 2010 market prices and are discounted to 2010 using Social Time Preference discount rates. The appraisal is in accordance with the DfT's WebTAG appraisal guidance. Results are shown for the relevant option/scenario etc relative to the Base Case. For net benefits etc, benefits are shown as positive. For costs to government etc, costs are shown as positive. This is a summary version of the TEE tables.

Table 8.9: Option 12: Train lengthening to provide capacity West Anglia Main Line to meet forecast demand to the end of CP6 (WACO1)		
Conditional Output	WACO1	To provide sufficient capacity for passengers travelling into central London and other employment centres during peak hours, taking into account anticipated growth over the period to 2024 – West Anglia services.
Timeframe	Sufficient capacity to end of CP6 and also providing for 2043 capacity gap	
Objectives/purpose	To provide sufficient peak capacity on the West Anglia Main line to London Liverpool Street.	
Description	Lengthening services from Cambridge, Stansted and Hertford East	
Infrastructure requirement	The following platforms are currently less than 12 car in length: • Shelford • Great Chesterford • Newport • Elsenham • Roydon • Harlow Mill • Hertford East (platforms 1 & 2) • Ware (platform 1) • St Margarets (platforms 1 & 2) • Rye House (platforms 1 & 2) • Broxbourne (platforms 1 & 4) • Cheshunt (platforms 2 & 3) • Waltham Cross (platforms 1 & 2) • Enfield Lock (platforms 1 & 2) • Brimsdown (platforms 1 & 2) • Ponders End (platforms 1 & 2) • Angel Road (platforms 1 & 2) • Northumberland Park (platforms 1 & 2) The cost of longer platforms on lengthened services has not been estimated and has not been included in the appraisal. This will be included for the Final route study.	
Operational requirement	One way of meeting the capacity requirements is to lengthen trains as follows: • The procurement of 2 additional 4 car units to lengthen peak Hertford East to London Liverpool Street services from 8 to 12-car. • The procurement of two additional 4-car units lengthening peak Stansted Airport and Cambridge to London Liverpool Street services from 8 to 12-car.	
Passenger impact	This would provide approximately an additional 16 vehicle arrivals in the peak hour to London Liverpool Street by the end of CP6, meeting the required passenger capacity for CP6 (conditional output WACO1a) on the outer suburban services into London Liverpool Street.	
Freight impact	NA	
Relates to other options	NA	
Socio-economic Value for money categorisation	High	
Rail Industry financial categorisation	Increases operating subsidies	
Note		

Table 8.10: Option 12 sensitivity reduced capital cost of headway improvements: Financial and socio-economic categorisation

Rail industry financial impact (Categorisation of Revenue, Operating costs & Capital costs over appraisal period)			**Socio-economic impact** (WebTAG VfM category, see summary TEE table for further details)
Scheme increases operating subsidies (i.e. R – O < 0)		✓	High
Scheme decreases operating subsidies (i.e. R – O > 0)	Low capital cost coverage (i.e. (R – O) / C <33%)	N/A	
	Medium capital cost coverage (33-66%)	N/A	
	High capital cost coverage (66-100%)	N/A	
	Positive financial case (> 100%)		

Table 8.11: Option 12a lengthening Hertford East services

60 year appraisal	**Option S1 PV £m**
Benefits (Present Value)	
Rail user benefits	28.6
Non user benefits	4.2
Other Government Impacts (indirect taxation)	-2.0
Total Quantified Benefits	**30.9**
Costs (Present Value)	
Investment Cost	0.0
Operating Cost	15.9
Revenue	-9.5
Other Government Impacts (road infrastructure costs)	0.0
Total costs	**6.4**
NPV	**24.5**
BCR	**4.8**
Note: All figures are presented in 2010 market prices	

Table 8.12: Option 12b lengthening of Stansted and Cambridge services	
30 year appraisal	Option S12b PV £m
Benefits (Present Value)	
Rail user benefits	22.5
Non user benefits	4.0
Other Government Impacts (indirect taxation)	-1.8
Total Quantified Benefits	**24.7**
Costs (Present Value)	
Investment Cost	0.0
Operating Cost	19.5
Revenue	-8.9
Other Government Impacts (road infrastructure costs)	0.0
Total costs	**10.7**
NPV	**14.0**
BCR	**2.3**
Note: All figures are presented in 2010 market prices	

