Long Term Planning Process

South East Route: Kent Area Route Study

Advice for funders

May 2018

System Operator Planning a better network for you

Network Rail

Contents

Front page photo: An aerial shot of Ebbsfleet International station. The line connecting HS1 to the North Kent Line (centre) and the 'bridge to nowhere' (top right) is the planned High Street bridge. It was far cheaper to build it ahead of time as this is on the main HS1 route.

Acknowledgements

We would like to thank the following for the photographs and illustrations in this document:

Network Rail (Alex Hellier, Luke Longley, Shravan Patel, Susanna Foster, Swathi Venkat and Paul Best), Transport for London (Steve Miles), Southeastern (Elliott Waters), Kent County Council and Ebbsfleet Development Corporation.

Ordnance Survey maps generated using Geo-RINM Viewer:

FAST FACTS

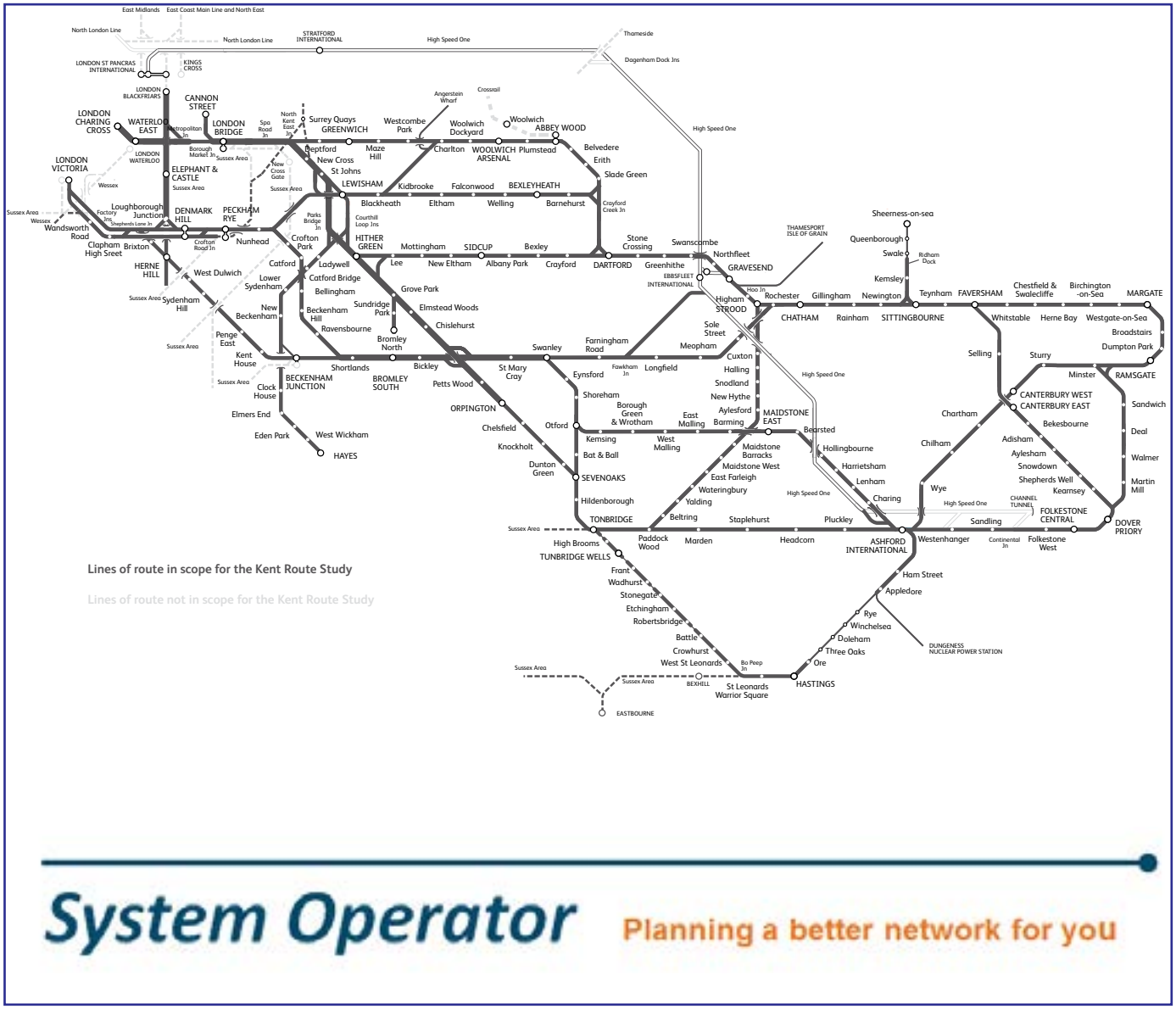
Look out for Fast Facts throughout the document, they will appear on little index cards like this one. Here's one to get you started:

The Kent Area covers 1,095 miles of track. HS1 has a 68 mile line.

FAST FACTS

London Bridge was the first London Terminus station ever built.

It was built by the London & Greenwich Atmospheric Railway which opened on 14 December 1836. For many years it was the only terminus in South London.



Foreword

WHAT IS... THE SOUTH EAST ROUTE?

Network Rail is split into eight 'Routes', South East Route is an amalgamation of the former Kent and Sussex Routes and is headed by John Halsall, Route Managing Director (RMD). John has overall responsibility for the operations, maintenance and safety activities within the Route as a devolved business. He joined South East Route in July 2016 and was previously RMD for Wessex Route.
South East Route is one of the most challenging Routes with 510 million passenger journeys per year (30 per cent of the national total).
John's team is tasked with keeping the trains running safely on this extensive and congested network every day.

WHAT IS... THE SYSTEM OPERATOR?

Network Rail also has a System Operator function, separate from the Route businesses. System Operator looks to the future through the Network Strategy & Capacity team. The team looks at network-wide issues, working with the Routes and stakeholders to model future demand, produce plans through the Long Term Planning Process and ensure that future timetables meet the demands of an ever-growing passenger market whilst also meeting the demands for freight.
By looking at the whole network, the team works to the principle that the 'whole is greater than the sum of the parts'.
Jo Kaye is Managing Director of System Operator.

We are delighted to present the Kent Route Study, which sets out the strategic vision for the future of this vital part of the rail network over the next 30 years. The Draft Study was published in 2017 and we were delighted to receive responses from MPs, Local Authorities, Transport User Groups and members of the public. In this final version, we aim to show how ideas will be taken forward and answer many of the comments received. The next stage is to work with funders on the choices identified to develop the network. As an example, since the publication of the Draft Study, funding has been approved for the development of enhancements at Ashford International station.

The Route Study builds on the recommendation in the Shaw Review that the railway is planned based on customer, passenger and freight needs. We have endeavoured to make this document different to previous studies through a more accessible style with context and explanation boxes provided throughout.

Each day the railway in South East London and Kent carries more than 68,000 people on 75 trains in the high peak hour (08:00-08:59) alone into Central London, with many thousands more accessing key interchange points such as Lewisham and Ashford International, and travelling between regional centres on the route.

Working closely with industry stakeholders, Network Rail and train operators have delivered significantly more capacity for passengers in recent years on the route, most notably infrastructure for extensive train lengthening in the London suburban areas. More people are choosing to travel by train in both the peak and the off-peak hours across the area and high levels of growth are predicted to continue, particularly on the high speed services that operate on the High Speed 1 Line (HS1) to St Pancras International. This is why we in the South East Route are proud to be running on one of the most intensely used metro-style railways in the UK.

This success brings challenges; maintaining and improving performance against a background of huge growth in passenger numbers over the last decade has been challenging for Network Rail and the train operators. We recognise that customers have high expectations and when there is a failure on the network, the impacts are widely felt. Improving the resilience of the infrastructure as it is renewed and enhanced will be of critical importance in improving the experience of customers. The Route's plans for CP6 include significant renewal activity and the System Operator team will be working with stakeholders on where further enhancements can deliver incremental benefits.

The Thameslink Programme, which will largely be completed this year, brings significant investment to the London Bridge area, with the station fully reopened on 2 January 2018. The opening of Crossrail, later in 2018, will provide new journey opportunities into central London from the north Kent area.

The purpose of this Route Study is to provide an evidence base to inform funders considering rail investment for the medium and long term. This means identifying ways in which the industry can meet forecast demand for both passenger and freight over the coming years. Whist there are options for the medium term, there are no simple solutions to meet the long term capacity challenge. A combination of train lengthening, timetable changes and infrastructure interventions will be required, but the lack of terminal capacity is the greatest challenge, and will need further industry-wide work to develop options.

Network Rail has led the production of this Route Study 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 all for their contribution.

John Halsall
Route Managing Director
South East Route

Jo Kaye
Managing Director
System Operator

Executive Summary

WHAT IS... A ROUTE STUDY?

In simple terms, it is a strategy for the rail network from now to 2024 and 2044, based on passenger and freight forecasts. Previous Route Study documents have contained detailed technical information. The aim of this one is to make it as accessible as possible to the general public, with a separate Technical Appendix and summary document.

Boxes like this are dotted throughout the document to provide information and explanation of the main text. There are also a series of information boxes on types of rolling stock, which can vary considerably across the Kent Route Study area.

Click on this box to see the South East Route's other Route Study - the Sussex Area Route Study.

A Class 375 unit heads north towards Tunbridge Wells from Strawberry Hill Tunnel. There are four narrow tunnels between Hastings and Tonbridge where the line was singled to enable standard-width trains to pass through.

Introduction

1. The railway in Kent is vital to the region, serving many markets and communities including the commuter market, which is concentrated in the peak hours into and out of London.

2. The number of passengers using the railway across the route study area has increased substantially in recent years and further growth is forecast. The routes into London are particularly busy, with little capacity to operate any additional services. However, only 10 per cent of trains in the AM and PM peaks are the maximum length.

3. The Kent Route Study, seeks to identify the capacity requirements in the medium and long term to allow the railway to play its part in delivering economic growth, in addition to improving the connections between people and jobs, and between business and markets.

4. Options have been identified to meet the projected growth up to 2024 and are set out as advice for funders. Beyond this, there are no simple options to meet projected demand and further development work in the coming years will be required to develop a clear strategy to deliver additional capacity into London that all parts of the industry can support. Options to improve connectivity across the region have also been identified in addition to ones that protect the resilience of the network.

5. The challenges that the study is based around providing more capacity and improving connectivity includes:

- **Meeting Demand to 2024** – The analysis has shown that the projected passenger capacity on trains can largely be met though lengthening services to the maximum length possible for each corridor. Some station enhancements will be required to handle the associated increase in passengers. New rolling stock and resulting stabling capacity will also be required.
- **Meeting Demand to 2044** – It is expected that additional terminal capacity will be required in London as well as the removal of strategic bottlenecks to allow more services to operate. Further development is required in the coming years to formulate a coherent strategy for major investment.
- **Improving connectivity across Kent** – There is the opportunity to better connect communities with faster journey times from areas such as Hastings to London as well as between regional centres. Options for improving the capability of the network for freight operators are also examined.

The Capacity Challenge

6. Rail is already the predominant mode of travel for the commuter market, with approximately 65 per cent market share including London Underground services. For the London and South East franchised operators this equated to 7.6 billion passenger kilometres during 2015-16.

7. The London and South East Market Study (Network Rail, 2013) projected that passenger numbers on most routes in Kent will grow by 15 per cent between 2011 and 2024 and 47 per cent up to 2044. Recent analysis has shown that the growth on Domestic High Speed services has been far higher, with an assumed growth rate of 80 per cent up to 2024 and 127 per cent up to 2044.

8. The capacity for any additional services into London from Kent is extremely limited. Making the best use of the network to provide the maximum capacity possible per train path is critical to meet the growth projections going forward. This means the priority should be for additional rolling stock to allow services to be lengthened to the maximum for the given route.

9. When train lengthening opportunities have been exhausted, there are no clear or simple options to provide additional capacity

An artists impression of Ebbsfleet Garden City

into London. A number of critical bottlenecks would need to be relieved, including central London terminal capacity and grade separation of some junctions alongside possible Digital Railway and rolling stock configuration solutions. Network Rail intends to commence further development of the strategy to meet projected growth beyond 2024.

10. Additional people travelling on trains will mean more people using busy stations along the route. Proving additional capacity is critical to enable a high performing metro railway, see **paragraph 26.**

11. It is important to note that South Eastern refranchising process is expected to deliver a significant increase in capacity for the franchise over today's level no later than the December 2022 timetable change. As such the conclusions this report draws with regard capacity/crowding will require reconsideration once the franchising process concludes (currently planned for November 2018).

London Bridge suburban (metro) services

12. The projected passenger growth up to 2024 on the suburban (also known as metro) routes into London Bridge can be met through lengthening more existing services to 12-car length. A small number of infrastructure interventions have been identified as advice for funders including signalling alterations to allow services to operate robustly.

13. Over the past few years, Network Rail has invested around £300m, completing enhancements to the power supply and platform extensions in the most congested areas, giving the capacity to lengthen more services.

14. There is also a restriction on operating 12-car trains that do not have Selective Door Opening (SDO) at Woolwich Dockyard and into Platforms 4, 5 & 6 at Charing Cross. The removal of these would involve a major rebuild of the station, which the use of SDO could mitigate.

15. There are aspirations to move towards a 'metro-style' railway across the routes that are closer to London. Transport for London has led development on this concept, which aims to provide a more consistent and regular service for passengers.

London Victoria suburban (metro) services

16. The suburban services into London Victoria are restricted to a maximum length of 8-cars. The projected passenger growth, across the peak, on these services can be met by extending more services to this length.

17. However, the busiest services are already at the maximum 8-car length so an alternative to lengthening these services could be to use high density rolling stock, such as Class 700s.

FAST FACTS

Southeastern operate 2,016 trains every weekday

ThamesLink operate 102 trains in Kent

Southern operate 172 trains in Kent (to Tonbridge and/or via Hastings/Rye)

FAST FACTS

There are seven Kent stations located in London's Zone 1:

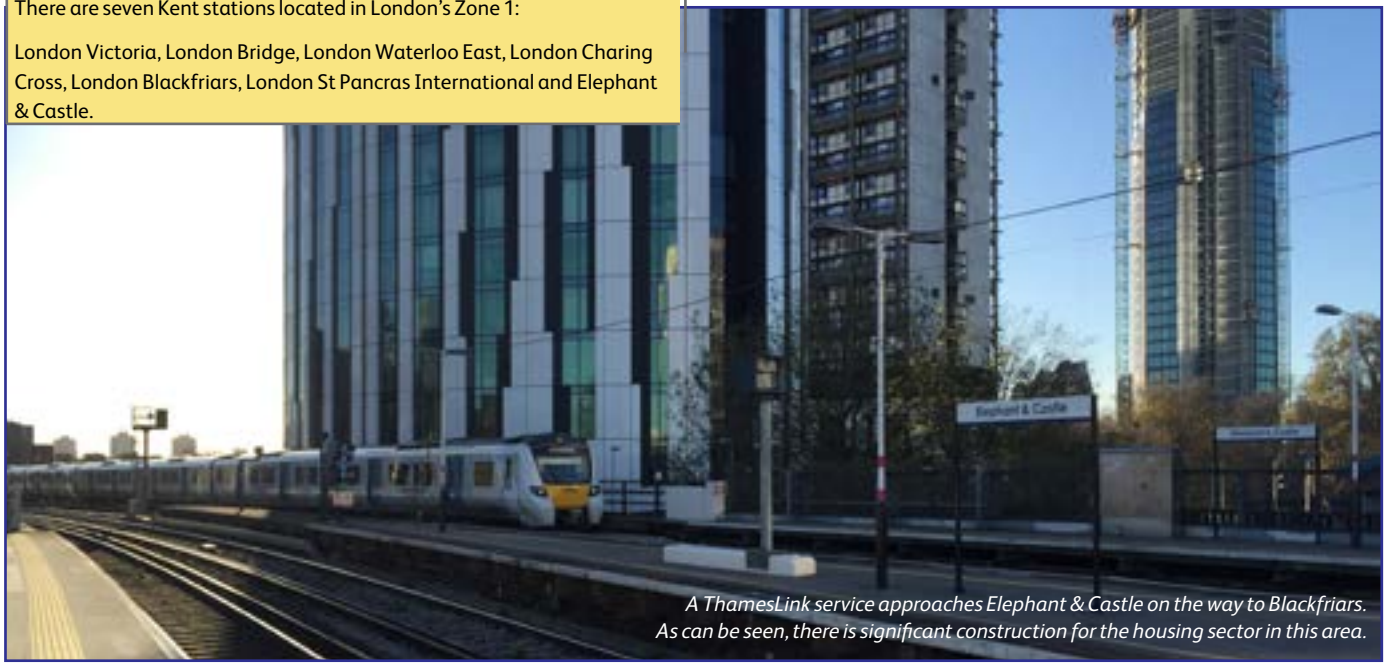
London Victoria, London Bridge, London Waterloo East, London Charing Cross, London Blackfriars, London St Pancras International and Elephant & Castle.

London Bridge & Victoria Main Line services

18. The projected growth on the main line services between Tonbridge and London Bridge cannot be accommodated through train lengthening alone. An additional peak hour train path would be required, which will be challenging to timetable through the congested two track sections of the route.

19. Terminal capacity is also a significant issue with Cannon Street and Charing Cross both being at capacity in peak times. An option that has been identified to alleviate this issue is to create a 12-car berthing siding on the existing Metropolitan Reversible line near Cannon Street. This would enable Cannon Street to accommodate one additional peak hour service.

20. It is recommended that development work should be undertaken to identify where addition terminal capacity in London can be created beyond 2024, when train lengthening options have been exhausted.



A ThamesLink service approaches Elephant & Castle on the way to Blackfriars. As can be seen, there is significant construction for the housing sector in this area.

High Speed Domestic Services

21. The passenger growth on the HS1 Southeastern services has been significantly higher than on other parts of the route and this is forecast to continue to grow at five per cent per annum over the next few years. A key driver for this is people moving to live near to the route to take advantage of the quick journey times into London. The demand is expected to be even higher when the full impacts of proposed major developments, such as Ebbsfleet Garden City and London Resort Theme Park are known.

22. To meet the projected passenger growth on HS1 services, more High Speed rolling stock is required. The advice for funders is to lengthen more trains to 12-cars and provide one additional service. This would include the Maidstone West services, requiring a platform extension at Maidstone West station. A new link between Platform 2 at Ashford International and High Speed 1 to improve the connections and perofrmance of the station.

Denmark Hill station seen from the accessible footbridge

Blackfriars services

23. The services from Blackfriars are predominantly those from the Thameslink Core, which are operated by high density Class 700 rolling stock. The recent introduction of these trains should cater for the projected passenger growth, albeit limited to the Catford Loop line from May 2018.

24. As ThamesLink services operate through central London to routes north, the options for extending the platforms on the Blackfriars routes south of the River Thames to allow 12-car operation have been examined and included in the choices for funders.

FAST FACTS

There are about 200 stations in the Kent Route Study area. The top ten busiest stations (passenger entry & exits) in London in 2016/17 were:

- Victoria - 75,889,396
- London Bridge - 47,874,250
- Charing Cross - 29,559,646
- Cannon Street - 22,660,250
- Lewisham - 10,748,918
- Waterloo East - 10.324,542
- Bromley South - 8,532,022
- Peckham Rye - 7,464,200
- Denmark Hill - 7,187,152
- Orpington - 5,155,016

Peckham Rye station, two stations linked by a common building

Orbital services - East and South London Lines

25. The East and South London line services have seen high levels of passenger growth following the introduction of the orbital route from Clapham Junction in 2012. The services are operated by high capacity, 5 car units, which cannot be extended due to short platforms on the East London Line core route.

26. Therefore, the only solution to overcrowding on this route is to introduce additional services. TfL have an aspiration to move to a six trains per hour service (currently four trains per hour). Network Rail is working with them on understanding what changes (timetabling and/or infrastructure) will be required to accommodate this.

Improving passenger capacity at stations

27. It is important to remember that increased passenger numbers will impact on stations and these have to work effectively and safely to accommodate this. The stations with the highest priority for crowding relief schemes that have been identified as advice for funders are (in alphabetical order):

- Brixton
- Bromley South
- Denmark Hill
- Lewisham
- Peckham Rye.

FAST FACTS

The top ten stations for entries & exits outside London in 2016/17 were:

- Tonbridge - 4,414,394
- Sevenoaks - 4,160,110
- Dartford - 3,908,158
- Tunbridge Wells - 3,820,560
- Ashford Intl - 3,798,486
- Gravesend - 2,984,420
- Chatham - 2,742,800
- Gillingham - 2,731,126
- Canterbury West - 2,467,975
- Sittingbourne - 2,164,064

Freight

28. The majority of freight services in the Route Study area are aggregate trains (sand and stone) for the construction industry. This market has grown consistently over the last 20 years. Key features of service in the Kent Area are sea-dredged aggregates from the North Kent area into London distribution terminals and a series of terminals in Kent receiving aggregates traffic from suppliers across the UK.

29. Channel Tunnel freight has been identified as a market that has potential for growth. After strong increases in freight volumes in recent years, external factors at the border have since led to a decline. The infrastructure is in place to accommodate growth when the market conditions improve. The gauge clearance of key routes to allow larger containers to operate without restriction would allow rail to become more attractive to freight customers.

Rolling stock

30. Additional rolling stock is projected to be required across Kent, which will drive power supply upgrades and a need for increased stabling capacity. The Networker rolling stock, which operate many of the metro services, is approximately 25 years old, so is likely to be replaced in the coming decade and this would provide the opportunity to provide higher capacity trains.

31. The rolling stock that operates on HS1 has to be compatible with multiple electrical and signalling systems, which is a further complication. Reforming units to include new intermediate vehicles could enable the trains to be lengthened without buying new driving vehicles.