Table 8.13: Essex Thamesside capacity options: Train lengthening to provide capacity to meet forecast demand to 2023 on the Essex Thameside route (ETCO1)		
Conditional Output	ETCO1	To provide sufficient capacity for passengers travelling into central London during peak hours, taking into account anticipated growth over the period to 2023 – Essex Thameside.
Timeframe	Sufficient capacity to end of CP6	
Objectives/purpose	To provide sufficient peak capacity on the Essex Thameside route to London Liverpool Street.	
Description	An additional 6 4-car units on the outer services (option 1) and an additional 2 4-car units on the inner services in the high peak hour (8-9). These are assumed to alleviate crowding in the afternoon peak also.	
Infrastructure requirement	All platforms affected by changes are already 12–car in length. In order to meet the capacity requirements, passenger circulation at London Fenchurch Street Station is a growing concern, and options should be considered to provide more capacity for passengers using the station in peak times. The cost of this intervention has not been included in the appraisal, an estimate of the necessary infrastructure has not yet been completed.	
Operational requirement	One way of meeting the capacity requirements is to lengthen trains as follows: • An assessment of the operational case for delivering extra capacity has been completed. Lengthening of 6 trains by 4 cars is required to deliver the required capacity in the peak into London Fenchurch Street on the outer services, three arriving between 07.00 and 08.00 and three arriving between 08.00 and 09.00. • Lengthening of two trains by 4 cars is also required to provide the required capacity by the end of CP6 on the inner services into London Fenchurch street.	
Passenger impact	This would provide approximately an additional 32 vehicle arrivals in the peak hour to London Fenchurch Street by the end of CP6, meeting the required passenger capacity for CP6 (conditional output ETCO1).	
Freight impact	NA	
Relates to other options	NA	
Socio-economic Value for money categorisation	High for lengthening outer services – medium for lengthening inner services	
Rail Industry financial categorisation	Increases operating subsidies	
Note		

Table 8.14: Option S1i sensitivity reduced capital cost of headway improvements: Financial and socio-economic categorisation

Rail industry financial impact (Categorisation of Revenue, Operating costs & Capital costs over appraisal period)			Socio-economic impact (WebTAG VfM category, see summary TEE table for further details)
Scheme increases operating subsidies (i.e. R – O < 0)		✓	High for lengthening outer services, medium VfM case for lengthening inner services
Scheme decreases operating subsidies (i.e. R – O > 0)	Low capital cost coverage (i.e. (R – O) / C <33%)	N/A	
	Medium capital cost coverage (33-66%)	N/A	
	High capital cost coverage (66-100%)	N/A	
	Positive financial case (> 100%)		

Table 8.15: Option 1: lengthening the outer services

30 year appraisal	Option 1 PV £m
Benefits (Present Value)	
Rail user benefits	91.7
Non user benefits	19.0
Other Government Impacts (indirect taxation)	-9.2
Total Quantified Benefits	**101.6**
Costs (Present Value)	
Investment Cost	0
Operating Cost	53.3
Revenue	-43.5
Other Government Impacts (road infrastructure costs)	0
Total costs	**9.8**
NPV	**91.8**
BCR	**>5**
Note: All figures are presented in 2010 market prices	

Table 8.16: Option 2: lengthening the inner services	
30 year appraisal	**Option 2 PV £m**
Benefits (Present Value)	
Rail user benefits	17.1
Non user benefits	2.8
Other Government Impacts (indirect taxation)	-1.4
Total Quantified Benefits	**18.5**
Costs (Present Value)	
Investment Cost	0.0
Operating Cost	16.8
Revenue	-6.3
Other Government Impacts (road infrastructure costs)	0.0
Total costs	**10.4**
NPV	**8.0**
BCR	**1.8**
Note: All figures are presented in 2010 market prices	