Improving Connectivity

32. There are Stakeholder ambitions across the South East route, with strong support expressed for upgrades to the Marshlink line between Hastings and Ashford, major housing developments planned across the region and enhancement schemes funded by Local Transport Authorities.

33. A new connection at Ashford International to allow services to operate between HS1 and Marshlink is being developed. Aligning this with line speed improvements and bi-mode rolling stock, could provide a substantial reduction in journey times and additional capacity between Hastings and London as well as improving the operational flexibility of Ashford International station.

34. The potential for a Southern Link to Ebbsfleet International from Swanley has been examined using the line formerly used by Eurostar services at Fawkham Junction. This would open up new journey opportunities for people travelling to this growing area.

35. Options for improving rail links between the Faversham and Ashford areas have been identified. The journey by road is known for congestion and rail does not currently provide a simple alternative. However, it is difficult to make a case for change when so few people currently make the journey. The new connectivity would open new markets, but these would need to develop over time as people's work and home patterns adjust.

36. The resilience of the network has been brought into sharp focus in recent years following the landslides on the Hastings Line and the collapse of the sea wall between Folkestone and Dover.

37. The latter severed the railway between the towns for nine months, causing disruption for passengers and harming the local economy. Around £40m has been invested in repairing the line. However, other parts of the route remain vulnerable to extreme weather in the future.

37. The feasibility of a new chord between the Canterbury East and Canterbury West lines has been reviewed. If implemented, this could allow trains to operate between Dover and Ashford even in the event of a catastrophic failure of the sea wall. This is a longer term proposal, which should be considered for development by funders.

Rochester Castle and grounds

1 Consultation responses

This chapter sets out:

- The consultation process
- Highlights of the consultation responses
- Details of how the responses will be represented in the rest of the document

If you have not read the Kent Route Study before, you may prefer to skip this chapter and head straight to Chapter 2. (Click on this box)

1.1 Development of the process

1.1.1. Network Rail has taken a collaborative and consultative approach to the development of the Long Term Planning Process (LTPP). The Kent Area Route Study is a key part of this process.

1.1.2. Care has been taken to ensure there is an opportunity for all interested stakeholders, both within and outside the rail industry, to contribute if they wish to influence the rail industry's plans for the future.

1.2 Kent Area Route Study – Stakeholder Groups

1.2.1. The Route Study has been developed with the close involvement of a wide range of stakeholders. This has sought to ensure that the work has been subject to comment and review by an informed audience throughout.

1.2.2. Consultation and guidance has been extensive and held at a number of levels, using the groups set out in the governance structure outlined in **Chapter 2**. The four key groups guiding the development of the work have been:

- Rail Industry Planning Group (RIPG)
- Kent Area Route Study Board
- Kent Area Route Study Working Group
- Kent Area Route Study Regional Working Group.

1.2.3. The study was discussed at a number of Regional Working Group and briefing events across the Route, where local authorities, local enterprise partnerships and other interested stakeholders were briefed on the work and informal feedback was received. These groups were an important opportunity for participants to raise any queries they may have and inform their own organisations to assist in focusing the responses received as part of the consultation process.

1.2.4. In addition, these groups have been complemented by wider stakeholder events and one-to-one discussions with individual group members to guide and develop the work.

1.3 Consultation process

1.3.1. The Kent Area Route Study Draft for Consultation was published on the Network Rail website on 14 March 2017 to coincide with the publication of the Department for Transport South East Franchise consultation document. The Route Study consultation period on the document closed on 30 June 2017.

1.3.2. The Network Rail website's Long Term Planning page reported a spike of 1,500 visits between 14-21 March 2017. There were over 52,000 visits in the 2015/16 financial year.

1.3.3. A series of articles on the Route Study appeared in the London Reconnections blog. Most of the media coverage was on the DfT's South Eastern Franchise Consultation document. Network Rail and the DfT teamed up for joint public consultation events. On 18th April 2017, the Prime Minister called a General Election, resulting in the cancellation or postponement of all consultation events.

1.3.4. This is because Network Rail is an 'arms length' body of the Department for Transport and therefore falls under the Purdah rules for national election. This meant no activity could be undertaken as that could be seen as influencing policy or votes for any particular party.

1.4 Consultation responses

1.4.1. A detailed review of all the responses is in the Technical Appendix to this document.

1.4.2. In total, 114 responses were received from stakeholders. Of these, 108 were by email, six by letter and one used the Network Rail Live Chat facility.

1.4.3. 46 members of the public responded, the rest being businesses, local authorities, transport industry, user groups, residents' associations etc.

1.4.4. Responses ranged from short emails to longer reports and there was one petition (against the construction of housing in Roper Road, Canterbury). Some included the DfT South Eastern Franchise Consultation response.

1.4.5. One of the reasons for publishing on the same day as the franchise consultation was to simplify the process for stakeholders, who may want to respond to both consultations. A number of respondents included their responses to the DfT's franchise consultation. These have been reviewed but largely been excluded as they are not responding to areas within the remit of the Route Study.

1.5 Response analysis

1.5.1. Each response was allocated a response number and recorded in two spreadsheets; one with all of the responses broken down to fit the cell structure which was shared with the Route Study Working Group for comment and information. The names of members of the public were not shared and do not appear in either spreadsheet.

1.5.2. The other spreadsheet analysed the content of each response and showed the subjects referred to in the response; this enabled the subjects to be identified by number of responses and prevented double-counting.

1.6 Key themes in the consultation responses

1.6.1. There was a wide range of subjects discussed in the responses, from Marshlink High Speed and Metroisation to the Canterbury West Second Entrance* and housing growth forecasts.

1.6.2. Many respondents expressed support for the approach taken by the industry in developing the Long Term Planning Process and the Route Study, particularly the opportunity to contribute to the final document through the consultation process. Industry, local government and user groups expressed their support for the level of stakeholder engagement that was undertaken as part of the Route Study process.

1.6.3. A number of responses included requests for clarification on maps, figures and wording which we have undertaken and updated in this document.

1.6.4. There were over 1,400 comments across 188 subjects in the responses. 44 subjects were only mentioned in one response rising to 53 subjects with more than ten responses. The top subjects were:

- Longer trains - 40 responses,
- Canterbury West second entrance (on Roper Road)* - 38 responses
- High Speed to Hastings - 34 responses
- Housing Growth - 34 responses.

Wordcloud pictogram of words used in consultation responses

1.6.5. Housing growth forecasts were commented on by several local authorities, members of the public and user groups. The Draft for Publication did not include revised Local Plan housing statistics that were being produced by Local Authorities during the data collection phase of its development. Most Local Authorities have now refreshed their Local Plans and these have been reflected in this final document.

1.6.6. Generally, the updated numbers have made little difference to the overall plan because a high growth scenario was assumed from the outset. The use of the revised figures show that the Route Study is joined up with other agencies.

1.6.7. Full analysis of the responses and line of route commentary can be found in the Technical Appendix to the Kent Route Study. Highlights will be shown through the Route Study document in 'You said...' boxes:

You said...

These boxes refer to consultation responses to the adjacent text. Some subjects were commented on by several parties so only a few comments may be shown.

More detailed comments can be found in the Technical Appendix.

Writing in italics below the quote from the consultation response comes from the Route Study team.

*this proposal did not appear in the Kent Route Study Draft for Publication - this is due to a property scheme in Canterbury which Network Rail is promoting.

2 Background

This chapter sets out the background to the Long Term Planning Process and the development of the Route Study.

2.1 Background to the development of the Long Term Planning Process

2.1.1 The purpose of the Long Term Planning Process (LTPP) is to inform funders as to how the railway could support the UK economy over the next 30 years (from 2014). It comprises a set of activities and documents that:

- Set out strategic options which address the demands that are forecast to be placed on Britain's rail network to 2044
- Capture stakeholders' aspiration to develop or enhance rail services and infrastructure in the light of forecast housing and employment growth
- Present investment choices for funders to inform their decisions in relation to the franchising programme; the development and delivery of enhancements; and the outputs and funding of Network Rail.

2.1.2. The LTPP proposes scenarios and options in which train services and infrastructure enhancements could develop over the longer term to 2044, and provides an evidence base for investment up to 2024, including the completion of the Thameslink Programme and arrival of Crossrail to Abbey Wood.

2.2 Structure

2.2.1. There are a number of elements that collectively form the LTPP:

- Market Studies present the forecast future rail demand and develop conditional outputs for future rail services, informed by the views of stakeholders of how rail services could support the delivery of regional and local strategic goals.
- Route Studies develop choices for future services and investment decisions in the rail network. Options are based on the aspiration to accommodate the conditional outputs and demand forecasts as outlined in the Market Studies, and are assessed against agreed industry appraisal criteria to provide choices for funders.
- Cross-boundary analysis considers options for services that operate across multiple Route Study areas to ensure consistent working assumptions are applied.

2.2.2. In addition to these studies, Network Rail facilitates the production of Network Studies (previously Network Route Utilisation Strategies (RUSs)). These strategies look at network-wide issues and address the future capacity and technology-related issues for the railway, such as freight, electrification and accessibility.

2.3 The Kent Area Route Study

2.3.1. A three tier structure for rail industry and wider stakeholder dialogue has been established to oversee and help produce this Kent Route Study:

- A Programme Board, chaired by Network Rail with senior level representation from passenger and freight train operating companies, Rail Delivery Group (RDG), Transport for London (TfL), Department for Transport (DfT) and the Office for Rail and Road (ORR), provides a high level review and a forum to resolve any significant issues which the Working Group wishes to remit to the Board for decision.
- A Working Group, chaired by Network Rail, has a mandate to discuss the study on behalf of the rail industry with other stakeholders and to review the ongoing work. Industry stakeholders meet to determine how the conditional outputs from the Market Studies can be accommodated, including the identification of service specifications and options with the aim of developing choices for funders up to 2024 and in the longer term to 2044. The working group comprises representatives from central Government, the current Train Operating Companies (both passenger and freight) that operate on the route, RDG, TfL, DfT, London TravelWatch, Network Rail, and the ORR as an observer.
- A Regional Group, convened and chaired by Network Rail, provides location specific oversight as well as an opportunity to collaborate in the production of the Route Study with the rail industry. Membership comprises Local Authorities at a county or unitary authority level, Local Enterprise Partnerships (LEPs), Airports, Ports and Freight stakeholders on the route.

WHAT IS... A TRAIN OPERATING COMPANY?

When British Rail was privatised, it was split into infrastructure (Railtrack, now Network Rail), Train Operating Companies (TOCs) to run the trains and Rolling Stock Companies (ROSCOs) to own the trains.

In the Kent Route Study area, Southeastern and Govia Thameslink Railway (GTR), trading as Southern and ThamesLink, are the key TOCs.

Arriva Rail London (ARL) operates the London Overground concession under contract to Transport for London (TfL).

WHAT IS... A FREIGHT OPERATING COMPANY?

In addition to the TOCs (above), Freight Operating Companies were set up at privatisation. They are open access operators - they can cover the whole network and are not subsidised or franchised.

They operate freight, infrastructure maintenance, test and private hire (charter) trains.

In the Kent Route Study area, operators include DB Cargo, GB Railfreight, Direct Rail Services and Colas Rail.

- A Wider Stakeholder Group represents the issues of the local authorities (at a district and borough level) and rail user groups. The county councils and unitary authorities acted as lead for the smaller local authorities, passing the details of the Regional Working Group onto them as necessary.

2.3.2. Network Rail has managed the development of the work through an internal Technical Working Group to deliver the information necessary to support the deliberations of the Working Group. Where industry input has been required, this has been augmented by attendance from rail industry stakeholders.

2.3.3. Additionally, several one-to-one meetings with stakeholders have been held to shape the proposals contained within this document.

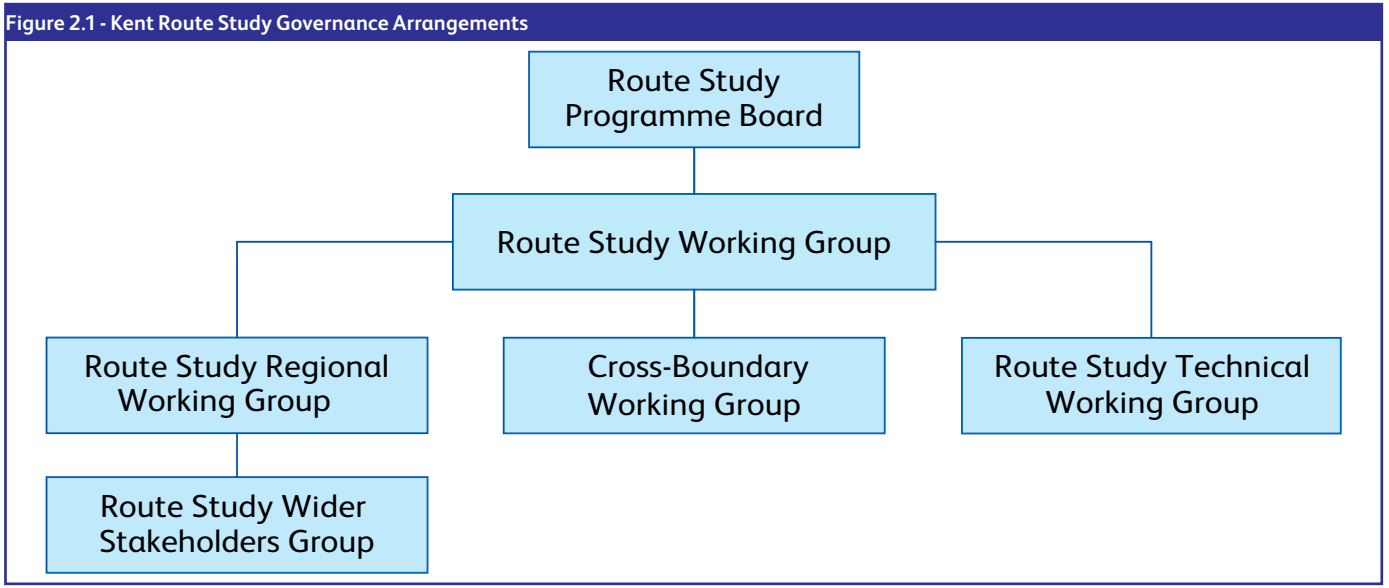
2.3.4. The Route Study is produced by Network Rail on behalf of the Programme Board with the assistance of the Working Group and is designed to facilitate public awareness of the industry's strategic options for the railway across the Kent Area.

2.3.5. **Figure 2.1** shows the Governance Arrangements in diagrammatic form.

2.3.6 The strategy takes its starting point as the railway as it will be following the delivery of currently committed investment (such as Thameslink Programme and Crossrail). Details of the changes which will result from this investment are discussed in **Chapter 3**.

2.3.7 In developing the investment choices for funders detailed in **Chapter 6**, this strategy has taken into account a number of key issues that shape the way the railway could develop in the UK. These are: safety, performance, resilience and the movement towards a digitally operated rail system.

Figure 2.1 - Kent Route Study Governance Arrangements



WHAT IS... PERFORMANCE?

Trains are measured to the timetable; every minute literally counts. Once a train has been delayed by two minutes, the delay is automatically flagged for investigation and attributed to an 'incident' which identifies the cause of the delays and the organisation responsible.

This system has been in operation since privatisation. Infrastructure incidents (track, power supply, signalling etc) are attributed to Network Rail. Train faults, passenger sickness, lack of traincrew etc are attributed to TOCs/FOCs.

Incidents caused by external influences such as trespass, vandalism, bridge strikes and the effects of poor weather area also attributed to Network Rail.

When there is a delay caused by Operator A to a train operated by Operator B, the latter would see compensation paid by Network Rail to reduce the financial impact on Operator A.

Performance measures have been defined (such as Public Performance Measures (PPM) for total minutes delay and number of cancelled trains per 28-day period). Failure to meet targets can result in further penalties from the Office for Rail and Road.

2.4 Safety

2.4.1. Network Rail sets out a vision for safety in its 'Transforming Safety and Wellbeing' report which takes a view through to 2024. Many of the choices for funders set out later in this document are at an early stage of development, therefore safety considerations and requirements can be embedded from the outset of their development. The Office of Rail and Road (ORR) has recognised that our railways continue to have a good safety record and remain among the safest in Europe as reported in the ORR Health & Safety Report 2015-16.

2.4.2. Safety on the railways is measured in three key areas: public, passenger and workforce safety. The approach taken in this strategy has the potential to further improve passenger safety through the removal of crossing movements at junctions and easing the flow of customers at stations. Furthermore, some investment proposals have the potential to eliminate level crossings, further improving public and passenger safety. Where this is the case, these opportunities have been identified and will be progressed if and when schemes are funded for further development.

everyone
home safe
every day

2.5 Performance

2.5.1. In developing the options set out in this strategy, the rail industry has principally considered how the conditional outputs identified in the London & South East Market Study could be met, both for 2024, and in the longer term to 2044. More immediately, Network Rail has been set targets to improve performance by 2019; these are set out in detail within the Delivery Plan for CP5 2014-2019. The trajectory of these changes is to improve performance, monitored through the Public Performance Measure (PPM).

2.5.2. The performance objectives for the rail industry in the medium term have not yet been established. However, the trend is likely to be one of continuous improvement across the industry. As the choices for investment are further developed, emerging opportunities for performance improvement can be considered in more depth.

WHAT IS... DIGITAL RAILWAY?

Digital Railway is the industry's plan for deploying digital technology to increase rail capacity and improve network performance.

Demand on the railway continues to grow at a pace that means we are running out of capacity at key pinch-points, leading to congestion for passenger and freight services. We need to find more innovative ways of releasing more capacity from the existing network by targeting deployment of relevant digital technologies.

Rather than Digital Railway deployment comprehensively across the national network, it's looking selectively at opportunities for bringing forward targeted investment.

South East Route, through the Thameslink Programme, is leading the way on several fronts, such as the first heavy-rail implementation of Automatic Train Operation (ATO) through the Thameslink Core in 2018.

Click on the box for more information on Digital Railway.

2.6 Resilience

2.6.1. The resilience of the transport networks was brought into sharp focus by the winter storms of 2015 and the collapse of the sea wall on the Folkestone to Dover line. The engineering works to re-open the line was completed in September 2016; however the risk of the cliffs collapsing and blocking the line or possibly damaging one of the tunnels in this area will remain.

2.6.2. These events have shown the vulnerability of the railway to storm damage and increased incidence of weather related events, bringing the impact of climate change into sharp focus. Whilst the tactical 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 in future.

2.6.3. Resilience of the infrastructure is also critical on a day-to-day basis due to the age of some assets. Two recent examples are storm damage resulting in landslips at Wadhurst and the wet conditions within Sevenoaks Tunnel.

2.6.4. The routes in Kent are at capacity in a number of key locations. The reactionary delays to trains and therefore customers from what could be a small initial incident or failure are magnified. The bar for acceptance of failure needs to be higher to deliver a railway that performs to our customers' expectations day in, day out.

2.7 Digital Railway

2.7.1. Digital Railway is an industry-wide programme designed to benefit Great Britain's economy by accelerating the digital enablement of the railway, which has the potential to provide capacity, performance and whole-life asset cost benefits.

2.7.2. The programme sets out to build the industry business case, to accelerate the digital enablement of the railway, in several key areas including infrastructure, train operation, capacity allocation, ticketing and stations.

2.7.3. The output of the programme will be an Outline Business Case to support options for consideration to 2024 and beyond. Digital Railway options in terms of enhancements have only been considered where they support the achievement of conditional outputs.

2.7.4. The Digital Railway programme could deliver the following outputs:

- Improved system safety
- Additional and improved allocation of capacity
- Improved passenger experience
- Digital train control and operation
- Better asset management and monitoring
- Improved performance.

2.7.5. The introduction of the European Train Control System (ETCS) and Automatic Train Operation (ATO) onto the network, coupled with the continued development of this technology, offers the opportunity for medium or longer term solutions to some of the identified network capability constraints.

2.7.6. Therefore, the assessment of the additional network capability required in future will inform the development of ETCS. The current asset renewals strategy is to upgrade to ETCS as signalling equipment becomes life-expired and is due for renewal. The Digital Railway workstream is currently investigating where options could be considered to accelerate this.

2.7.7. 2018 sees the introduction of Traffic Management and Automatic Train Operation on the Thameslink Core. Traffic Management is due to be rolled out over a wider area to ensure that trains are on time before London Bridge/Blackfriars; see **sections 2.8-2.10** for more information

You said...

"The key to providing additional capacity on the Kent Route is to expand London termini capacity and allocations of extra rolling stock, noting the need for additional berthing too. As Digital Railway is a signalling system, Southeastern considers the impact will be felt greater within operational performance."

There will be a lot of interest in post-Thameslink operations and how Digital Railway delivers a step change in performance across other parts of the Route.

Document Structure

The rest of this document is structured as follows:

Chapter 3: Baseline

This chapter summarises the characteristics of the railway of the Kent Area of the South East Route following the delivery of the current planned enhancements.

Chapter 4: The Capacity Challenge – Accommodating Demand

This sets out the forecast levels of demand and the crowding impacts.

Chapter 5: Improving Connectivity

This sets out the strategic objectives around train frequency between locations in the study area and improving connectivity to social infrastructure, in particular the role the railway can play in better connecting people to places.

Chapter 6: Strategy and Investment Choices for Funders

Here, the outputs are detailed in terms of investment options that can be considered as choices and advice for funders to 2024, and the longer-term development strategy.

Chapter 7: Next Steps

This final chapter explains how the strategy is taken forward.

This document has been published exclusively on Network Rail's website. If you require a paper copy please request this via email directed to the following address:

KentRouteStudy@networkrail.co.uk

2.8 Interoperability

2.8.1. 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 Department for Transport website .

2.8.2. 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.

2.8.3. European and UK legislation defining objectives for Interoperability and the Trans European Transport Network (TEN-T) will be taken into account in the development of this Route Study. As yet, it is unclear what the impact will be from the recent Referendum result where the UK voted to leave the European Union.

2.8.4. 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.

2.9 Congested Infrastructure

2.9.1. When Network Rail receives more requests for train paths to be included in the Working Timetable (WTT) than can be accommodated on a section of line, the section of line concerned must be declared as 'Congested Infrastructure' under Regulation 26 of The Railways Infrastructure (Access and Management) Regulations 2016.

2.9.2. If infrastructure is declared as congested, Network Rail will undertake and publish a capacity analysis within six months under paragraph 23 of the regulations. Thereafter, Network Rail will also undertake a capacity enhancement study and publish that within a further six months under paragraph 23 of the regulations. The Route Study will be used to support the capacity enhancement element of this.

2.10 Accessibility and Diversity

2.10.1 Network Rail's vision is to provide world-class facilities and services to everyone who uses the network. For the passenger interface, this is particularly around stations where Network Rail seeks to make all its stations:

- Safe
- Accessible and inclusive
- Efficient in the way natural resources are used and waste is managed
- Focused on the needs of all Network Rail customers
- Staffed by a competent, high quality team.

2.10.2. Travelling by train should be as easy as possible for everyone who uses the railway network, irrespective of age, disability, race, religion or belief, sex or sexual orientation. This brings Network Rail in line with the Public Sector Equality Duty (PSED).

2.10.3. Network Rail receives specific funding for accessibility at stations through the Access for All (AfA) fund and will continue to design infrastructure that meets all accessibility legislation. Where appropriate, Network Rail also undertakes Diversity Impact Assessments when developing schemes.

3 Baseline - the starting point

This chapter discusses the starting point for the Route Study and details the baseline timetable and projects that are expected to be completed by 2019.

3.1 Geographic scope

3.1.1. To understand the scope of the Route Study, **Figure 3.1** shows the typical geographic view of the Kent Area and some of its boundaries.

3.1.2. The area consists of the entirety of the Kent County Council and Medway Unitary Authority areas, plus eastern sections of East Sussex and Surrey.

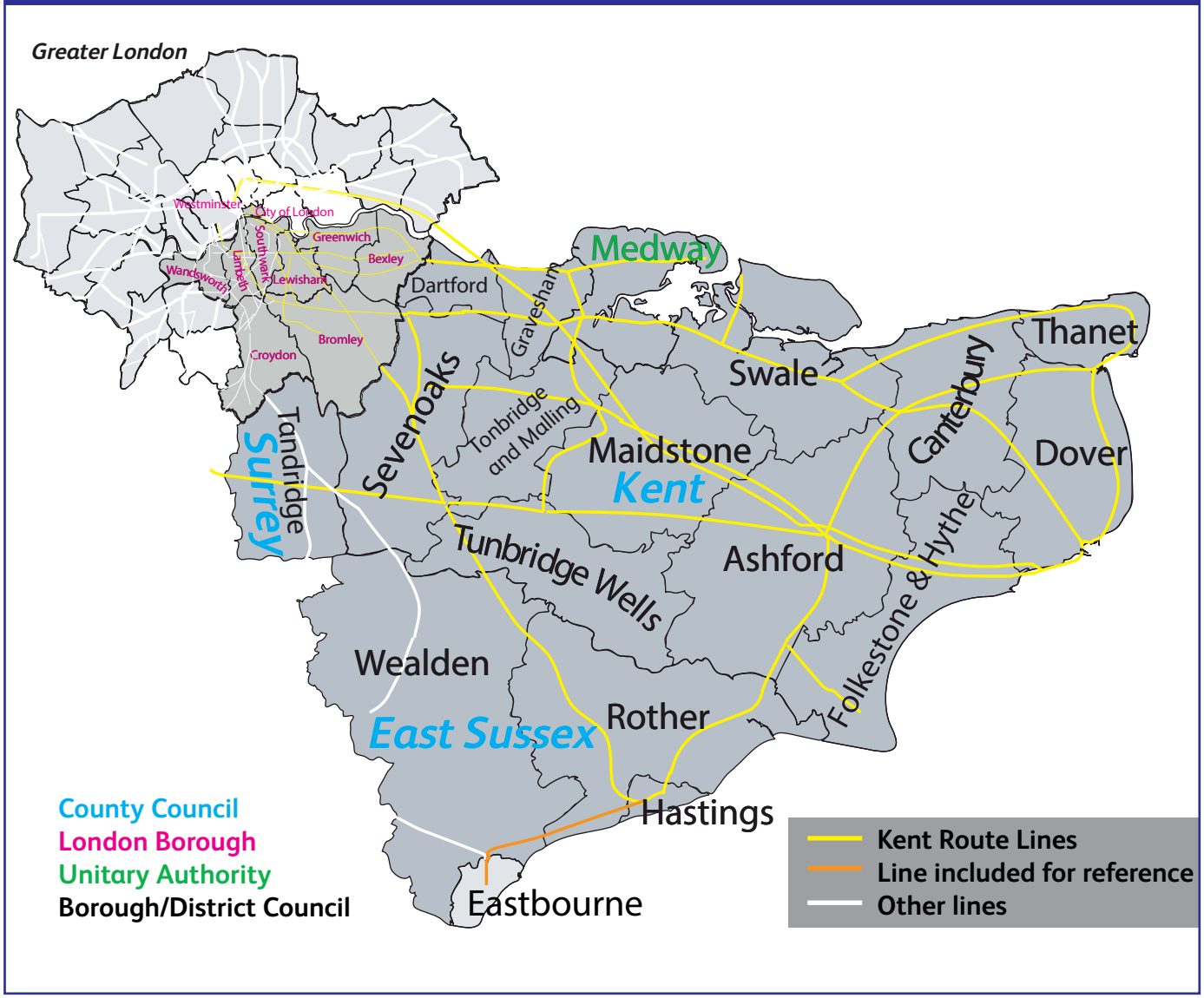
3.1.3. It also includes several London Boroughs:

- Westminster
- City of London
- Wandsworth
- Lambeth
- Croydon
- Southwark
- Lewisham
- Greenwich
- Bexley
- Bromley.

3.1.4. The map also shows the local authorities in more detail to borough and district council level. Eastbourne Borough Council is shown for reference. Shepway District Council was renamed Folkestone and Hythe District Council on 1 April 2018.

3.1.5 The complexity of the railway lines, particularly in the London area, means using this style of map does not provide the granularity required. From this point on, the Route Study uses a schematic map.

Figure 3.1 - Geographic scope



3.1.6. The lines included in the scope of the Kent Area Route Study are set out in **Figure 3.2**. For analysis purposes and consistency across the wider South East Route, cross-boundary services that also operate in the Sussex Area Route are considered within the scope of this study.

3.1.7. The geographic scope covers the complex network of lines linking south east London, Kent and parts of East Sussex with central London. Passenger services on the network operate to and from a comparatively large number of London terminals including London Victoria, London Charing Cross, London Cannon Street, London Blackfriars and London St. Pancras International. Some services do not terminate in London and instead head north through the Thameslink Core between London Blackfriars and London St Pancras International to destinations such as Bedford, Luton, Peterborough* and Cambridge*.

WHAT IS...THE DIFFERENCE BETWEEN THAMESLINK PROGRAMME AND THAMESLINK?

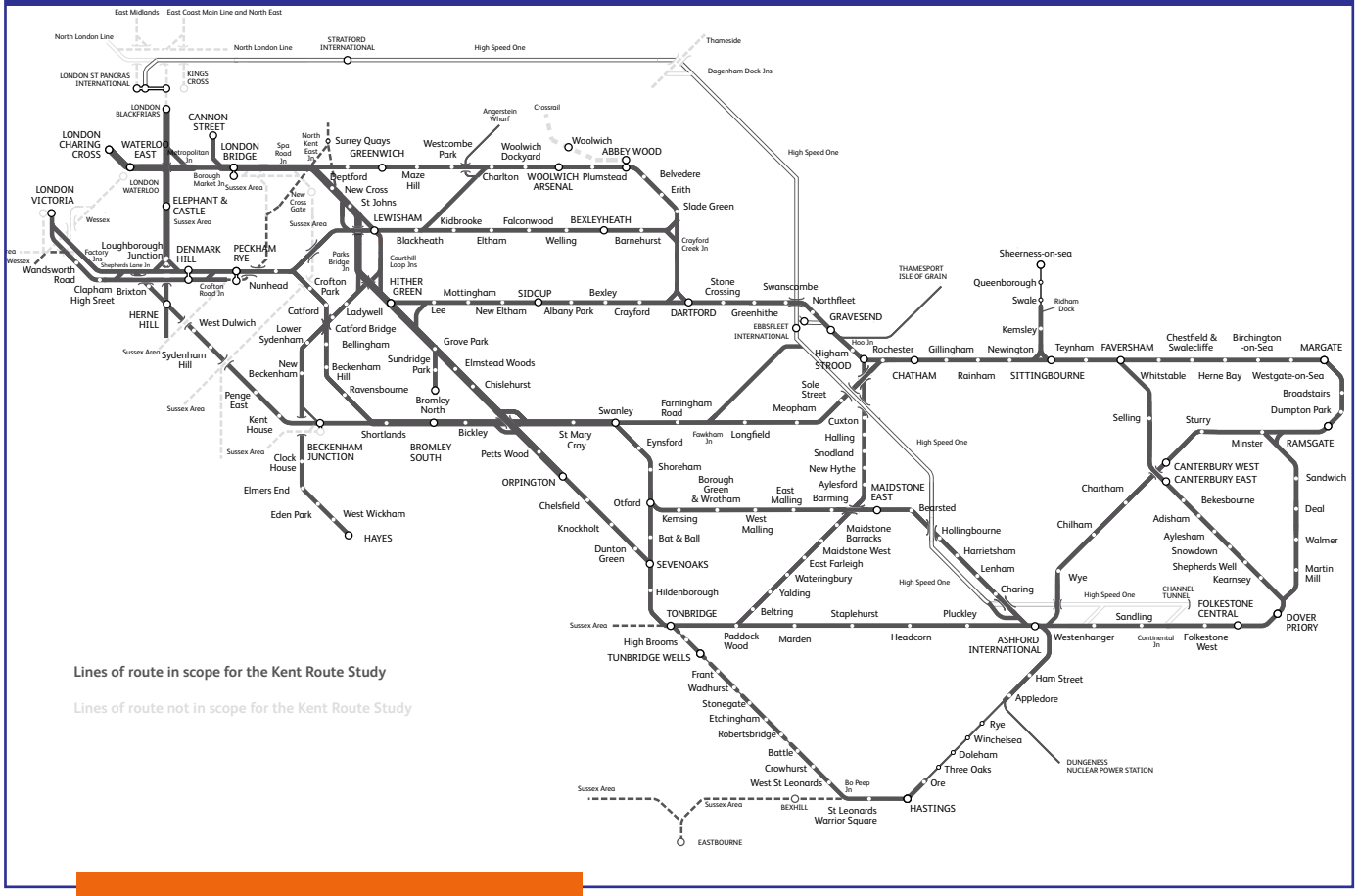
Thameslink Programme is the name of the project to prepare the infrastructure for additional trains through the Thameslink Core (between Blackfriars and St Pancras International), there's more information on this on Page 19.

ThamesLink is the trading name for GTR services which use the Thameslink Core. The Thameslink name was replaced by First Capital Connect (FCC) but has now returned to all trains using that route, albeit with a capital 'L' in the logo - this is used in this document to differentiate between the two.

Click on the logos (under the map) to be taken to the relevant website.

* New destinations from 2018; post-Thameslink Programme.

Figure 3.2 - Lines of route included in the scope of the Kent Route Study



THAMESLINK PROGRAMME

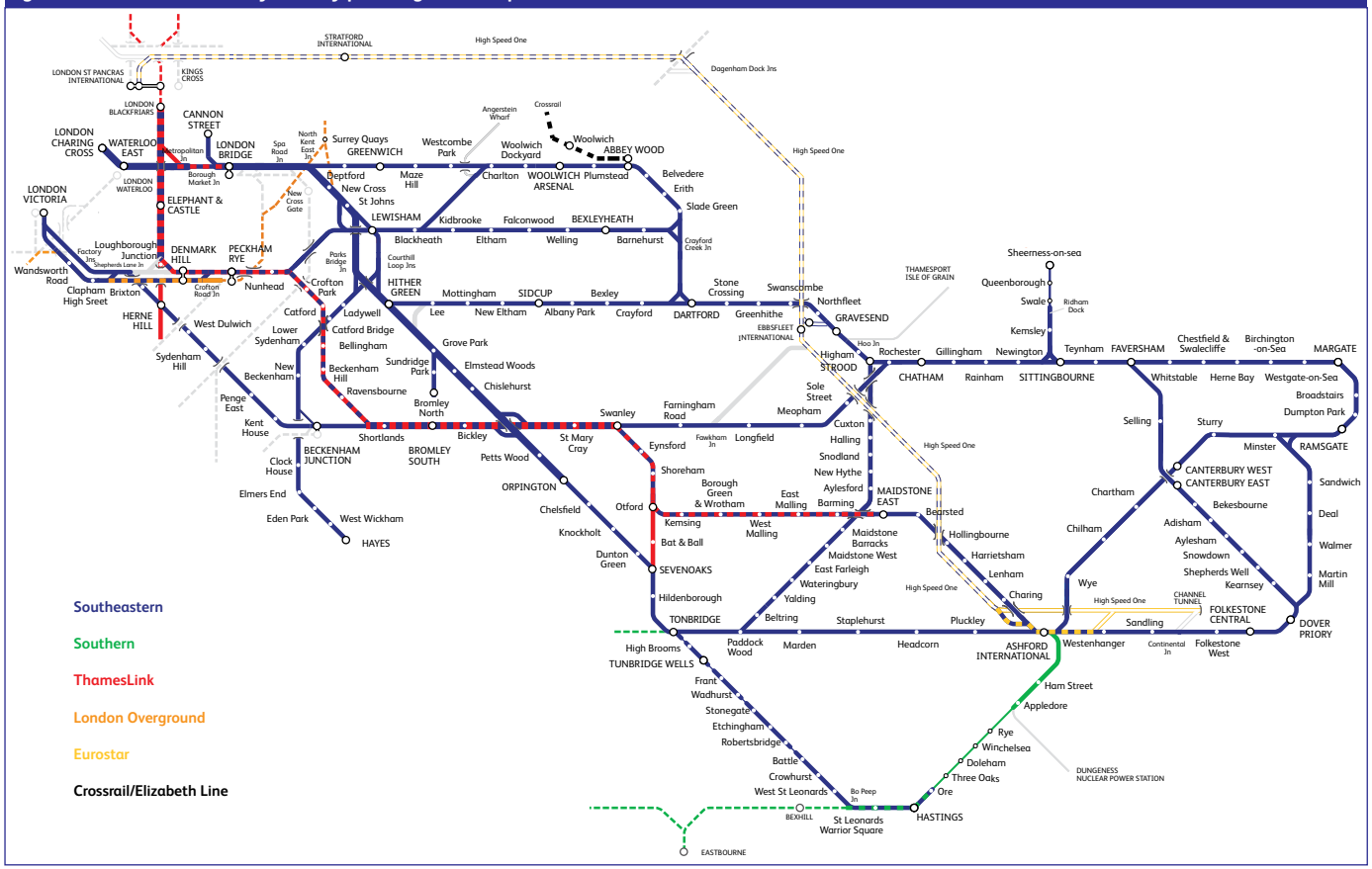
ThamesLink/

3.1.8. **Figure 3.3** shows the lines of route operated by the different train operators. Freight services and operators are detailed in paragraph 3.1.10.

3.1.9. Trains in the Kent Route Study area are operated by a number of passenger train operating companies:

- **Southeastern** – operates the majority of trains across the area, from metro services in south east London, its mainline commuter services to towns in Kent and parts of East Sussex and high speed services to Ebbsfleet, Ashford, Canterbury and the Kent Coast
- **Southern** (part of Govia Thameslink Railway) – operates 'Marshlink' services between Brighton and Ashford International and local services between Tonbridge and London via Redhill
- **ThamesLink** (part of Govia Thameslink Railway) – operates most services through Elephant & Castle and London Bridge to London Blackfriars and beyond. A new half-hourly service from Rainham via Abbey Wood and Greenwich will operate from 2018 and a new fast half-hourly service from Maidstone East from December 2019.
- **London Overground** (operated by Arriva Rail London for TfL) – operates East London Line services from Clapham Junction via Denmark Hill to Surrey Quays and beyond
- **Eurostar** – although not technically within the scope of the Route Study, it is important to keep in mind that these services have pathways that affect Southeastern's services at Ashford International and on HS1
- **Crossrail/Elizabeth Line** (operated by MTR Corporation (Crossrail) Ltd for TfL) – the baseline year of the Route Study is 2018 so these new cross-London services will be operating, although not in scope due to the separation of the networks.
- **Open Access Operators** - charter trains regularly depart London Victoria for excursions around Kent and Sussex as well as other parts of the country. These trains are operated by a variety of locomotives from classic steam to modern diesel locomotives by open access operators such as West Coast Railways or freight operators such as DB Cargo.

Figure 3.3 - Kent Route Study area by passenger train operator



3.1.10. **Figure 3.4** shows the freight terminals and sidings in use or available to freight operators in the Kent Route Study area. Freight operators include:

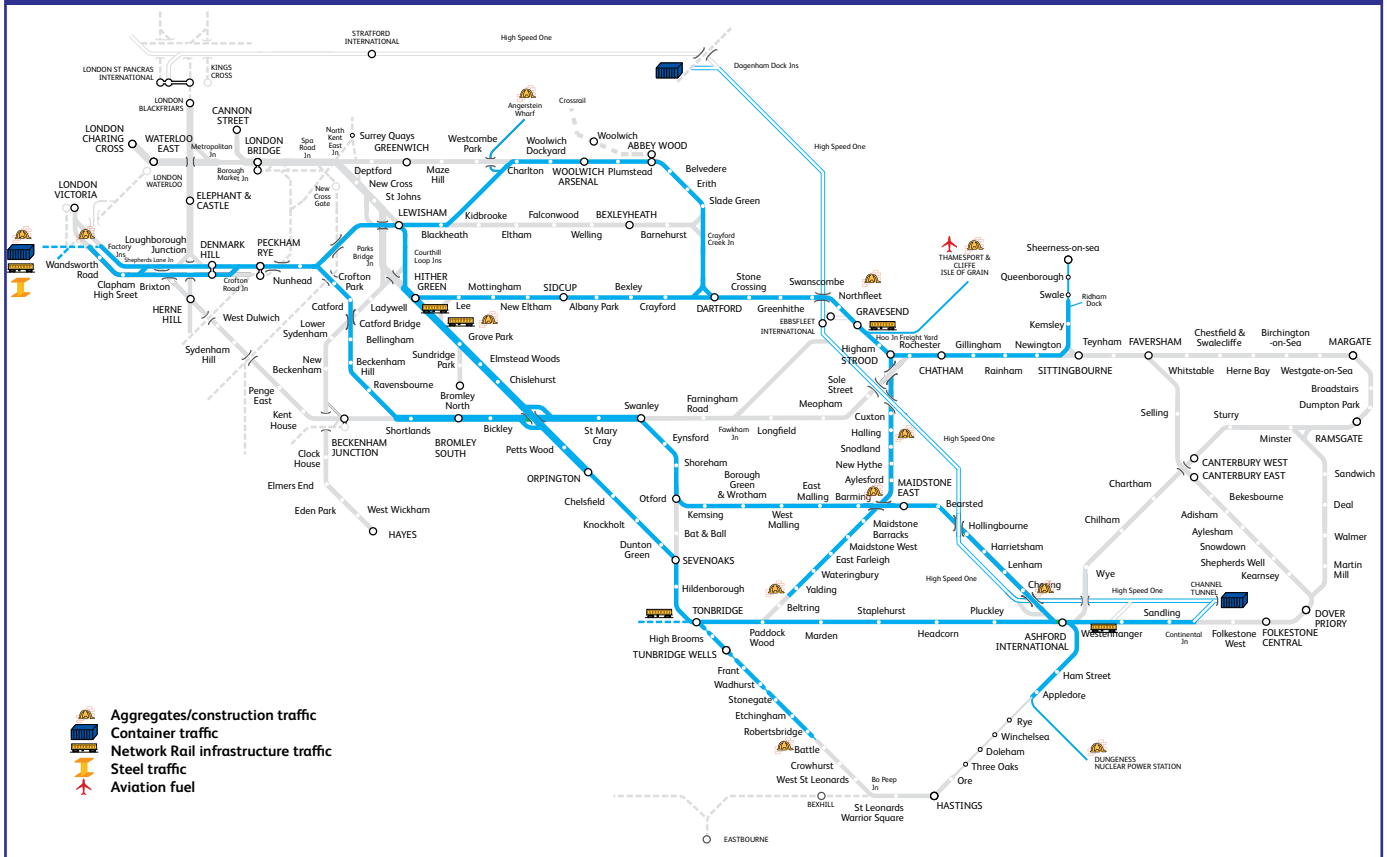
- DB Cargo
- GB Railfreight (GBRf)
- Freightliner
- Direct Rail Services (DRS)
- Colas Rail.

3.1.11. There are numerous freight operators and freight flows in the Route Study area. The majority of the freight is construction traffic and international traffic via the Channel Tunnel. Construction includes raw materials for concrete such as sand and aggregates.

3.1.12. Network Rail is a big freight customer too with on-track machines, engineers, inspection, test, ballast, railhead treatment trains etc are based across the area. Facilities at Hither Green, Hoo Junction and Tonbridge are essential for the day-to-day operation and maintenance of the railway.

3.1.13. Freight operators also operate regular charter train services for customers such as the Belmond excursion trains (formerly known as the Venice-Simplon Orient Express) from London Victoria amongst other locations.