Glossary

Term	Meaning
Access for All	a programme which is part of Department for Transport's (DfT) Railways for All Strategy and is designed to address the issues faced by disabled passengers using railway stations in Great Britain. As a part of this programme new footbridges have been installed at some stations with new stairs and lift access between station entrance and platforms
AFC	Anticipated Final Cost, a cost presented in the Route Study to allow options to be compared, composed of the Point Estimate plus Risk (also known as a Proposal Estimate)
Baseline	Infrastructure, timetable or rolling stock which is assumed to be in place as a starting point for the route study. This is detailed in Chapter 2 of this document
BCR	Benefit to Cost Ratio, a measure of the value for money presented by an option. Schemes with a BCR of greater than 4.0 are deemed to offer very high value for money, whilst schemes with a BCR of less than 1.0 are considered to offer poor value for money
Churn	The sum of boarding and alighting passengers for a train service that stops at a given station.
Class 4	A classification of freight train timetabled to operate at up to 75mph, typically carrying intermodal containers or automotive traffic
Class 6	A classification of freight train timetabled to operate at up to 60mph, typically heavier than a Class 4 train due to the goods carried
Committed Enhancement	Infrastructure investment schemes which have been identified for funding in the Government's High Level Output Specification (HLOS) or are funded by third parties
Conditional Outputs	Aspirations for the industry to provide, subject to feasibility, value for money and affordability etc.
Control Period 4 (CP4)	Network Rail is funded in five yearly periods. Control Period 4 is the funding period between 2009 – 2014.
Control Period 5 (CP5)	Control Period 5 is the funding period between 2014 – 2019
Control Period 6 (CP6)	Control Period 6 is the funding period between 2019 – 2024
Control Period 7 (CP7)	Control Period 7 is the funding period between 2024 – 2029
Crowding standards	Threshold levels above which crowding is not acceptable, and which would trigger the need for measures to mitigate the crowding. The standards used in the Route Study are that passengers should have a seat available within 20 minutes of boarding a train, and that the standard class load should not be greater than the specified total standard class capacity of the train (including standing where appropriate). The standards are based on relevant DfT and franchising guidance and documentation

Term	Meaning
Crossrail	a project to provide new railway infrastructure to allow trains from London Paddington (and west thereof) to continue across London and through to the Anglia and South Eastern routes, and trains to make use of this infrastructure.
Devolved Route	one of the ten organisations to which Network Rail has devolved the day-to-day running of Britain's railway infrastructure, to work more effectively with passenger and freight operators. Each route operates as a separate business unit with its own accounts allowing greater benchmarking of financial performance and efficiency between the routes and sharing of best practice. Each devolved route also has its own management team to operate, maintain and renew the infrastructure
DfT	Department for Transport, a Government department
Digital Railway	Digital Railway is a rail industry-wide programme designed to benefit Great Britain's economy by accelerating the digital-enablement of the railway
DMU	Diesel Multiple Unit
Down line	Usually the line(s) in the direction away from London
East West Rail	a project to provide new and upgraded infrastructure between Oxford/Aylesbury in the west, and Milton Keynes and Bedford in the east.
ECS	Empty Coaching Stock
Electric Lines	Lines that carry metro services from Shenfield to London Liverpool Street on the Great Eastern Main Line.
EMU	Electric Multiple Unit.
ERTMS	European Rail Traffic Management System. A system for managing train movements using ETCS to signal trains.
ETCS	European Train Control System. A system providing signalling control and train protection, designed to a common European standard, which replaces lineside signals with in-cab displays.
FOC	Freight Operating Company
Freight delay measure	A metric for lateness of a freight train
Gauge	Key dimensions of the railway which define the size of trains which can be accommodated. Track gauge is the distance between rails. Loading gauge is the width, height and shape of the trains which can be accommodated.
GEML	Great Eastern Main Line
Generalised Journey Time	A measure of the passenger rail service offer that takes account of in-vehicle time, service frequency and interchange penalty
GLA	Greater London Authority
GOB	Gospel Oak - Barking Line

Term	Meaning
Grade separation	Infrastructure which allows trains to pass over or under another route to avoid the timetable conflicts which would otherwise occur.
GRIP	"Governance for Railway Investment Projects", a Network Rail standard for project managing changes to the infrastructure.
Headway	The minimum interval between trains allowed by the signalling system.
High-peak hour	The busiest hour of the day for passenger arrivals or departures, taken as 8am-9am and 5pm-6pm, typically at a London terminal
HLOS	High Level Output Specification, the Government's statement of what it wishes to buy from the industry over a Control Period.
HS1	The High Speed link between St Pancras International and the Channel Tunnel.
HS2	The planned High Speed link between London, Birmingham, and beyond to Manchester and Leeds.
Indicative cost	See AFC.
Inner suburban	Relating to trains or demand in the area near London served by trains which call at all or most stations.
ITSS	Indicative Train Service Specification. A list of possible or proposed train services including key characteristics such as: • origin • destination • routeing • stopping pattern (full passenger trains).