Figure 3.4 - Kent Route Study area showing freight routes and terminals



An engineers train passes through Ashford International station hauled by a Freightliner Class 66 locomotive

For further information regarding the specific characteristics of the Kent Area Route, please refer to the South East Route: Kent Area Network Specification and Route Specification that outline this information. Click this box for more info.

3.1.13. **Figure 3.5** shows the geographic scope map with colloquial names for the lines of route and designates the metro area.

3.1.14. For analysis purposes, the geography of the Kent Area Route Study has been divided into service groups incorporating corridors across the route area as follows:

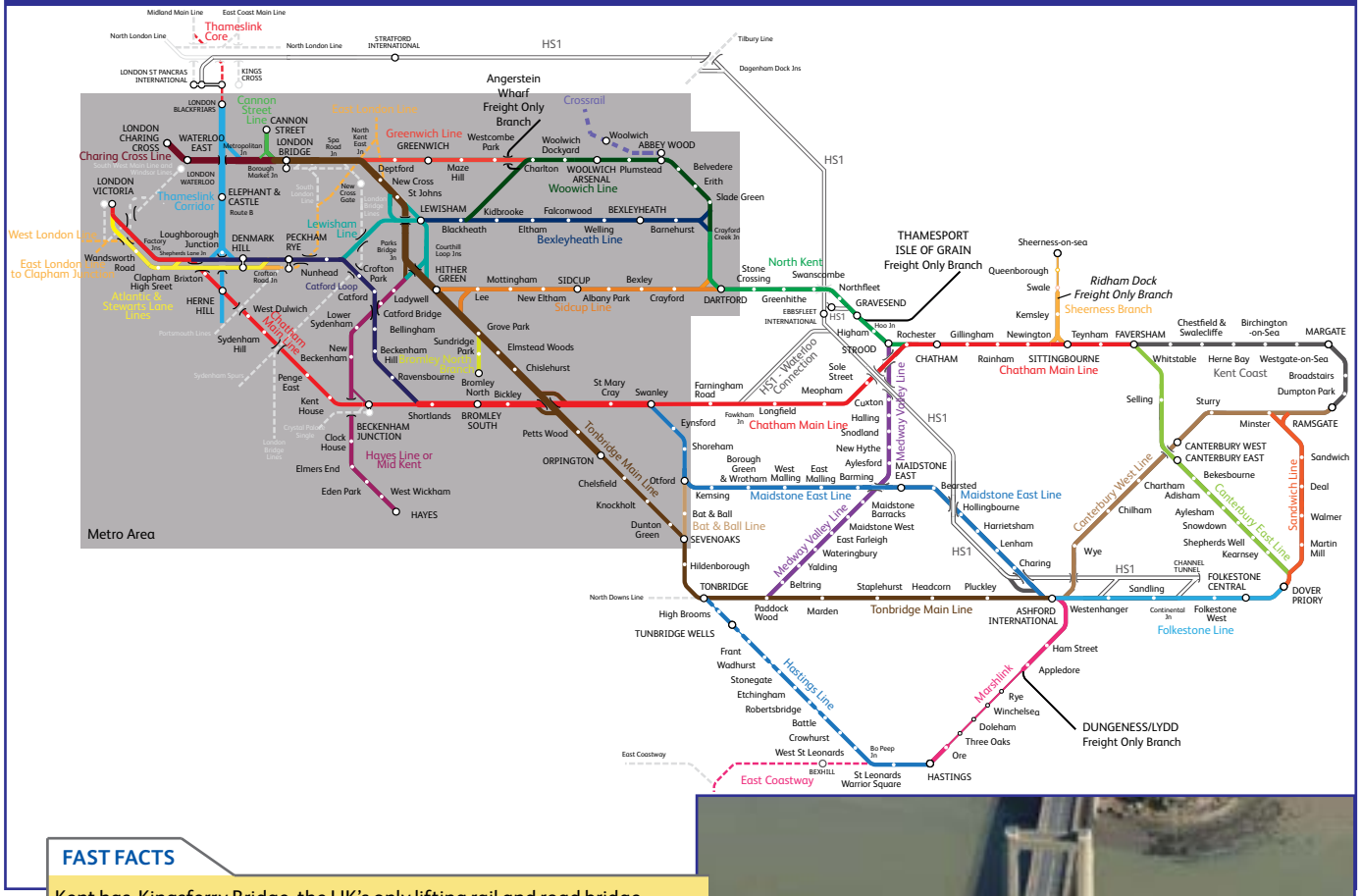
- London Bridge Metro Services
- London Victoria Metro Services
- London Blackfriars Services
- Domestic High Speed Services
- London Victoria and London Bridge Main Line services
- Regional Services.

3.1.15. Although not part of Network Rail regulated infrastructure (owned by Network Rail Infrastructure Ltd.), High Speed One (HS1) forms an integral part of the rail network in Kent. Network Rail (High Speed) carries out operations and maintenance on this route under contract to its owners, HS1 Ltd.

3.1.16. Since 2009, Southeastern has operated domestic high speed services on HS1 from various locations in Kent to St Pancras. Eurostar also operates international services to/from mainland Europe via HS1 and the Channel Tunnel. For the purposes of this Route Study, domestic high speed services which operate on both the National Rail network and HS1 are considered within scope. International services, which sit outside the domestic regulatory regime, do not form part of the Route Study scope.

3.1.17. Since the Long Term Planning Process started, Network Rail's previously devolved Kent and Sussex Routes have merged to form the South East Route with a central management team covering the day-to-day operational management of the newly established route. Given specific line of route issues on this area and the adjacent former Sussex Route area, the Route Study Board, whose role it is to direct and oversee the Route Study, agreed to produce a full Route Study dedicated to this specific geographical area.

Figure 3.5 - Kent Route Study area showing colloquial names for the lines of route and metro area



FAST FACTS

Kent has Kingsferry Bridge, the UK's only lifting rail and road bridge connecting the mainland with the Isle of Sheppey. Opened in 1960, it replaced a toll road and rail bridge.

It stands at about 123ft (37m) high whilst the lifting span can only reach 84ft (26m) and lifts to enable ships to pass under to access Ridham Dock or leisure craft such as yachts which can circumnavigate the Island.

There is no third rail on the lifting span so electric trains coast across.

WHAT IS... THE THAMESLINK PROGRAMME?

Thameslink Programme is the government-sponsored project that is transforming north-south travel through London.

This programme will help us meet a massive rise in demand, increasing the number of ThamesLink services through Central London to every two or three minutes in the peak and help relieve overcrowding on London Underground - particularly the Northern Line.

It will improve connections, giving passengers better travel options to more destinations by linking some services from Cambridge, Peterborough and Welwyn Garden City into the ThamesLink network, providing new through services to London Bridge, Orpington, Sevenoaks, Maidstone East and Rainham.

Click on this box for more information.

WHAT IS... CROSSRAIL?

Crossrail is the new railway that has been built under London and will be known as the Elizabeth Line when it opens in late 2018.

Linking Reading and Heathrow Airport to Shenfield and Abbey Wood via Central London, it will transform east-west travel through London and also help relieve overcrowding on London Underground.

Click on this box for more information.

3.2 Planned Schemes

3.2.1. There are several projects and programmes currently planned or that are being delivered across the Kent Area Route, all of which, in addition to the existing infrastructure, have contributed to the formation of a starting position for the study.

3.2.2. **The Network Rail Enhancement Delivery Plan (EDP)** sets out the key milestones for the planned completion of enhancements to the network. In January 2016, Sir Peter Hendy completed a review of the EDPs, which impacted the Long Term Planning Process (LTPP) and has resulted in the scope of some elements of the EDP being deferred or delayed. The Enhancements Delivery Plan Update (EDPU) outlines the revised enhancement delivery plan.

3.2.3. The Kent Area is fortunate that the committed schemes on the Route Area had commenced delivery when the Hendy Review was undertaken, therefore the baseline for the Kent Area Route Study has not changed following the outcomes of this process.

Thameslink Programme

3.2.4. The Department for Transport's Thameslink Programme aims to provide a step change in capacity on an extended ThamesLink network. This will provide new journey opportunities for passengers as well as delivering congestion relief and providing additional capacity for forecast future growth in passenger demand on the National Rail and London Underground networks.

3.2.5. Govia Thameslink Rail (GTR) carried out a consultation on future ThamesLink train services, which included major proposals for routes in Kent, namely services to:

- Rainham via Greenwich (replacing existing Southeastern Gillingham to Charing Cross services)
- Maidstone East via London Bridge.

3.2.6. The Draft Study was based on the 2014 Development Timetable proposal for Thameslink Key Output 2 in 2018. For this Final Route Study, we have undertaken further demand modelling to understand the effect.

3.2.7. It is likely that the introduction of the Maidstone East services will have a major impact, from December 2019. Currently, the county town of Kent has a relatively slow service to London and it is expected that many commuters 'railhead' to stations on the main line via Sevenoaks. This means they drive to a station further away that has a better service than their local service.

3.2.8. Therefore, a key future activity will be to assess change of usage following the introduction of these services.

Crossrail/Elizabeth Line

3.2.9. The Crossrail project will deliver a new railway route through central London from Reading and Heathrow Airport in the west to Shenfield and Abbey Wood in the east. Services will be branded as Elizabeth Line.

3.2.10. The services to Abbey Wood will interchange with the North Kent line and are expected to lead to changes of travel patterns on the route. The lines at Abbey Wood will be operationally separate from the existing lines, so trains will not be able to pass from one network to the other; passengers will have to interchange to continue their journey.

3.2.11. The Crossrail project benefits include:

- Up to 24 Crossrail trains an hour running through the central section in each direction (from May 2019)
- The upgrade of 28 existing surface stations, including being made fully accessible, and a rebuilt station at Abbey Wood
- Greater connectivity to and beyond central London
- Reduced crowding on London Underground services.

Mobile Maintenance System

3.2.12. Network Rail has purchased bespoke maintenance trains that support a new way of working for maintenance personnel. This enables them to work on the track, under cover and in the safety of the train which has all the equipment required to carry out many of the tasks that currently require carrying equipment to and from site in all weathers. Delivery of core maintenance works in a more efficient manner such as this will lead to improved utilisation of track access.

3.2.13. This system has the potential to deliver significant safety, capability and quality benefits. The system provides a platform from which greater work quantities can be delivered without increasing track access times.

Power Supply Enhancements

3.2.14. Most of the passenger lines of route covered by the Kent Route Study are electrified with the 750 volt direct current (750V DC) conductor (third) rail system. The exceptions are HS1 and its interfaces, where 25,000 volt alternating current (25kV AC) overhead lines are provided, and Marshlink, which is not electrified. The Angerstein Wharf, Grain and Dungeness freight branches are also not electrified. **Figure 3.6** shows the traction power supply on the network.

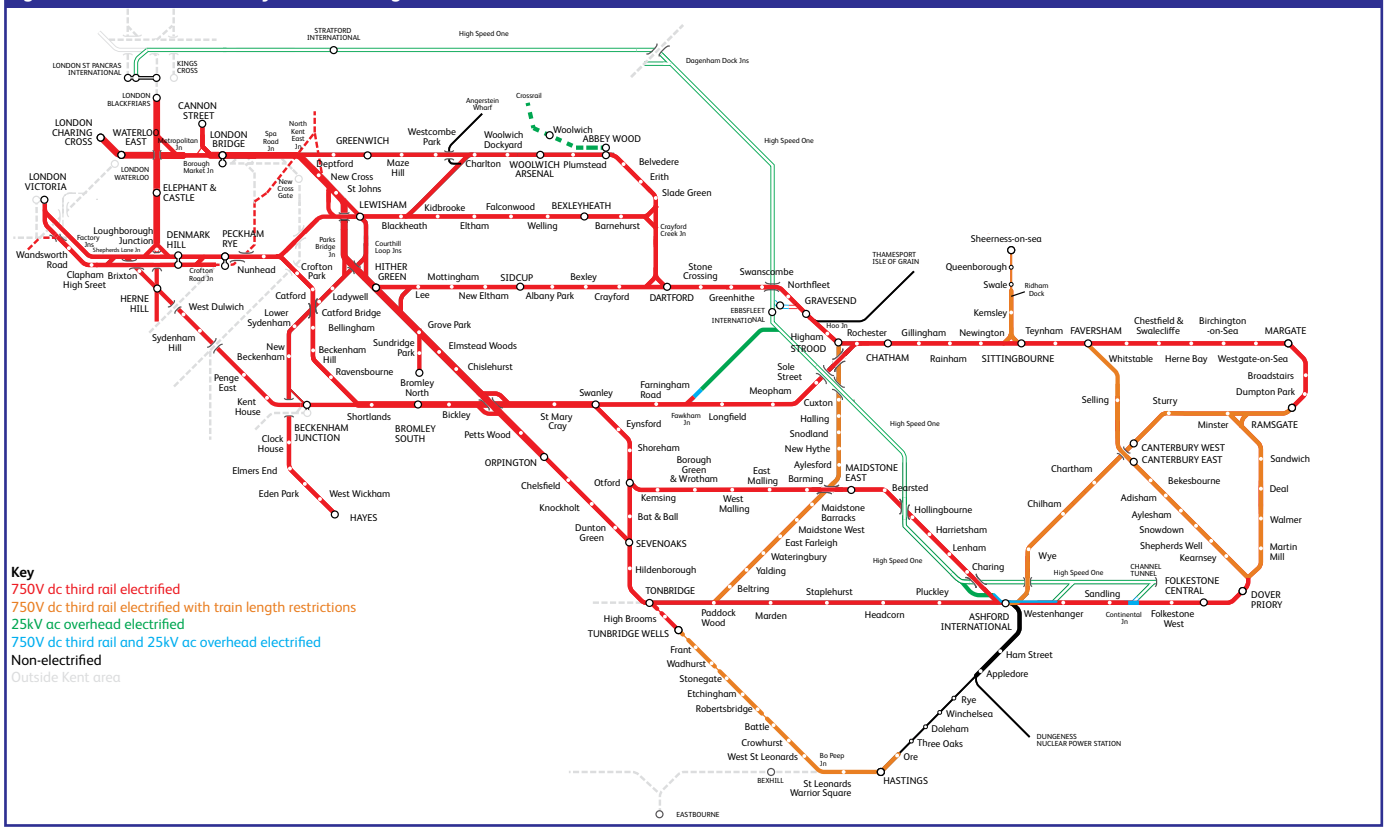
3.2.15. The third rail system is susceptible to power reductions when longer or more frequent trains are operated so the power supply has to be bolstered to cope with new demand. Historically, power supply upgrades have been delivered on a piecemeal basis to address short-term problems, rather than on a strategic long-term basis.

3.2.16. Power supply enhancements on the Kent Route are being delivered through several CP5 projects as detailed in the Enhancements Delivery Plan. These are concentrated on the Metro Area, however, further issues are known to affect the rest of the Route and will need to be developed before longer trains can operate.

3.2.17. The power supply upgrade project has been delivered in three phases in order to provide the necessary infrastructure to facilitate the operational plan assumed with train operators to deliver the 2018 capacity metrics. 12-car formations of existing Class 465 units are now operated on the following routes between London Charing Cross, Cannon Street, London Bridge and:

- Dartford via Woolwich/Greenwich, Bexleyheath and Sidcup (three routes)
- Hayes (Kent)
- Sevenoaks (via Grove Park)
- Gravesend via Dartford.

Figure 3.6 - Kent Route Study area showing electrification



3.2.18. The next phase enabled 12-car Class 465 train operation on the remaining corridors (except Brixton - London Victoria) in preparation for supporting the post-Thameslink Programme 2018 timetable specification:

- Gravesend to Gillingham
- Outer Kent resilience: Grove Hill and High Brooms substation upgrades.

3.2.19. The New Cross Grid Upgrade project is upgrading the electricity supply feed from the national grid to provide increased traction power supply capacity for DC electric services in South London, North Kent and Sussex. It is required to enable post-Thameslink Programme 2018 service upgrades and provides additional baseline capacity in the area for forecast future train service increases, as well as greater resilience with the ability to be fed by the Wimbledon grid feed if required.

WHAT IS... MARSHLINK?

It is the line between Ashford International and Hastings. It is one of three passenger lines in the South East Route that are non-electrified. Services are operated by Southern.

You said...

Kent County Council, Kent and Medway Economic Partnership and South East Local Enterprise Partnership mentioned the reconstruction of Strood station.

The station building at Strood has been completely rebuilt in a £2.8M upgrade as part of the National Stations Improvement programme and Medway Council's regeneration of the local area.

The new station is bright and modern and complements the neighbouring Rochester station which was upgraded in 2015.

The new building was opened in late 2017.

East Kent Resignalling Phase 2

3.2.20. The project is completed and has centralised signalling control to the East Kent Signalling Centre in Gillingham. This will enable more trains to operate through the Medway Towns. Improvements include:

- A new three-platform station at Rochester improving integration of the railway with other forms of public transport, closer to the heart of the city centre and providing a direct link to the area of disused dockland which is now being redeveloped
- Two loop lines at the former Rochester station have berthing capability
- Lengthening of all three platforms at Strood to 12-cars
- The new Platform 0 at Rainham.

Gravesend Train Lengthening

3.2.21. This scheme facilitated 12-car operations on specific services between Gillingham and Gravesend and has been delivered.

The new Rochester station has proved very popular as it is closer to the City Centre, Cathedral and Castle - passenger numbers have risen from 1,385,260 in 2015/16 to 1,631,718 in 2016/17

3.3 Working approach and assumptions

3.3.1. This section outlines the working approach and assumptions that have been applied in developing the strategy that underpins the Kent Area Route Study.

Development and Methodology

3.3.2. The study has developed and assessed choices for the long-term use and development of the network. The starting point of the study is to determine whether the conditional outputs from the relevant Market Studies can be accommodated on the existing infrastructure with committed enhancements.

3.3.3. These conditional outputs reflect the emerging requirements for capacity and connectivity, building on the current infrastructure and the committed development of other interventions including Crossrail.

3.3.4. It is important to note that the conditional outputs are dependent upon affordability, funding and a value for money business case. Equally, the conditional outputs are required to be feasible and deliverable – technologically, operationally and physically.

3.3.5. In order to address the identified constraints, a standard toolkit of intervention options has been used. In the first instance, better use of existing infrastructure and available capacity is considered. This can be delivered through, for example, investigating options for improved timetabling, or train lengthening to accommodate forecast demand. Where these options are not possible, or do not fully accommodate forecast growth, infrastructure enhancement options are considered. Options are then defined and developed to an initial stage to ensure that they are feasible and deliverable and are assessed against funders' decision-making criteria.

3.3.6. In conjunction with assessments of affordability and value for money, factors such as connectivity, journey times, performance and engineering access requirements are considered.

3.3.7. To ensure that interventions are part of a long-term, affordable and deliverable strategy, it is essential that system requirements are considered beyond 2024 as part of planning.

Identification of Choices

3.3.8. The investment choices for funders have been identified based on one of the following criteria:

- The intervention is required to accommodate forecast passenger and/or freight demand to 2024
- There is a renewal due between 2019 and 2024 that presents a 'once in a generation' opportunity for infrastructure enhancement during the renewal process to reduce 'whole life cost'
- The intervention can deliver whole-industry cost savings
- The intervention is a funder identified priority or aligns to funder aspirations.

Baseline timetable

3.3.9. A baseline timetable was essential to the development of the Route Study but due to the complications of the Thameslink Programme works, the Charing Cross/Cannon Street diversions and the proposed post-Thameslink Programme timetable proposed by GTR, the following were decided as the base:

- **Freight** – May 2015 timetable
- **International passenger trains** – May 2015 timetable
- **HS1 domestic** – May 2015 timetable but with the capacity of the May 2018 timetable, assuming all four trains arriving at London St Pancras International from Ashford International in the High Peak Hour are formed of 12-cars
- **Non-London services** – May 2015 timetable
- **Kent ThamesLink services**:
  - Rainham - Luton 2 trains per hour (tph), replacing the Gillingham - Charing Cross service and running via Greenwich
  - Maidstone East - Cambridge 2tph, this is an additional all day service running fast from Swanley to London Bridge via Chislehurst (replaces the peak only Ashford International to Blackfriars service) - from December 2019
  - Sevenoaks - Welwyn Garden City 2tph all day
  - Orpington - Luton 2tph all day

  (4tph via Catford)
- **London services** – Southeastern May 2018 timetable with stops at London Bridge reinstated, including 22tph to Cannon Street and increased use of Blackfriars Bays (Platforms 3 & 4) - the Autumn 2017 Class 377 cascade has been included and the Bromley North Branch is assumed to be 4tph in the High Peak Hour
- **London Overground** – 4tph Highbury & Islington to Clapham Junction
- **Other amendments:**
  - Additional stops on the Catford Loop to retain current service levels at some stations
  - Contra-peak train lengthening to support improved service to Abbey Wood on completion of Crossrail
- **Crossrail/Elizabeth Line** – 12tph Abbey Wood to central section via Canary Wharf.

New style Customer Information System at London St Pancras International ThamesLink platforms.

3.3.10. In the Draft for Consultation, there was a spider diagram of services into London in the High Peak Hour. This has been removed from this document as the December 2018 and 2019 timetables are not fully confirmed.

3.4 Safety

3.4.1. Safety is a key priority for the rail industry and it is important that safety is considered from the very start when developing strategies and interventions. Safety has been considered in this study in terms of:

- Opportunities to reduce existing system safety risks when developing strategic concepts
- Understanding and seeking to mitigate any system safety implications of forecast growth, and our strategies to enable that growth
- Opportunities to enact relevant industry safety strategies through the study.

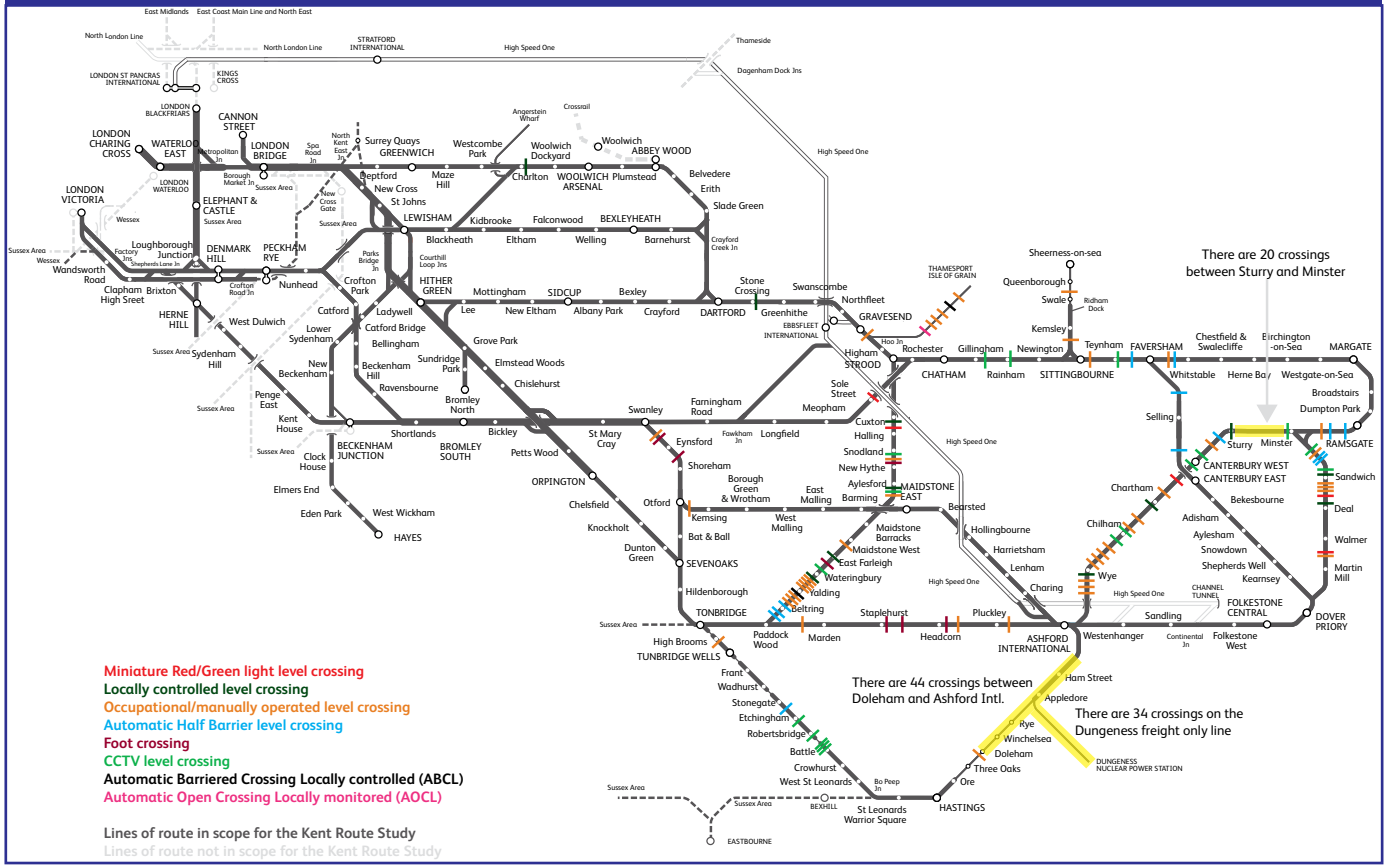
3.4.2. In addition to safety considerations being part of the development of each strategic concept, this approach has driven a focus on two areas which are clear strategic safety priorities: safety at level crossings and safety at stations.

3.4.3. The level crossings approach is to identify level crossings affected by the changes outlined in the strategy, whether they are changes to service level or to the infrastructure itself. Where the strategy requires changes in infrastructure to deliver outputs, the option to improve safety at or close to level crossings has been incorporated into the intervention. The impact of the future service specification on all level crossings across the route has also been considered and shows where additional and/or faster train services may be operating over the crossing. This work will feed into discussions with local transport providers and local planning authorities about the future of each affected level crossing. The level crossings are shown on the map in **Figure 3.7**.

3.4.4. Stone Crossing level crossing closed in early-2018 as it has been replaced by a footbridge. This has improved access to the platforms when trains are in the vicinity.

3.4.5. For stations, the focus has been on the interface between passengers and trains, particularly for platform capacity and overcrowding. Congestion on stairwells, escalators, footbridges, subways and concourses has also been considered. In order to quantify the safety benefits, we have used accident frequency data and assessed how a proposed change might reduce the risk.

Figure 3.7 - Kent Route Study area showing level crossings by type



3.4.6. South East Route has been trialling remote isolation protection equipment to enable staff on the ground to turn off the power to the conductor rail safely. Currently, staff have to carry heavy straps to site. These are physically attached to the conductor rail and running rails to cause a short circuit if the power should be accidentally switched back on.

3.4.7. The time taken to protect an engineers possession of the line for engineering works will be reduced by this innovative equipment as well as providing a safer method of working for staff on the ground.

3.5 Rolling stock, depots and stabling

3.5.1. Trains are maintained and serviced in depots. Some servicing, such as cleaning and refilling of toilet water tanks, is undertaken in stabling sidings, remote from depots. **Figure 3.8** shows the locations of depots and stabling facilities, as well as typical usage.

3.5.2. Ramsgate and Ashford are the main depots for High Speed and Main Line trains, Slade Green for Metro trains and New Cross Gate for London Overground trains. Southern's trains are maintained at Selhurst or Brighton Lovers Walk depots.

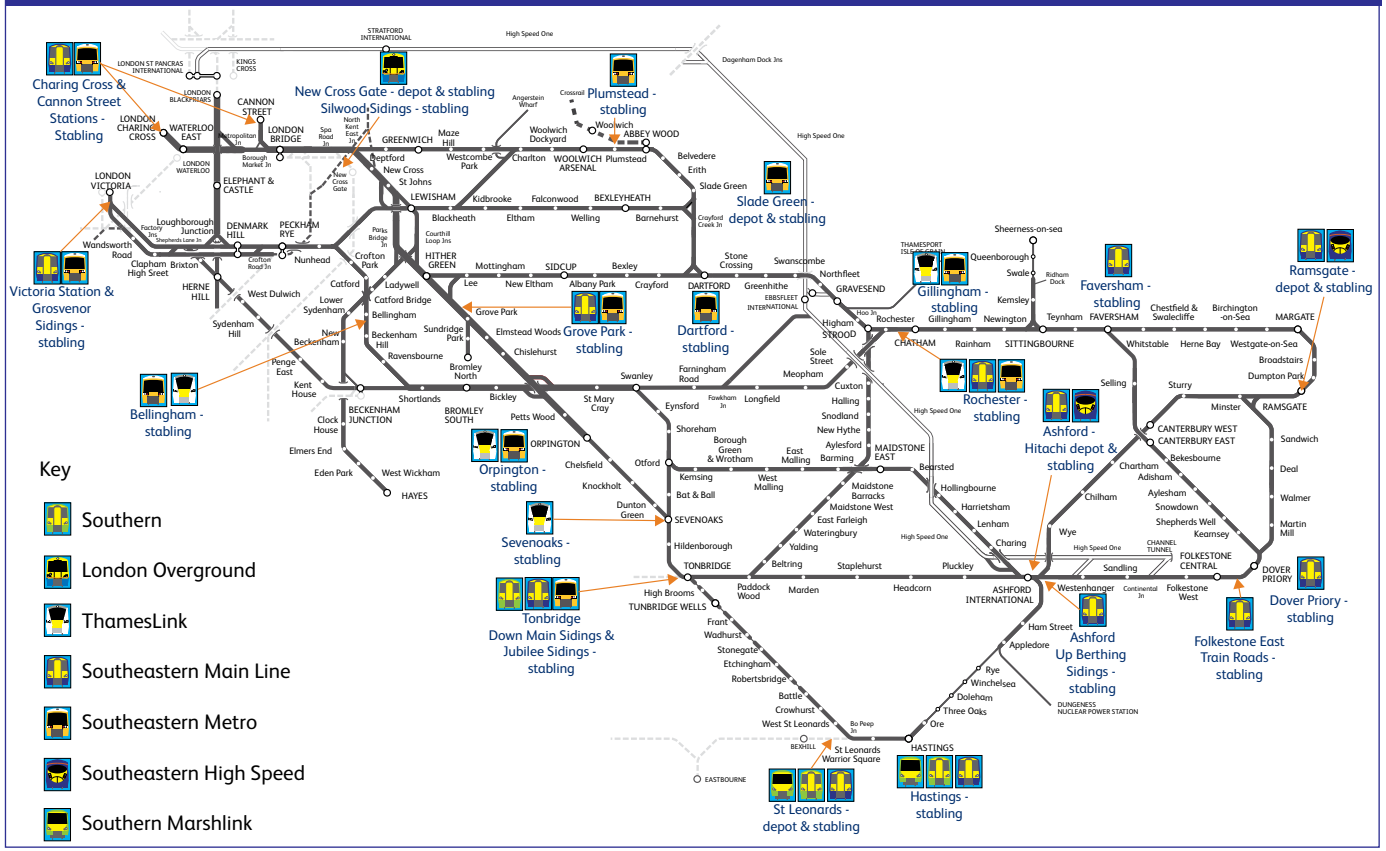
3.5.3. Whilst units can be coupled together to form longer trains, due to coupling types and manufacturers policies, not all classes of unit can work in passenger service together. This adds a level of complexity when trying to timetable trains and rolling stock.

3.5.4. In the Kent Route Study area, the typical vehicle length is 20m but some vehicles are slightly longer or shorter than others, even within a unit. This is an issue with Networkers; the driving vehicles are longer than the intermediate vehicles and the coupling protrudes further than other units. When two 4-car multiple units are coupled together, an 8-car Networker is longer than an 8-car Electrostar.

3.5.5. Classes 465, 466 and 376 are not fitted with Selective Door Opening so all doors are unlocked on the platform-side, whereas other classes can keep the rear vehicle doors locked - this is useful at short platforms as it enables longer trains to call there. Often, platform lengthening at these stations is unaffordable or impractical or not justified by passenger demand.

A Class 465 Networker (left) stands alongside a Class 375 Electrostar (right) in berthing sidings at Tonbridge, the difference in length is visible.

Figure 3.8 - Kent Route Study area showing depots and stabling



3.5.6. The next two pages briefly detail the rolling stock types used on Kent Route Study area trains. The type and length of train and its seating layout is vital for maximising passenger accommodation and there is a trade-off between more seats, less standing or more standing space, fewer seats. Rolling stock is expected to be operational for 25-40 years.

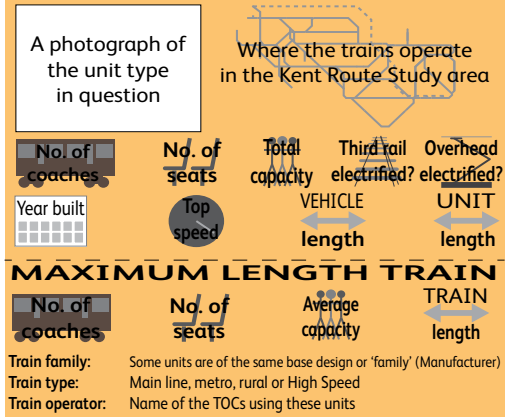
Below is an example showing the information presented.

WHY THIS IS IMPORTANT

Click on the box above to start the video - it runs for approximately two minutes and has no sound.

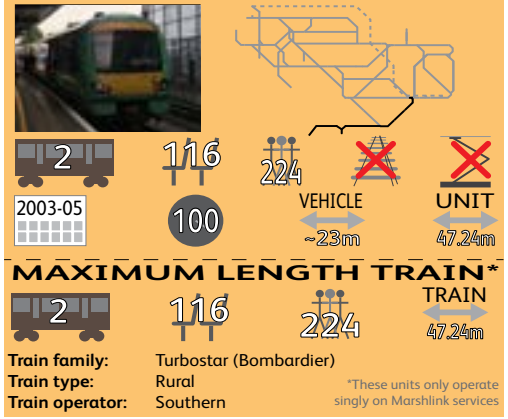
(The video only appears in the interactive version of the document, an empty box will be shown in the print version)

WHAT IS... A CLASS xxx?



Train family: Some units are of the same base design or 'family' (Manufacturer)
Train type: Main line, metro, rural or High Speed
Train operator: Name of the TOCs using these units

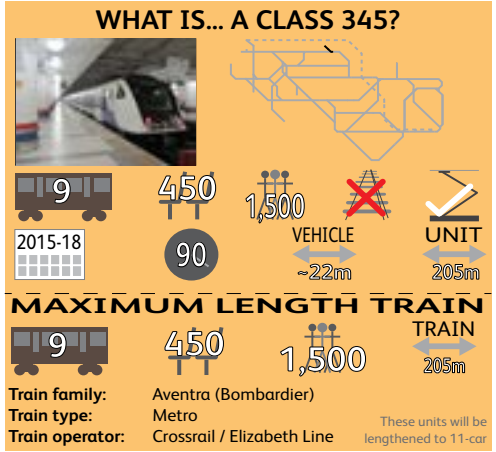
WHAT IS... A CLASS 171?



Train family: Turbostar (Bombardier)
Train type: Rural
Train operator: Southern

*These units only operate singly on Marshlink services

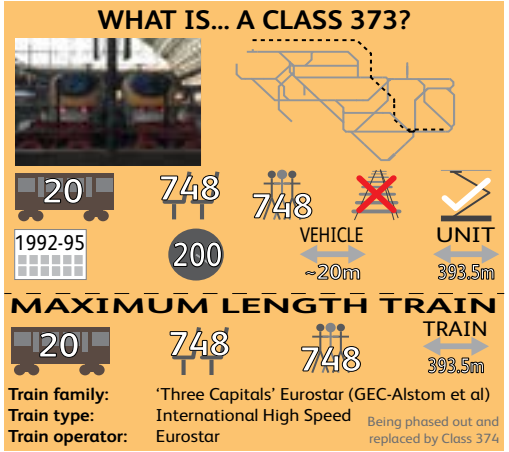
WHAT IS... A CLASS 345?



Train family: Aventra (Bombardier)
Train type: Metro
Train operator: Crossrail / Elizabeth Line

These units will be lengthened to 11-car

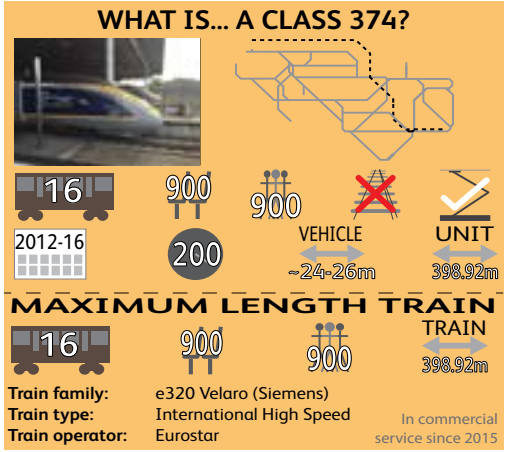
WHAT IS... A CLASS 373?



Train family: 'Three Capitals' Eurostar (GEC-Alstom et al)
Train type: International High Speed
Train operator: Eurostar

Being phased out and replaced by Class 374

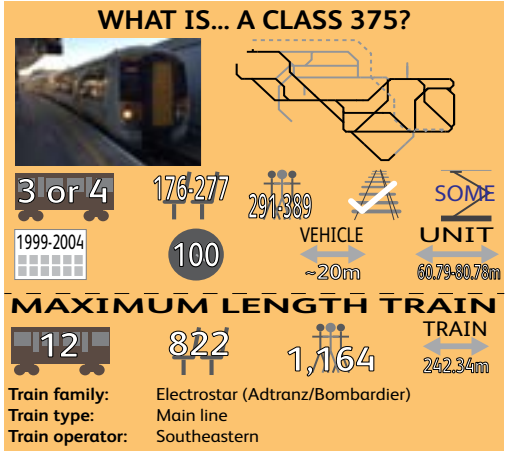
WHAT IS... A CLASS 374?



Train family: e320 Velaro (Siemens)
Train type: International High Speed
Train operator: Eurostar

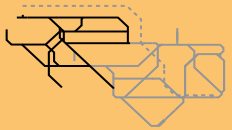
In commercial service since 2015

WHAT IS... A CLASS 375?



Train family: Electrostar (Adtranz/Bombardier)
Train type: Main line
Train operator: Southeastern

WHAT IS... A CLASS 376?



5 | 224 | 640 | ✓ | ✗

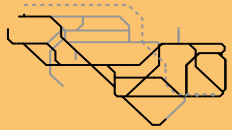
2004-05 | 75 | VEHICLE ~20m | UNIT 100.77m

MAXIMUM LENGTH TRAIN

10 | 448 | 1,280 | TRAIN 201.54m

Train family: Electrostar (Bombardier)
Train type: Metro
Train operator: Southeastern

WHAT IS... A CLASS 377?



4 | 241-6 | 386 | ✓ | ✓

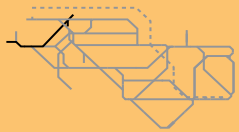
2002-03 2008-09 | 100 | VEHICLE ~20m | UNIT 80.78m

MAXIMUM LENGTH TRAIN

12 | 723-38 | 1,158 | TRAIN 242.34m

Train family: Electrostar (Bombardier)
Train type: Main line
Train operator: Southeastern

WHAT IS... A CLASS 378?



5 | 186 | 525 | ✓ | ✗

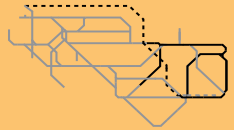
2009-10 2014-15 | 75 | VEHICLE ~20m | UNIT 100.34m

MAXIMUM LENGTH TRAIN

5 | 186 | 525 | TRAIN 100.34m

Train family: Capitalstar (Bombardier)
Train type: Metro (High Density)
Train operator: Arriva Rail London

WHAT IS... A CLASS 395?



6 | 349 | 533 | ✓ | ✓

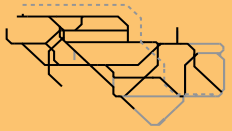
2006-09 | 140 | VEHICLE ~20m | UNIT 121.76m

MAXIMUM LENGTH TRAIN

12 | 698 | 1,066 | TRAIN 243.52m

Train family: A-Train (Hitachi)
Train type: High Speed
Train operator: Southeastern

WHAT IS... A CLASS 465?



4 | 348 | 464 | ✓ | ✗

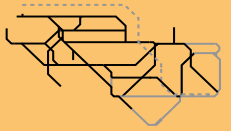
1991-94 | 75 | VEHICLE ~20m | UNIT 81.9m

MAXIMUM LENGTH TRAIN

12 | 1,044 | 1,392 | TRAIN 245.7m

Train family: Networker (BREL/ABB & Metro-Cammell)
Train type: Metro
Train operator: Southeastern

WHAT IS... A CLASS 466?



2 | 168 | 225 | ✓ | ✗

1993-94 | 75 | VEHICLE ~20m | UNIT 41.6m

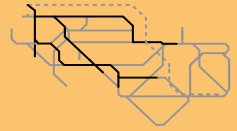
MAXIMUM LENGTH TRAIN*

10 | 864 | 1,153 | TRAIN 205.4m

Train family: Networker (GEC-Alstom)
Train type: Metro
Train operator: Southeastern

* 465+465+466

WHAT IS... A CLASS 700/0?



8 | 427 | 1,160 | ✓ | ✓

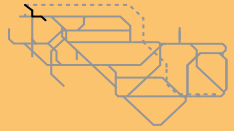
2014-18 | 100 | VEHICLE ~20m | UNIT 160.96m

MAXIMUM LENGTH TRAIN

8 | 427 | 1,160 | TRAIN 160.96m

Train family: Desiro City (Siemens)
Train type: Metro (high density)
Train operator: ThamesLink

WHAT IS... A CLASS 700/1?



12 | 666 | 1,776 | ✓ | ✓

2013-18 | 100 | VEHICLE ~20m | UNIT 241.6m

MAXIMUM LENGTH TRAIN

12 | 666 | 1,776 | TRAIN 241.6m

Train family: Desiro City (Siemens)
Train type: Main line
Train operator: ThamesLink

3.5.7. As detailed in **Figure 3.8** , there are 169 sidings/platforms used for stabling trains, including some platforms that can be used for overnight berthing. They vary in length from 4-car to 20-cars, whilst the units vary from 2- to 12-cars.

3.5.8. The graph in **Figure 3.9** (overleaf) shows the number of sidings and capacity by general location in bar graph form. Not all sidings are the same length so capacity by fixed formation unit is shown as a line graph.

3.5.9. **Table 3.1** details the fleets that berth in Kent. All of the Southeastern fleet (390 units, totalling 1,558 vehicles) are berthed in the Kent Area. Some ThamesLink Class 700/0s are berthed at Ashford and Sevenoaks overnight. Southern berth two/three Class 171s at St Leonards and several Class 377s at Hastings and Tonbridge

3.5.10. The summary table, **Table 3.2** shows the capacity and impact of longer fixed-formation units from 4-cars to 12-cars and details the capacity that is lost by being unable to use shorter sidings when deploying longer units. It may be possible for some of these shorter sidings to be lengthened but this will obviously come at an additional cost. There will be some locations, such as Gillingham Depot, were there is no more room to extend the sidings so new locations will need to be looked for. It should be noted that berthing rarely acheives 100 per cent utilisation due to constraints on entries into service and on the maximum length of train permitted on the route.

3.5.11. The table and graph clearly show that 4-car units provide the best use of existing capacity. Due to the number of 12-car sidings and platforms, 6-car units have better capacity utilisation than 5-cars.

3.5.12. Fleet flexibility is also better with shorter units as a fault or failure can mean the difference between a short-formed and a cancelled train. Moreover, it is better for the environment as shorter trains can be operated at the appropriate time, rather than a long train with few passengers.