Term	Meaning
Jn	Junction.
LEP	Local Enterprise Partnership.
Load factor	The ratio of standard class passengers to standard class seats, on a train or averaged over a defined time period, at a given location.
LOCIP	London Overground Capacity Improvement Programme
LTPP	Long Term Planning Process, the programme of Market and Route Studies which together define the capacity and capability required of the Great Britain railway network over a 30-year time horizon.
LUL	London Underground Limited, the company which operates the 'tube' network.
Market Study	One of four studies undertaken at the beginning of the Long Term Planning Process, to forecast demand and to articulate Conditional Outputs for the markets, namely London & South East, Long Distance, Regional Urban and Freight.
MOIRA	A piece of software used by train operating companies and others to forecast how demand and therefore revenue will be distributed between trains in a given timetable. For the purposes of the Route Study it has been used to estimate the number of passengers boarding or alighting at a station where data is unavailable.
Mph	Miles per hour.
NLL	North London Line.
NSIP	National Stations Improvement Programme, a series of projects to improve railway stations.
ORR	Office of Rail Regulation, the safety and economic regulator for the rail industry in Great Britain.
Peak period	the busiest hours of the day for passenger train loading, often defined as 7am to 10am,and 4pm to 7pm, at a particular location, typically a London terminal.
Periodic Review	The regulatory process which establishes Network Rail's outputs and funding for the next Control Period.
Planning headways	The minimum time which can be used within a timetable for one train to follow another. This is determined by the signalling system, signal spacing, linespeed and train braking characteristics.

Term	Meaning
RA	Route Availability, a measure of the maximum axle-loads that can be conveyed on any given line of route.
RDG	Rail Delivery Group, a cross-industry body which exists to promote greater co-operation between train operators and Network Rail through leadership in the industry and by working together with Government, the supply chain and stakeholders.
Regional Working Group	A stakeholder group formed of representatives of local authorities with transport responsibities plus ports, airports and freight end-users.
Resilience	The ability of the railway to continue to operate despite the impact of events such as severe weather.
RfL	Rail for London
RIPG	Rail Industry Planning Group, a cross-industry body which exists has as its purposeprovides railway industry input into the structure and development of the national railway strategic planning processes. Its members are drawn from railway funders, operators and users.
ROC	Rail Operations Centre, a modern, electronic, and centralised operations control centre
Route Study	A piece of work to define the future required long-term capacity and capability of part of the network, taking into account the demand forecasts and relevant Conditional Outputs from the Market Studies.
Route Study Board	A body formed to steer development and approve publication of the Route Study composed of senior representatives from Network Rail, passenger and freight train operating companies, Department for Transport and Transport for London.
RUS	Route Utilisation Strategy, a report which considers the future development of the railway in a particular area (geographic RUS), or one aspect of its development in depth (Network RUS). Geographic RUSs are being superseded by Market Studies and Route Studies in the Long Term Planning Process.
SDO	Selective Door Operation, used where the whole of a passenger train does not fit into a station platform to allow passengers to board and alight safely.
SFN	Strategic Freight Network.

Term	Meaning
TEN-T	Trans-European Network – Transport, a strategy to develop a trans-European network in the transport sector, adopted by the European Parliament and the Council in 1996, to establish a 'master plan' connecting national networks of all transport modes.
TfL	Transport for London.
TOC	Train Operating Company.
tpd	trains per day.
tph	trains per hour.
Traffic Management	A system to assist signallers to regulate train services by automating certain functions and providing advice to signallers where there is a decision which requires their input. See also ERTMS.
Train service specification	See ITSS.
Turnback	A bay platform or siding which provides the functionality for terminating services to reverse either in or clear of the platform ready to depart in the opposite direction
Up line	Usually the line(s) in the direction towards London.
W10	A loading gauge which allows 9' 6" high containers to be conveyed on conventional railway wagons.
W12	A loading gauge which allows a 9'6 high container to be carried on a standard container wagon, including refrigerated containers up to 2,600mm wide; this is the recommended loading gauge for renewed structures.
WAML	West Anglia Main Line.
Working Group	A body formed to develop the Route Study composed of representatives from Network Rail, passenger and freight train operating companies, Department for Transport and Transport for London.
WTT	Working Timetable.

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