3.5.13. The Office for Rail and Road (ORR) has published 'Guidance Note for the Development and Design of Passenger Depots'. The consultation draft was issued in January 2018 and should be adopted in Summer 2018. It documents best practice and lessons learnt for depot design teams and should be used as guidance for improvements to existing depots and stabling sidings.

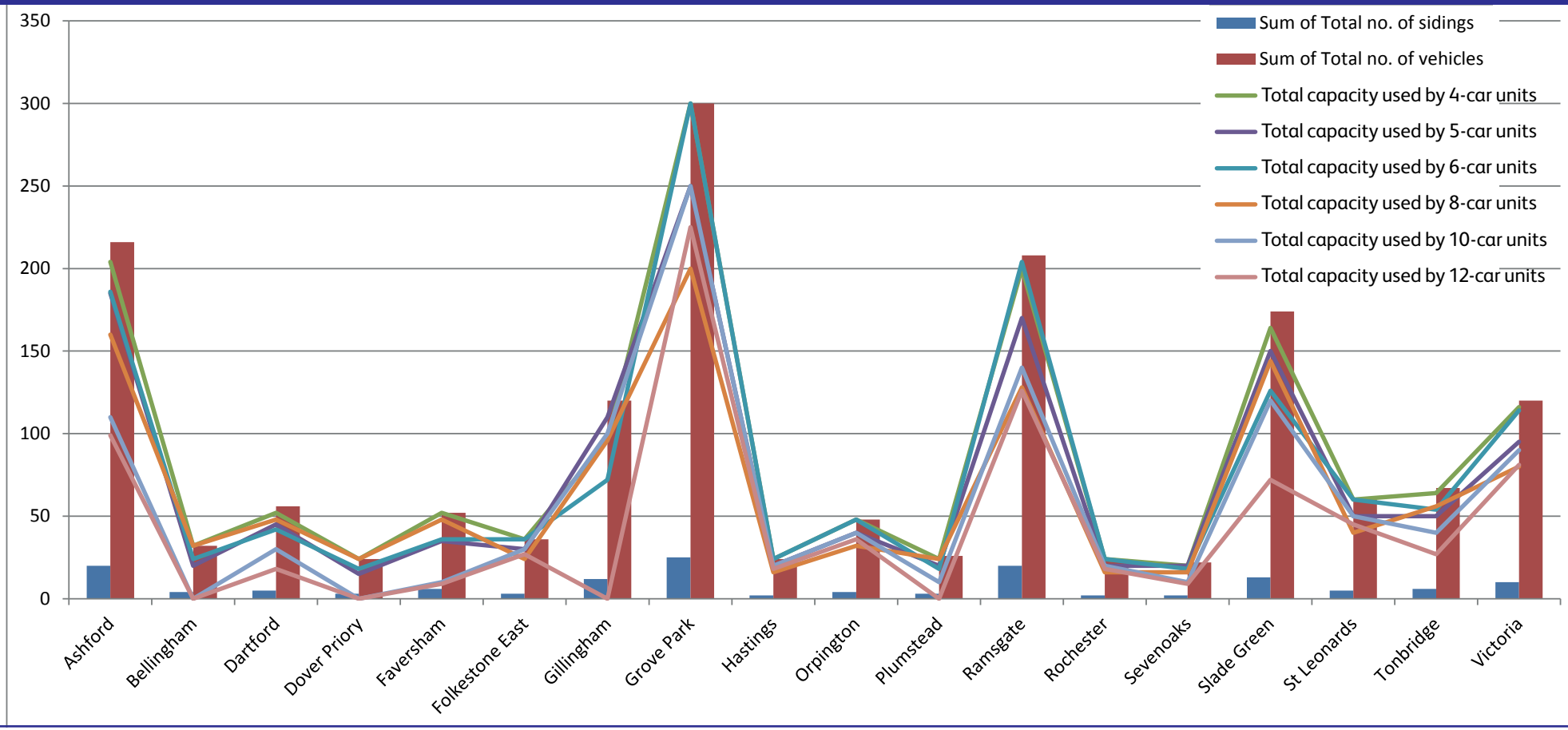
Table 3.1 - Train fleets berthing in Kent

Train operator	Class	Total number	2-car	3-car	4-car	5-car	6-car	8-car
Southeastern	375	Units		10	102			
		Vehicles		30	408			
	376	Units				36		
		Vehicles				180		
	377	Units			25			
		Vehicles			92			
	395	Units					29	
		Vehicles					174	
	465	Units			147			
		Vehicles			588			
	466	Units	43					
		Vehicles	86					
ThamesLink (Dec 19) (berthed in Kent)	700/0	Units						17
		Vehicles						136
Southern (berthed in Kent)	171/7	Units	2					
		Vehicles	4					
	377	Units			3			
		Vehicles			12			

Table 3.2 - Summary of siding capacity and the impact of fixed-formation unit lengths

	Total number of vehicles by unit length					
	4-car	5-car	6-car	8-car	10-car	12-car
Total used space (20m vehicles)	1792	1545	1638	1376	1270	945
Unused space (20m vehicles)	79	326	233	495	601	926
Percentage of overall capacity	**96%**	**83%**	**88%**	**74%**	**68%**	**51%**

Figure 3.9 - Graph showing the number of sidings and total capacity by location overlaid with the impact of various length units



The blue bar shows the number of sidings at each location and the red bar, the total number of vehicles that are capable of being berthed.

The lines represent fixed-formation units from 4- to 12-car and shows the impact of the number of vehicles that would be able to be berthed. The variation in siding length has an impact on the length and number of units that can be berthed there.

3.6 Signalling

3.6.1. The movement of trains is governed by the signalling system. The Kent Route Study area has signalling control systems ranging from basic mechanical signalling through colour light signalling to in-cab signalling (on HS1). **Sections 3.8-3.10** discuss the plans for the Digital Railway upgrade.

3.6.2. Nationally, Network Rail is working towards in-cab signalling. Much of the control of the signalling is planned to migrate to Gillingham or Three Bridges Route Operations Centre (ROC). **Figure 3.10** shows the existing 24 signal boxes, signalling centres and ROC.

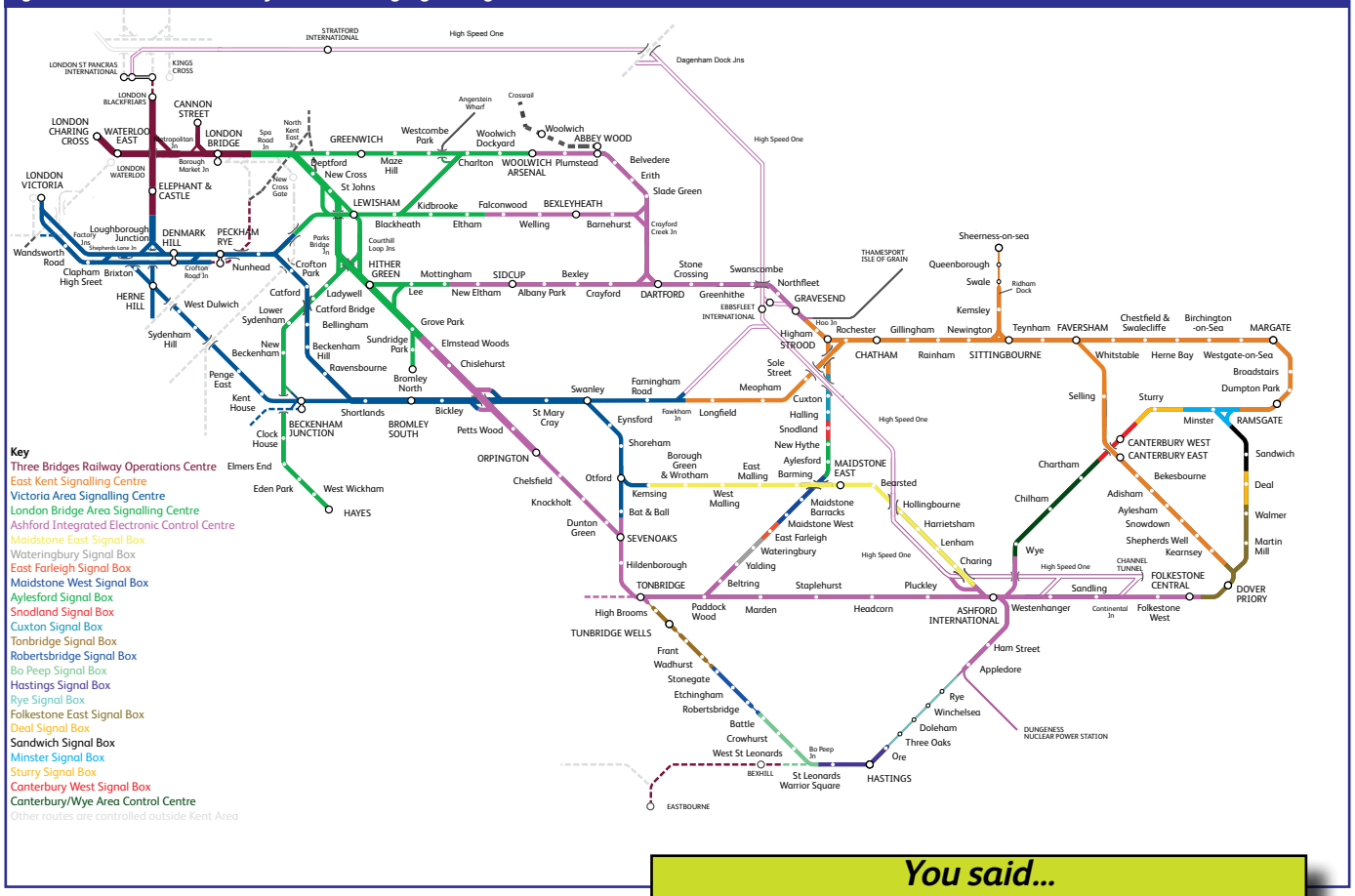
3.7 Performance

3.7.1. Performance on the Kent area of the South East Route has been adversely affected over the past few years by the Thameslink Programme rebuilding London Bridge station and adapting the associated network. The Programme will be completed in late 2018, with new and improved infrastructure and ThamesLink trains automated over the core route. The final impact of the programme on performance will not be understood until the end state of the 2018 timetable has been agreed.

3.7.2. Delays are attributed to a cause once they hit a threshold of two minutes. However, 30 per cent of delays in the Route Study area are sub-threshold delays, so the cause is not investigated unless the total delay is more than 50 minutes. In **Section 3.8,** the introduction of Traffic Management Systems is discussed as an opportunity to reduce sub-threshold delays. Changes to the measurement of performance are also expected in CP6 and as part of the new South Eastern franchise.

3.7.3. Control of trains by large signalling control areas can enable the signaller to get a greater understanding of current train performance and the impact of regulating decisions, reducing delays to trains. The recent amalgamation of Rochester, Gillingham, Rainham and Sittingbourne signal boxes into East Kent Signalling Centre, for example, has seen four signallers controlling trains through those areas, reduced to just two but with visibility of the whole area.

Figure 3.10 - Kent Route Study area showing signalling control areas



You said...

[Southeastern] welcome the technology that has enabled regulating decisions, however given the proposed remapping of GTR (ThamesLink) services into Kent, this will mean a risk of regulation conflicts between TOCs.

The current plan is to widen the coverage of the traffic management system so this should improve regulation regardless of TOC.

3.8 Digital Railway: Traffic Management System

3.8.1 The Traffic Management System (TMS) is a stepping-stone to full in-cab signalling and automatic train operation. The Class 700 trains will operate on the Thameslink Core using this system from 2018. This computer-based system monitors live train running information, the planned timetable and any incidents or faults that may hamper the journey for each train, and recommends solutions to minimise delay to that and other trains. It can also have access to train crew and rolling stock schedules so could be able to plan for train service recovery thus reducing delay and disruption during and post-incident.

3.8.2. **Figure 3.11** shows the current Thameslink Programme plan for TMS. It will be provided in different formats depending on location:

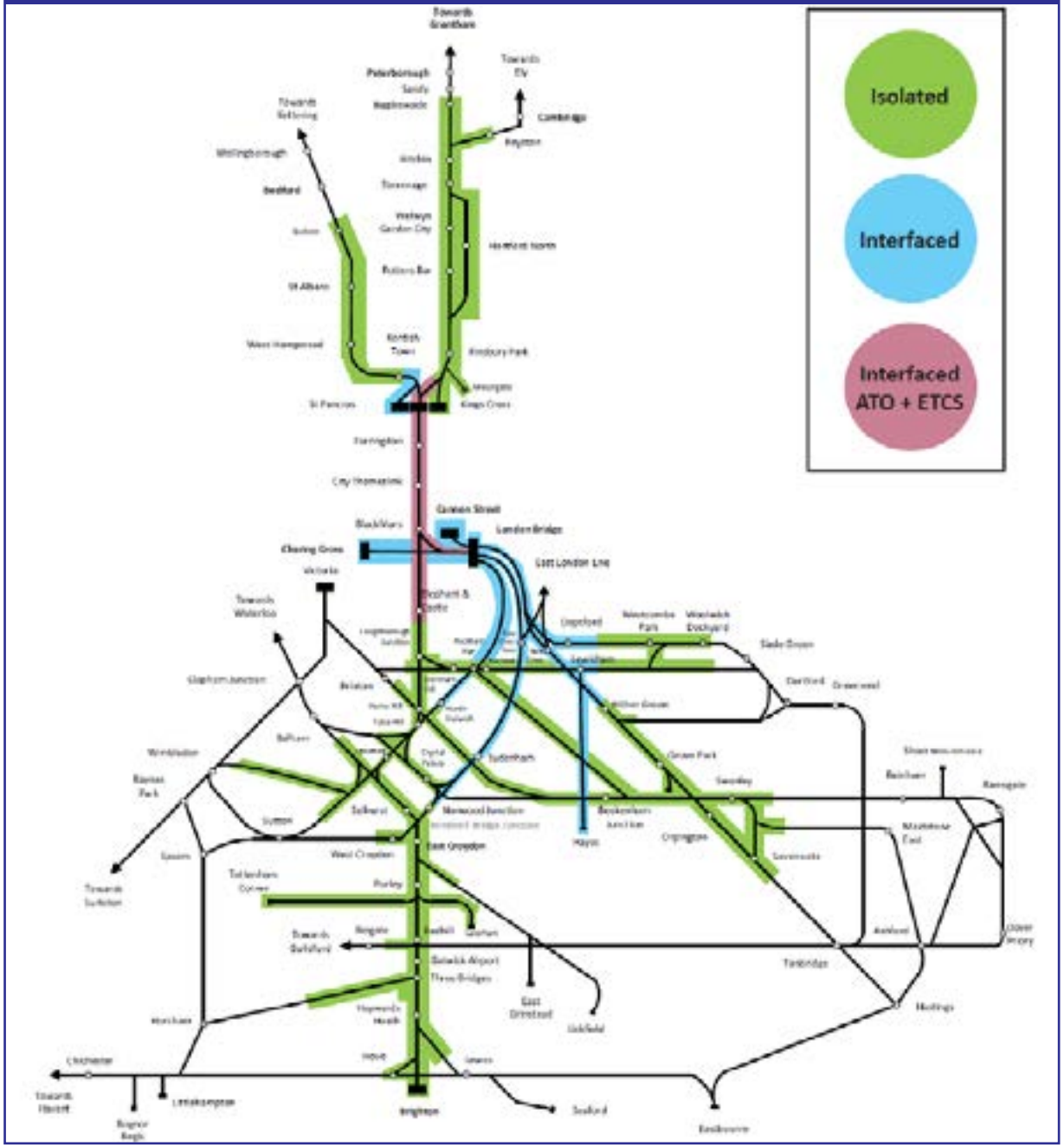
- **Integrated -** signalling control and traffic management are fully integrated on the same workstation - *this version is not being implemented by the Thameslink Programme*
- **Interfaced** – which allows the system to automatically control the signalling and make regulating decisions
- **Isolated** – provides signallers with recommendations for regulating trains.

3.8.3. It is anticipated that TMS will reduce sub-threshold delays, particularly if it is interfaced, as it will enable decisions to be made earlier, updating information systems and apps to ensure everyone is aware of, for example, a platform change, and then signalling the train in a timely manner. It will also remove some of the issues caused by the current signalling interface which only allows one signal route to be set at a time in a particular area, so even if two signallers are working the same panel, it might be possible to operate the signals more quickly. The TMS could communicate directly with the signal interlocking computers, enabling several signals to be operated simultaneously. Despite all of the above, the performance outputs are yet to be proven.

3.8.4. Rather than dealing with the pathing of trains in real-time, signallers at Three Bridges ROC will be expected to make all such decisions, with advice and recommendations from the TMS, up to 20 minutes ahead of time. This is a big change in the way the network is controlled and may enable the integrated systems that TMS works with to update Customer Information Systems (CIS) across the network and on trains as well as providing accurate information to station staff, mobile apps and other information systems.

3.8.5. As part of the Invitation to Tender for the South Eastern franchise (published in November 2017), the DfT have required bidders to put forward proposals for a TMS to cover the areas of the Kent network that are not part of the Thameslink Programme.

Figure 3.11 - Thameslink Programme plan for Traffic Management System roll-out



A Class 700 at London Blackfriars. From 2018 train movements here will be controlled by Automatic Train Operation to enable up to 24 trains per hour to operate through the Thameslink Core

3.9 Digital Railway: Automatic Train Operation (ATO)

3.9.1. In 2018, as part of the Thameslink Programme's Key Output 2, the first TMS will be operational at Three Bridges ROC and will work hand-in-hand with the ATO system through the Thameslink Core (London Bridge/Elephant & Castle – St. Pancras International).

3.9.2. ATO will take control of the train, leaving the driver to control the closure of the doors when the train is ready to depart. The driver resumes traditional duties once the train has left the core route.

3.10 Digital Railway: Driver Advisory System (DAS) & Connected Driver Advisory System (C-DAS)

3.10.1. The TMS will also be able to influence decision-making in the cab, assisting drivers by use of a Driver Advisory System. This will advise the driver about the optimum speed of the train because it will be aware of the situation ahead of the train before the driver. It may advise a driver to travel slower to reduce the chance of catching up with the train ahead and reducing heavy braking or accelerating, improving the passenger experience and reducing wear and tear to the train and track as well as improving the environmental efficiency of the train.

3.10.2. These systems will also be able to advise drivers of the cause of delays or disruption to improve information dissemination, although some trains will be advised directly by the TMS for CIS displays and announcements. Thameslink Programme will be providing passive provision for future introduction.

3.10.3. The ITT for the South Eastern franchise requires the winning bidder to introduce C-DAS during the franchise period.

Digital Railway

3.11 Passenger capacity at stations

3.11.1. Stations form an integral part of a passenger's journey and providing sufficient space at stations for passengers is crucial for safety and customer experience. If passenger pedestrian capacity is compromised, this can impact upon the safe operation of a station and can detrimentally impact train performance through increased dwell times. An industry-wide stations working group has been set up to review current passenger capacity issues at stations across the network and on a route-by-route basis.

3.11.2. A high-level prioritisation exercise has taken place to categorise the shortlisted stations based on the current and anticipated capacity constraints identified. This prioritisation process has also taken cognisance of option development work undertaken and the subsequent resulting strategy from the station capacity work stream. A methodology was agreed based on passenger capacity, safety and performance; this included the impact of forecast growth in passenger numbers.

3.11.3. This approach has produced intervention concepts for the high priority stations, including cost ranges and timelines. Benefits have also been analysed for the high priority stations, including the benefits of safety improvements, and strategic outline business case appraisals have been undertaken. Examples of outputs of this work are captured in **Chapter 6**; further details on all shortlisted stations can be found in **Technical Appendix**.

4 The Capacity Challenge: Accommodating the demand

This chapter sets out:

- forecast growth in passenger and freight demand across the study area through to 2024 and beyond to 2044
- the conditional outputs developed for the study area
- the capacity challenge across the study area
- the impact of Crossrail/the Elizabeth Line
- the impact of Ebbsfleet Garden City and London Resort Theme Park

Two trains pass at Lewisham Crossover Junction (as seen from the London-end of Platform 3) - they are travelling on the Lewisham Platforms 1 & 2 - St Johns lines whilst a third train waits on the flyover for the signal into Platform 4

4.0.1. This chapter summarises the capacity conditional outputs identified for the Kent Area Route Study by applying the growth forecast from the Market Studies, including freight, to each service group within the Kent Route. Following the publication of the Draft Route Study, the growth forecasts were assessed against the latest housing growth figures supplied by the Local Authorities to confirm they were still credible. The rail industry Working Group has developed on-train capacity analysis work to identify gaps in future train capacity, together with the known infrastructure constraints. The combination of these constraints has then driven the option development process to identify the investment choices for funders as detailed in Chapter 6.

4.1 Demand and Economy

4.1.1. The link between a growing economy and growth in the use of rail services is well established. Increased economic activity generates demand for rail services. In turn, improving the frequency, speed and reliability of rail services facilitates economic growth by better connecting:

- Businesses to each other
- People to jobs and leisure opportunities.

4.1.2. Rail demand in the UK has increased by 69.5 per cent to 1.65 billion journeys since 2002/03. The London and South East franchised operators totalled 7.6 billion passenger kilometres during 2015-16, up by 3.4 per cent on the previous year. Southeastern, the predominant operator on the Kent Route, saw a rise of 2.4 per cent* in passenger kilometres over the same period.

4.1.3. Therefore, the challenge is to develop options that are affordable and represent value for money to accommodate this growing demand for rail services.

4.2 Market Studies: Strategic aims and conditional outputs

4.2.1. In 2013 the rail industry established four Market Studies to understand the demand for rail over a 30-year planning horizon. This reflects the long life of rail infrastructure assets and investments. The Market Studies identified four key market sectors: long distance, London and South East, regional urban passenger services and freight. The aim of the studies, published in 2013, was to demonstrate how the rail industry could contribute to delivering a series of outcomes important to the prosperity of the United Kingdom. The Market Studies set out four strategic aims:

- Enabling economic growth
- Reducing the carbon footprint and the impact of the transport sector on the environment
- Improving the quality of life for communities and individuals
- Improving affordability and value for money to funders.

4.2.2. The Market Studies also identified a series of high level 'conditional outputs' that would accommodate forecast growth and connectivity requirements. The conditional outputs cover:

- The amount of capacity required to accommodate forecast demand for passenger journeys during weekday peak periods
- The level of rail connectivity between large towns and cities across the country
- The amount of freight demand forecast between pairs of locations
- The amount of capacity required at stations for better passenger circulation, especially during peak times.

4.2.3. The Market Studies set out a range of economic scenarios for 2023 and 2043 to better understand potential demand in the future and set out four low to high growth scenarios. The 'prospering in global stability' scenario (the highest growth scenario) was used to identify the network capacity requirement which helps to inform railway development for the future. The highest growth was considered as the most credible scenario by stakeholders as it reflects the recent growth observed in the study area. The low growth scenario can be used to test the robustness of any business case appraisals.

4.2.4. The impact on future demand of the vote to leave the European Union is still unclear so existing forecasts are being maintained pending further information becoming available.

*ref ORR Passenger Usage Data

Table 4.1 - Anticipated growth between 2011 and 2023/2044

	Anticipated growth between 2011 & 2023**	Anticipated growth between 2011& 2043**
London Bridge Metro – services from: • Gillingham and Dartford (via Greenwich, Bexleyheath and Sidcup) • Hayes • Sevenoaks via Orpington and Grove Park • Bromley North branch	15 %	47 %
London Victoria Metro – services from: • Gillingham via Swanley • Dartford via Bexleyheath • Orpington via the Catford Loop and Herne Hill	15 %	47 %
London St Pancras High Speed Domestic – services from: • East Kent – from Margate via Canterbury West and Ashford and from Ramsgate via Dover and Ashford. • North Kent from Ramsgate via Chatham and Gravesend. • Medway Valley – Peak services from Maidstone West	80 % *	127 %
London Bridge & London Victoria Main Line – London Bridge services from: • Ramsgate via Canterbury West, Tonbridge and Grove Park • Hastings via Tonbridge and Grove Park • Broadstairs via Chatham – peak services • Dover via Tonbridge – peak only London Victoria services from: • Ramsgate & Dover via Chatham • Sheerness via Chatham – peak only • Ashford via Maidstone East	15 %	47 %
London Blackfriars Metro – services from: • Orpington via Herne Hill and the Catford Loop • Sevenoaks via Bat & Ball and the Catford Loop	11 %	21 %
East London Line – services from Clapham Junction to Surrey Quays and vice-versa	178 %	407 %
Regional services – • Brighton to Ashford International via Hastings • Strood to Paddock Wood/Tonbridge • Sittingbourne - Sheerness	15 %	47 %

*L&SE Market study except for period from 2011 to 2023 when 5 % growth per annum is assumed
**Figures above reflect the market study which have been adjusted to reflect the Route Study timescales of 2024 & 2044

4.3 Passenger demand in the study area

4.3.1. The growth rates anticipated in the Market Studies for the Kent Area Route Study scope area are outlined in **Table 4.1**. The effect of growth will vary between suburban/metro area services and longer distance services to locations in outer Kent and East Sussex, but an average percentage is taken.

4.3.2. Network Rail has reviewed the passenger growth on HS1 Southeastern services since they were introduced in 2009. The analysis shows that these services experienced significantly higher passenger growth than other services provided by Southeastern (4.5 per cent between 2012-2014 and 5.7 per cent between 2012-2015 once the impact of disruption at London Bridge and changes to the January 2015 timetable have been removed).

4.3.3. Given this high level of growth the working group agreed to increase the short term forecast for HS1 services to five per cent per annum until 2023/24. One of the main reasons provided for such high growth is that people are moving to live near the HS1 route so they can commute quickly to London. However, it is expected that by 2023/24, this migration will have completed and so London employment could be expected to be the main driver for peak passenger demand.

4.3.4. However, this forecast excludes the impact of the London Resort Theme Park, which is discussed later. The demand would be higher if this were to materialise. It is recommended that the growth after 2023 is reappraised in the next Route Study when there is a richer set of data.

4.3.5. Passenger demand on some metro routes will be affected by the arrival of Crossrail services at Abbey Wood. It is expected that there will be a large number of passengers interchanging at Abbey Wood to travel towards central London via Crossrail rather than via London Bridge.

4.3.6. Although significant levels of commuting into several different economic centres are undertaken, peak demand is largely driven by commuting between central London and Kent, East Sussex and suburban London.

4.3.7. In central London, rail's modal share of the commuter market, including London Underground services, is approximately 65 per cent. It is forecast that employment growth, rather than people transferring to rail from other modes of transport, will be the key factor in driving further demand for rail.

4.3.8. Away from London, stations such as Ashford International have seen growth as a result of High Speed services. The introduction of ThamesLink services will provide more journey opportunities.

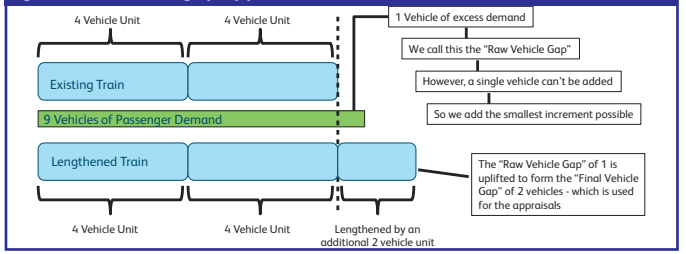
WHAT IS... THE BASIS OF THE DEMAND FORECAST?

The Kent Route Study uses the 'prospering in global stability' scenario from the London & South East (LSE) Market Study, which is the highest growth scenario. This was considered the most credible scenario by stakeholders as it reflected the growth at the time of writing the Draft for Consultation.

Since the Draft for Consultation was published, the LSE market has experienced a slow-down in growth, with Southeastern growth being broadly flat for the last two years. This can be attributed to a number of factors such as London Bridge disruption.

The 'Network Modelling Framework' has been shared by the DfT and its forecast for 2023-43 is the same as the Market Study, whilst shorter term growth is forecast to be much higher. This is likely to be driven by interventions that have already occurred or are committed such as timetable and rolling stock changes.

Figure 4.1 - Vehicle gap appraisal



4.4 Conditional outputs relating to capacity

4.4.1. **Tables 4.2, 4.12, 4.13, 5.1 & 5.4** present the conditional outputs addressed in the Kent Area Route Study, for both 2024 and 2044.

4.4.2. The busiest time for commuting into central London is between 08:00 and 08:59 and is referred to as the 'high peak hour'. The assumption taken forward in the strategy is that options identified to accommodate morning peak demand will also be sufficient to accommodate evening peak demand, which is typically distributed over a longer period than the morning peak.

Table 4.2 - Passenger capacity conditional outputs

Conditional Output Reference	Conditional Output
CO1 (2024)	Provide sufficient capacity for passengers travelling into central London to accommodate peak demand – London Bridge Metro services
CO2 (2024)	Provide sufficient capacity for passengers travelling into central London to accommodate peak demand – London Victoria Metro services
CO3 (2024)	Provide sufficient capacity for passengers travelling into central London to accommodate peak demand – High Speed services to St Pancras International
CO4 (2024)	Provide sufficient capacity for passengers travelling into central London to accommodate peak demand – London Blackfriars metro services
CO5 (2024)	Provide sufficient capacity for passengers travelli ng into central London to accommodate peak demand – Main Line services to London Bridge and London Victoria
CO6 (2024)	Provide sufficient capacity for passengers travelling into central London to accommodate peak demand – London Orbital services (East and South London Lines)
CO7 (2044)	Provide sufficient capacity for passengers travelling into central London to accommodate peak demand – London Bridge Metro services
CO8 (2044)	Provide sufficient capacity for passengers travelling into central London to accommodate peak demand – London Victoria Metro services
CO9 (2044)	Provide sufficient capacity for passengers travelling into central London to accommodate peak demand – High Speed services to St Pancras International
CO10 (2044)	Provide sufficient cap acity for passengers travelling into central London to accommodate peak demand – London Blackfriars Metro services
CO11 (2044)	Provide sufficient capacity for passengers travelling into central London to accommodate peak demand – Main Line services to London Bridge and London Victoria
CO12 (2044)	Provide sufficient capacity for passengers travelling into central London to accommodate peak demand – London Orbital services (East and South London Lines)
CO13 (2024-44)	Provide sufficient capacity for passengers travelling between Brighton and Ashford to accommodate all day demand

4.5 Passenger demand analysis

4.5.1. The purpose of this analysis is to ensure there is sufficient capacity on the network in the future.

4.5.2. The on-train capacity provided by the service groups is defined as the total number of seats, plus a further allowance for passengers standing on short trips of up to 19 minutes as described in DfT metrics. Actual and predicted seat utilisation across the corridors into central London in 2014, 2024 and 2044 is shown across **Tables 4.3, 4.6-4.10**.

4.5.3. Demand is generally considered as in 'excess of train capacity' when the number of seats and standing space allowance is exceeded. **Figure 4.2** shows the average capacity and demand profile in the three hour peak. It should be noted that some trains are currently in excess of capacity at the critical load points.

4.5.4. Assumptions for the network in 2024 and 2044 reflect the known committed schemes by the end of 2019, as listed in **Chapter 3**. This is referred to as the baseline in the following sections, reflecting the anticipated capacity provided by the end of 2019. The baseline position is based on train operator counts and known changes to operational plans; it does not include any uncommitted schemes or proposed choices for funders presented in this study.

Figure 4.2 - Morning three hour peak profile

4.5.5. **Table 4.3** below summarises the number of additional vehicles (single train carriages), based on an average across the hour, that will be required in the high peak hour in 2024 and also by 2044 over what operated in 2014. This is known as the vehicle gap. The table also shows this as a percentage increase. **Figure 4.1** outlines the vehicle appraisal methodology. It is unlikely that individual vehicles can be added - it would have to be additional units.

4.5.6. This analysis excludes the need for additional vehicles to cover the capacity gap in the shoulder peak hours and also for any that may be required to ensure effective train diagramming. The incumbent TOC and the DfT will need to undertake further analysis to determine the total vehicle gap.

4.5.7. The analysis shows that there is a gap on all the corridors by 2024, except the Blackfriars route. This will be analysed further in the following section. All train lengthening options and infrastructure choices to meet the expected gaps are subject to value for money and affordability.

Table 4.3 - High Peak Hour vehicle gaps

Corridor	Number of vehicles on the route in 2014	Forecast for additional vehicles in 2024	Percentage increase in vehicles forecast between 2014 & 2024	Forecast for additional vehicles in 2044	Percentage increase in vehicles forecast between 2014 & 2044
London Bridge Metro services	362	40	11%	120	33%
Victoria Metro services	72	6	8%	22	31%
St Pancras High Speed Domestic services	66	36	55%	52	82%
Blackfriars Metro services	56	0	0%	8	14%
London Bridge Main Line services	170	21	12%	67	39%
Victoria Main Line services	42	2	5%	8	19%

4.6 Capability and Capacity Analysis

4.6.1 It is known that the railway in Kent is constrained in a number of locations, as shown in **Figure 4.3.** This can be driven by a number of factors including locations where trains have to cross paths at flat junctions requiring clear space in the timetable, the required space between trains to safely operate (signalling headways) and the length of platforms or the number of platforms at a particular station. The capacity on a route and ability to meet the predicted demand could be restricted by just one constraint that prevents additional services running or a number of constraints that would have to be addressed.

4.6.2. The Network Rail Capability and Capacity Team has reviewed the number of additional vehicles that is predicted to be needed to meet the capacity gaps highlighted in **Table 4.3**. They have examined whether longer trains can be operated or whether additional trains could fit into the timetable. For each service route the capacity assessment was undertaken in three stages:

- The ability to lengthen existing services to meet 2024 demand: the usable platform lengths for each station were reviewed according to the Train Planning Rules and Sectional Appendix to assess whether they could accommodate lengthened services in their existing state.
- The ability to operate additional services to meet 2024 demand: The December 2015 timetable was used as a base to assess whether additional paths could be accommodated, while adhering to current timings and planning rules.
- The theoretical maximum number of train paths on a route was also assessed based on the signal spacing and line speeds.

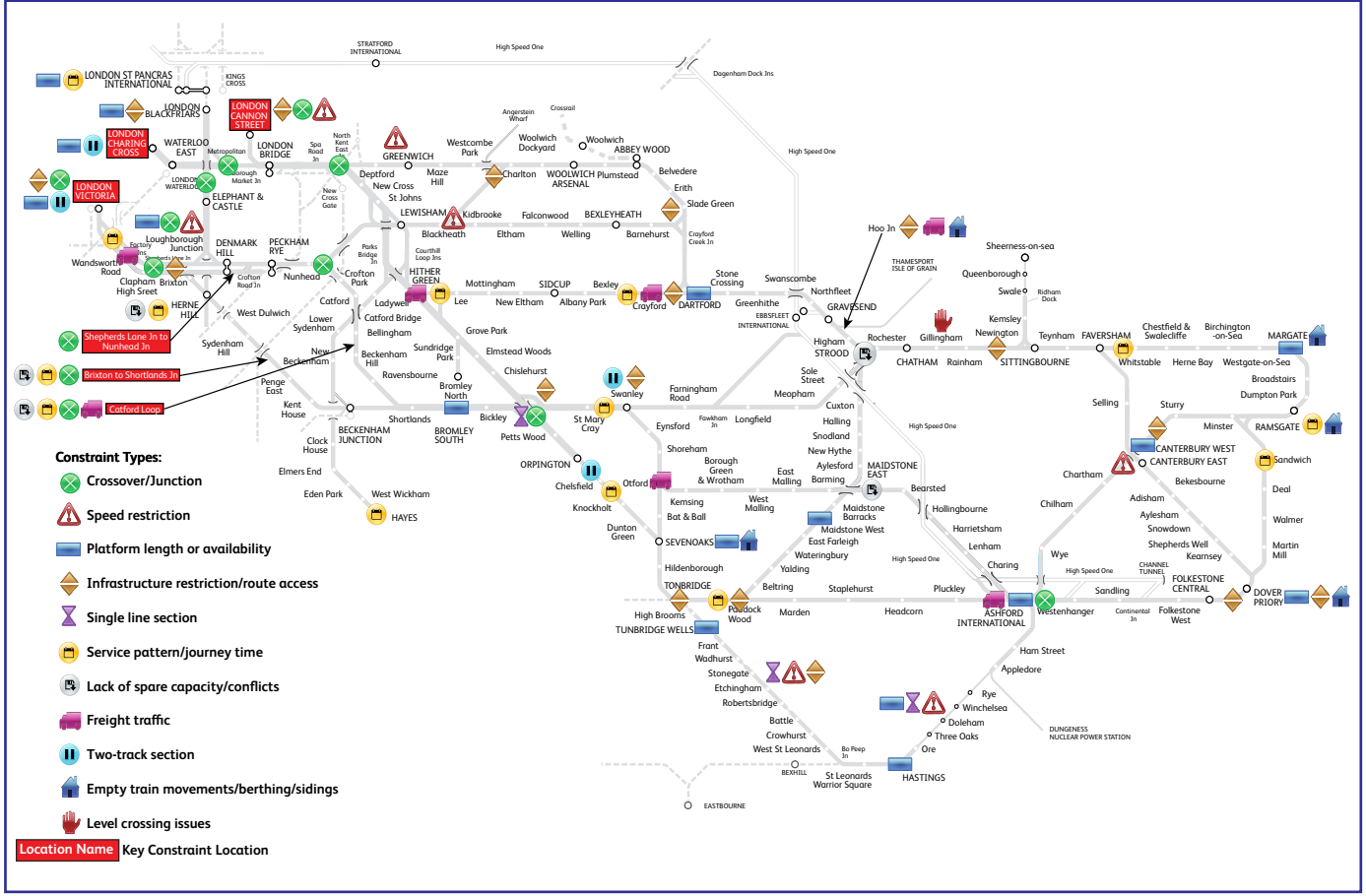
4.6.3. Network Rail will be working with the TOCs to understand the depot and stabling constraints and how they also impact capacity.

4.7 Capacity Gap Analysis

4.7.1. The following sections give by service group:

- The breakdown of on-train demand analysis and vehicle gaps
- Maps showing crowding predicted in 2024
- Analysis of the capacity constraints on each route.

Figure 4.3 - Capability and capacity constraints



4.7.2. On the following pages, the service group maps are coloured to correspond to the percentage of seating or allowed standing space that is occupied. The maps also highlight with an orange triangle the first instance of passengers necessarily standing on each route. The station when a passenger will have stood for 20 minutes is shown as a purple box and the first instance of a train being over capacity as a sky blue circle.

4.8 London Bridge Metro (CO1 & CO7)

4.8.1. London Bridge metro service group is split into the following routes (as shown in **Figure 4.4 and Table 4.4**): –

A. Gillingham/Dartford via Abbey Wood and Greenwich

B. Gravesend/Dartford via Bexleyheath

C. Gravesend/Dartford via Sidcup

D. Sevenoaks/Orpington via Grove Park

E. Hayes

F. Bromley North to Grove Park branch.

4.8.2. Peak services on these routes currently run in 8-, 10- or 12-car formation (except the Bromley North branch, which is operated by a 2-car train). The analysis indicates that 40 additional vehicles will be required by 2024 and 120 vehicles by 2044.

4.8.3. Up to 2024, the projected growth in vehicles can be accommodated on all routes through lengthening existing services that do not currently operate at the maximum formation of 12-cars.

4.8.4. Beyond 2024 additional services would be needed on all the metro routes (except via Abbey Wood) to meet projected demand.

4.8.5. The key challenges or constraints to overcome are:

- Lack of available capacity at Charing Cross and Cannon Street for additional services
- Compliant timings between trains to ensure robust performance across the network
- Conflicting train movements at Orpington
- Conflicting train movements in the Lewisham area
- Two platform layout at Hayes – improving the time required to reuse the platform (platform reoccupation).

4.8.6. The choices for funders for meeting the capacity gaps will be identified in **Chapter 6**. All options to meet projected demand are subject to value-for-money, affordability, deliverability and operability.

Figure 4.4 - London Bridge Metro capacity in 2024

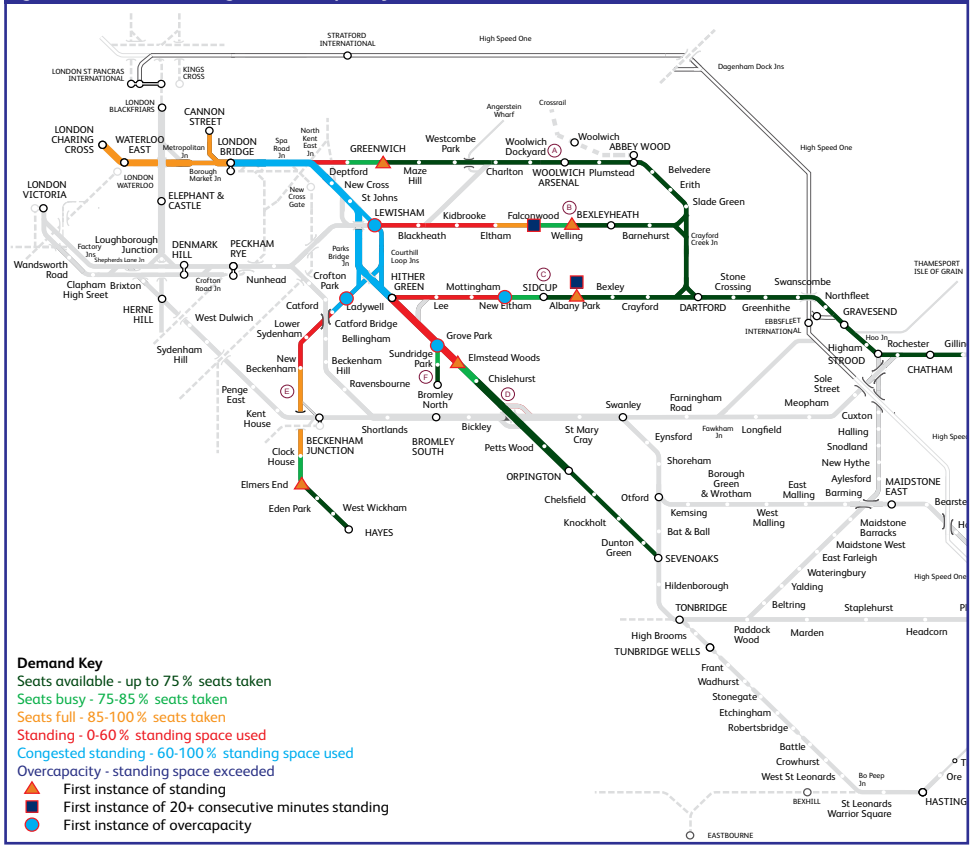


Table 4.4 - London Bridge Metro vehicle gaps*

Corridor	Map ref	Number of vehicles in 2014	Number of vehicles in 2018	Forecast additional vehicles in 2024	Forecast additional vehicles in 2044
Woolwich Line	A	78	84	0	2
Bexleyheath Line	B	76	78	6	24
Sidcup Line	C	78	82	8	28
Orpington Line	D	72	84	12	32
Hayes Branch	E	52	56	6	20
Bromley North	F	6	8	0	2

***Table 4 .4 assumptions footnote:**

Effect of the Elizabeth line at Abbey Wood - TfL modelling suggests that loads on departure west from Abbey Wood will fall by approximately 50 %. This is a combination of passengers alighting for the Elizabeth Line, and passengers from Abbey Wood starting their journey on the Elizabeth Line. We are not assuming any switching from the Bexleyheath or Sidcup lines. While the introduction of Crossrail eliminates a capacity gap on the Woolwich and Greenwich line, congested standing is still forecast into London Bridge in 2024. This is because of continued growth into London from stations west of Abbey Wood, as well the introduction of high-capacity Class 700 ThamesLink trains with fewer seats per train.

The effect of Crossrail/Elizabeth Line

4.8.7. The analysis of the route via Abbey Wood has not forecast a vehicle gap due to changes in demand driven by the introduction of Crossrail services which will operate as the Elizabeth Line.

4.8.8. Based on modelling estimates provided by TfL, it is assumed that demand on the route will increase east of Abbey Wood by 25 per cent up to 2021 and by 45 per cent to 2031. Here a large number of passengers will interchange to Crossrail to take advantage of reduced journey times to central London.

4.8.9. As a result there is assumed to be a decrease in passenger demand to the west of Abbey Wood travelling towards London Bridge by approximately 50 per cent up to 2021 which then moderates to 35 per cent by 2031.

4.8.10. There is, however, likely to be an increase in passengers travelling towards Abbey Wood from the west in what is normally the 'contra peak' direction, when capacity on board trains is not expected to be an issue. In **section 5.5.13** we look at proposals to extend the Elizabeth Line to Ebbsfleet.

A new Class 345 train for the Elizabeth Line

4.9 London Victoria Metro (CO2 & CO8)

4.9.1. London Victoria metro service group is split into the following routes (as shown in **Figure 4.5 and Table 4.5**): –

A. Services via Herne Hill

B. Services via Lewisham

4.9.2. The peak services on these routes operate in 4-, 6- or 8-car formation. The maximum length that can operate on metro services is currently 8-cars due to platform length restrictions on the route and at Victoria. The analysis indicates that six additional vehicles will be required by 2024, which could be accommodated through lengthening existing services to 8-cars or switching to higher density rolling stock. All the platforms on the route can accommodate the services lengthened to 8-cars or some alternative higher density rolling stock types.

4.9.3. By 2044, 24 additional vehicles are expected to be required to meet demand. Additional services would be required via each of Peckham Rye and Herne Hill routes, which cannot currently be accommodated in the timetable. Higher density rolling stock may contribute to the solution.

4.9.4. The capacity analysis work undertaken has highlighted the following constraints:

- Shortlands Junction, where services via Herne Hill and the Catford Loop diverge, is where a previous grade separation scheme has removed many of the clashes
- Swanley Junction, where services from Maidstone East and Sevenoaks via Bat & Ball join the Chatham Main Line, to St. Mary Cray Jn
- The mix of fast trains and stopping trains on the route
- The different distances between the signals affecting the spacing of trains (headway values), which increase with distance from London.

4.9.5. The choices for funders for meeting the capacity gaps will be identified in **Chapter 6**.

Figure 4.5 - London Victoria Metro capacity in 2024

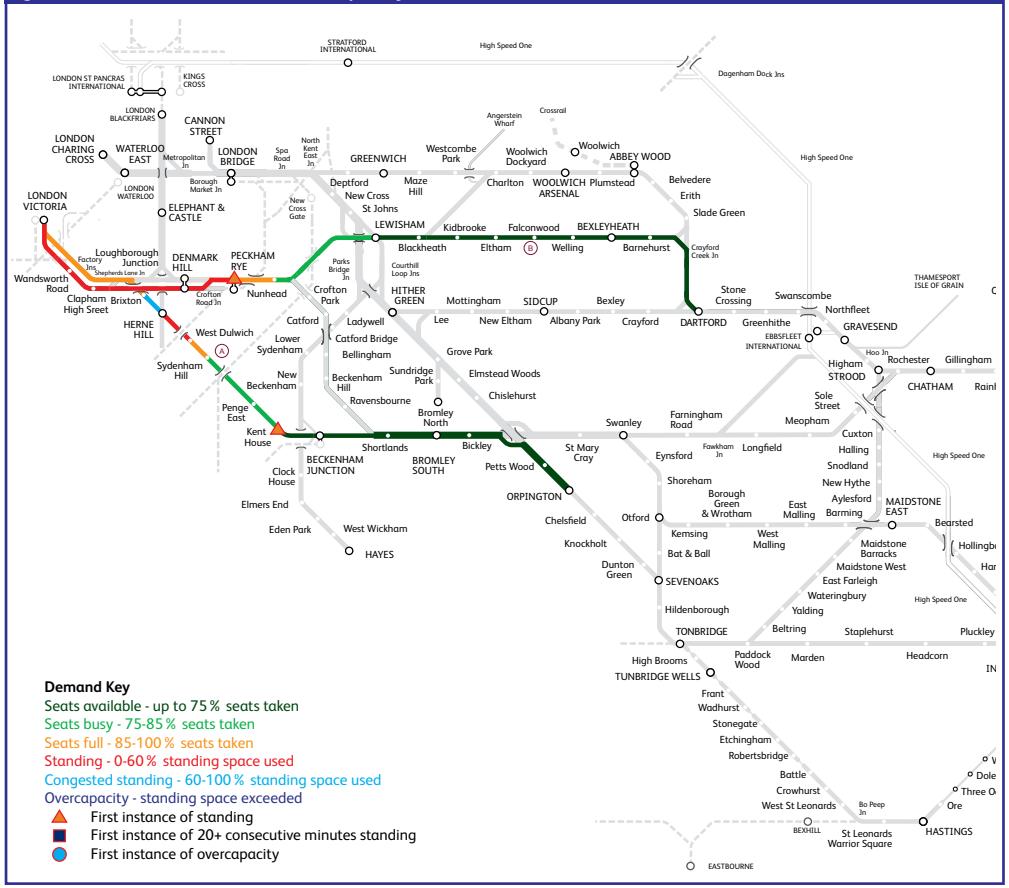


Table 4.5 - London Victoria Metro vehicle gaps

Corridor	Map ref	Number of vehicles in 2014	Number of vehicles in 2018	Forecast additional vehicles in 2024	Forecast additional vehicles in 2044
Via Herne Hill	A	36	38	2	12
Via Lewisham	B	22	24	2	8

4.10 High Speed (CO3 & CO9)

4.10.1. The High Speed service group is split into the following routes (as shown in **Figure 4.6 and Table 4.6**):

A. Services via Ashford International

B. Services via Faversham

C. Services from Maidstone West

4.10.2. The analysis based on the revised growth figures indicate that 12 additional vehicles via Ashford International (to provide seated capacity) and nine vehicles from Ebbsfleet International (seated and standing) will be required by 2024. This would mean that all current Ashford International services will be 12-car maximum length.

4.10.3. By 2044, there will be a capacity gap of 15 vehicles via Ashford International and 16 vehicles from Ebbsfleet International route but is greatest from Ebbsfleet International into London.

4.10.4. There will also be a capacity gap of one vehicle via Gravesend by 2024 and two by 2044. Strood and Gravesend are only served by Maidstone West High Speed services so both can be resolved by lengthening the High Peak Hour service.

4.10.5. To meet 2024 requirements, a number of capacity options have been considered:

- Operate an additional 12-car service from Ashford International (calling at Ebbsfleet International)
- Extend the Ebbsfleet International shuttle to Ashford International, Faversham or Rainham and lengthen to 12-cars
- Lengthen Maidstone West services to 12-cars
- Operate an additional train from Maidstone West

Figure 4.6 - High Speed capacity in 2024

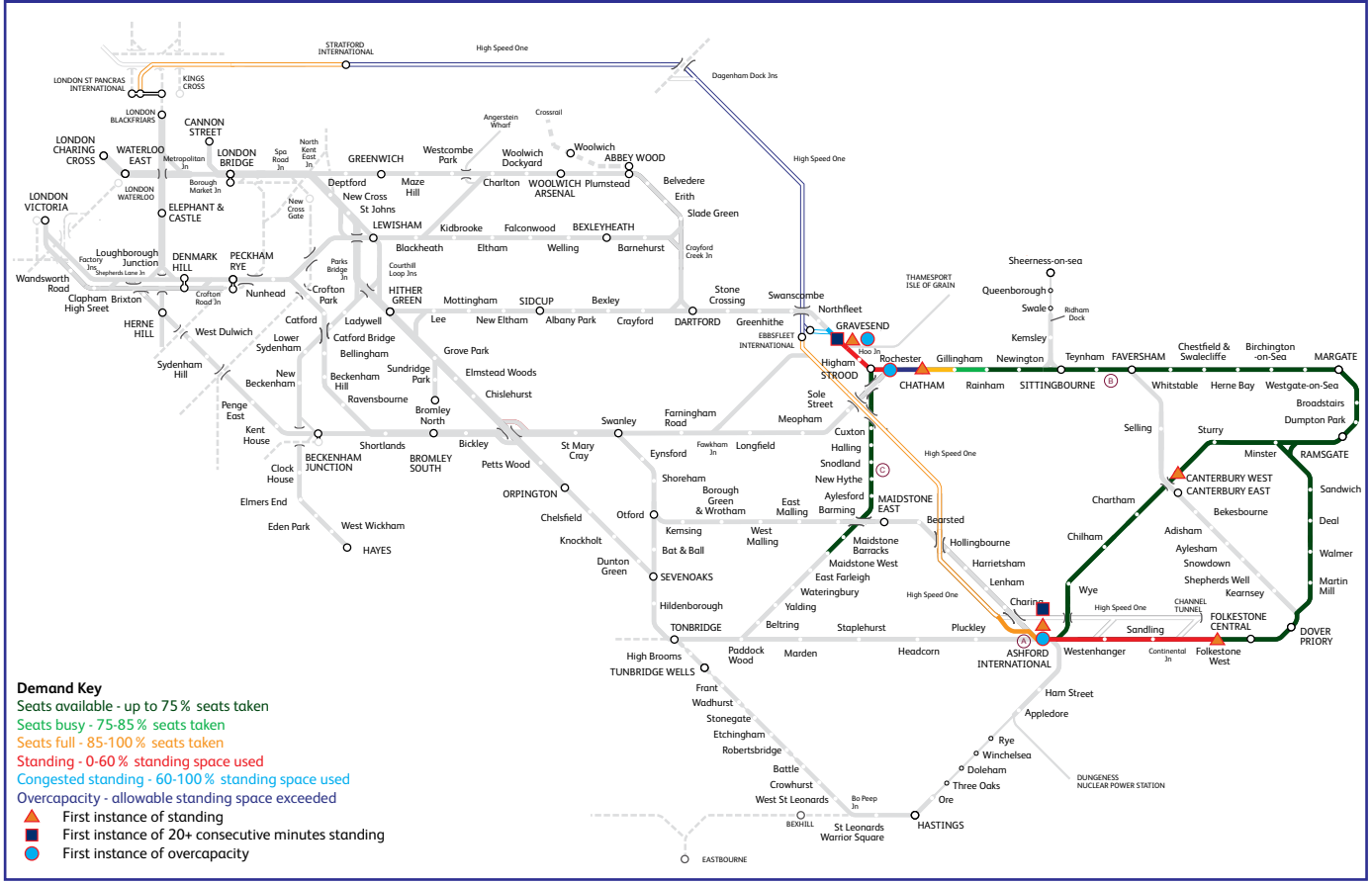


Table 4.6 - High Speed vehicle gaps

Corridor	Map ref	Number of vehicles in 2014	Number of vehicles in 2018	Forecast additional vehicles in 2024¶	Forecast additional vehicles in 2044¶
Via Ashford international	A	30	48	6	6
Via Faversham	B	24	24	6	12
Via Maidstone West & Ebbsfleet Shuttle	C	12	12	6*	6

¶capacity gap from Ebbsfleet International could be met by the additional vehicles on all three service groups

*capacity gap from Rochester to London St Pancras International

4.10.6. The lengthening of services on the Maidstone West line to 12-cars would fill the capacity gap from Ebbsfleet International, making best use of the route. However, platform extensions would be needed at Maidstone West and Snodland (or selective door operation at the latter), which are currently 6- and 8-cars long respectively. It is expected that power supply upgrades would also be required.

4.10.7. No additional high peak hour paths into London St Pancras International are currently available based in the current timetable but one additional service is required for 2024.

4.10.8. Network Rail (High Speed) are confident that a pathway can be identified for this. The flexing of the timing of Eurostar services, particularly empty train moves to/from Temple Mills Depot, would allow an additional service to operate.

4.10.9. The service that starts at Ebbsfleet International could be started back from Ashford International. However, this would not provide the additional capacity needed from Ebbsfleet and would require additional rolling stock. It could not be extended back to Faversham or Rainham without a major timetable recast.

4.10.10. The option to attach two services in the Folkestone area delivering extra capacity would work from a timetabling perspective. However, the signalling in the area does not currently allow for permissive working (two trains sharing a platform) to enable the two trains to be coupled.

4.10.11. There is a safety restriction through Shakespeare Tunnels that permits passengers and staff to only be carried in the front six coaches of a 12-car Class 395 train because there is a lack of corridor connection between the 6-car units. This is due to the shape of the tunnels and method of evacuation in an emergency.

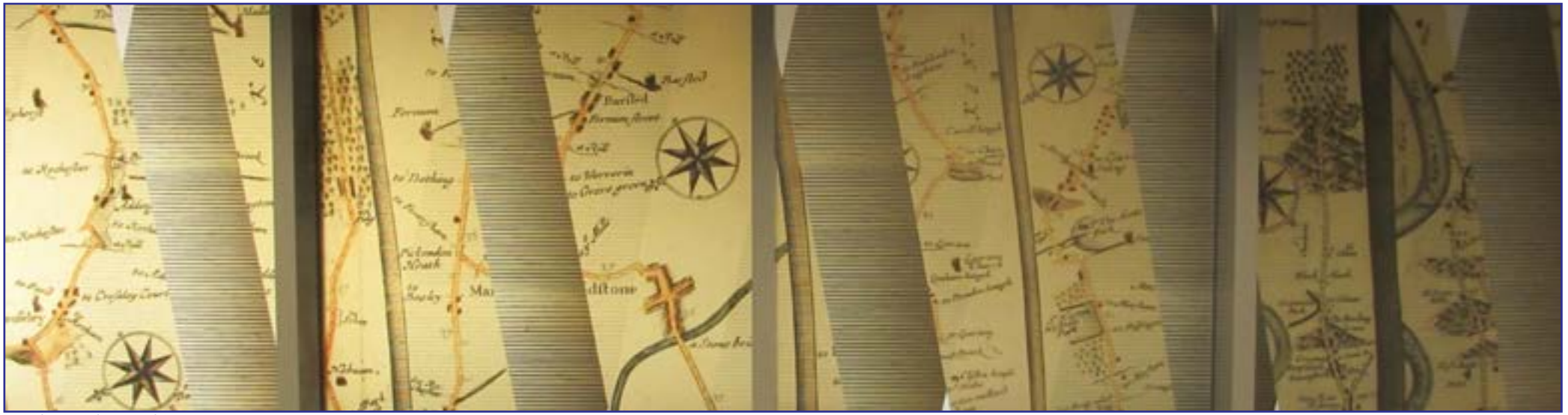
4.10.12. In the same way as a 12-car Class 375 train, a 12-car fixed formation Class 395-style train would not attract such a restriction as the whole train would be connected by corridor.

Potential future developments in the north Kent area

4.10.13. The north Kent area is one where significant developments are expected in the coming years. Major housing expansion is expected at Ebbsfleet Garden City (EGC) and there are proposals for a London Resort Theme Park.

4.10.14. The London Resort Theme Park and some phases of Ebbsfleet Garden City are not classed as committed and therefore anticipated demand from them does not form part of the baseline. However, sensitivity analysis has been undertaken to understand what the effect may be.

4.10.15. Network Rail continues to work with HS1 Ltd, Southeastern and Ebbsfleet Development Corporation to understand more about the plans for the area and updated analysis will be included in a modular route study.



Window vinyls at Rochester station

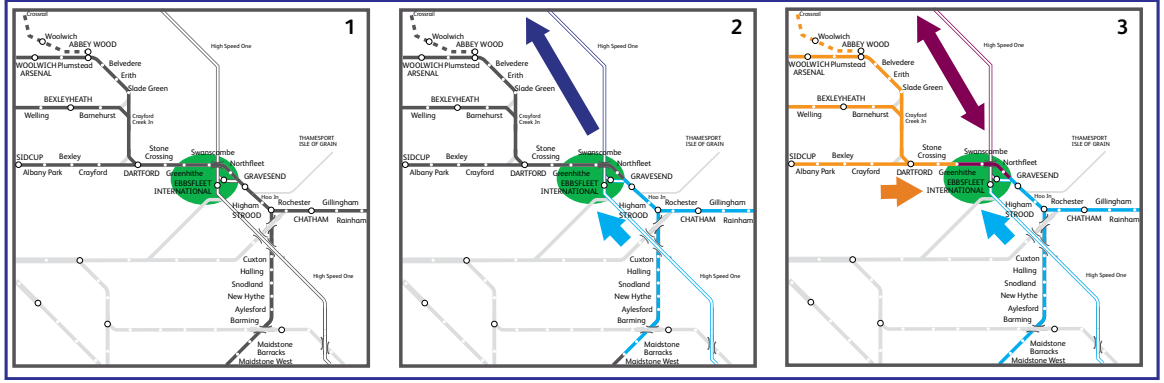
Ebbsfleet Garden City

4.10.16. There are proposals to provide up to 15,000 new houses in the area by 2026. This could have a major impact on required capacity, depending on where people work. There are three potential scenarios as depicted in the diagram below (**Figure 4.7**):

1. EGC residents work locally as the development will provide employment opportunities => No capacity impact on rail
2. EGC residents commute to London and EGC jobs are filled by people from Medway/Maidstone/Ashford who would have previously travelled to London => No capacity impact on rail as there will be a passenger churn at Ebbsfleet with the released capacity from people getting off taken up by new people getting on
3. A combination of the above but also EGC residents commuting to London and EGC jobs filled by people in the surrounding areas who may not have travelled by rail previously or may now travel in the contra-peak direction=> Additional capacity will be required to accommodate the increased demand for travel to London

4.10.17. Forecast planned housing growth at Ebbsfleet Garden City is considered in the High Speed demand forecast.

Figure 4.7 - Ebbsfleet Garden City scenarios



You said...

Only the third of the scenarios briefly outlined for Ebbsfleet [paragraph 4.10.16] is considered tenable, resulting in increased demand for travel to London. Ebbsfleet residents will not all work locally, not least given the profile of local job provision and the price of the brand new homes been provided. It is equally unreasonable to assume Ebbsfleet jobs all be of a type that they will be wholly filled by people in Kent substituting employment there for their current London job. - Dartford Borough Council.

We see the proposals for additional High Speed 1 services to Maidstone, Hastings, and the strengthening required between Ebbsfleet International and London to support the London Resort and the Ebbsfleet Development Corporation as entirely complementary. - London Resort Holdings

London Resort Theme Park

4.10.18. There are proposals to open a major new theme park near Ebbsfleet in 2023/2024, which would be expected to be fully operational by 2028. Annually, 15 million people are estimated to visit the park (30 per cent international) and it is anticipated that 20 per cent to 25 per cent will travel by rail (24,000 staff and 60,000 visitors per day). It has been advised that there would be 10,000 full time employees working at the park.

4.10.19. Given the nature of a leisure park, it can be expected that the majority of travel would be undertaken by both visitors and employees outside the peak hours (predominantly during weekends and late nights for return travel). Also, given the location, it can be anticipated that people would travel in the contra-peak direction. This means that the peak capacity gap estimated above would not generally be impacted. However, the Theme Park is expected to have a number of hotels. Some guests staying overnight at the park are likely to be leaving London St Pancras International within the evening peak hours, leading to further capacity pressures.

4.10.20. It should also be noted that the current configuration of the Class 395 units does not assume large numbers of passengers with luggage would be travelling.

4.10.21. Initial analysis shows that additional rolling stock would be required to accommodate this demand. The effectiveness of commercial options, such as ticket restriction are outside the scope of the Route Study. If additional paths are required in the off-peak, the impact on freight paths, power supply and track maintenance will need to be analysed.

4.10.22. Ebbsfleet International station is owned by HS1 Ltd. It is not designed for high numbers of passengers leaving at the same time and only has two escalators (one up & one down) to the domestic platforms. Station capacity analysis has shown that investment would be required at the station, for example additional escalators, to enable passengers arriving for the Theme Park to exit the platform within a reasonable time period. It is expected that the promotor of the Theme Park would fund any enhancements driven by the visitors to the Park.

4.11 London Blackfriars (CO4 & CO10)

4.11.1. The London Blackfriars service group is split into the following routes (as shown in **Figure 4.8 and Table 4.7**):

A via Kent House

B via Catford Loop

4.11.2. The analysis indicates that no capacity gaps are anticipated in 2024. This is due to the introduction of ThamesLink Class 700 rolling stock, which has greater on board capacity than current rolling stock on the routes and the low forecast growth.

4.11.3. However, ThamesLink services operate north from Blackfriars through the Thameslink Core to the Midland Main Line and East Coast Main Line. The demand on some of these routes requires 12-car services in the peak hours and therefore platform extensions on the routes in Kent would also be required if they were to operate there. If services were lengthened to 12-cars, the capacity demand up to 2044 would be met. Additional services would be subject to the same constraints as those experienced by Victoria Metro services.

4.11.4. The choices for funders in **Chapter 5** include options for platform extensions on the routes where 12-car ThamesLink rolling stock may operate. Power supply and berthing capacity will require further investigation.

4.11.5. The benefits from train lengthening south of Blackfriars alone are valued at £40m (PV, 2010 prices, 60 years discounted), which would not cover the costs. However, we expect greater benefits to be realised from:

- Crowding reduction in the Thameslink Core and north of the river where most platforms are already capable of accommodating 12 coaches;
- Wider economic benefits from enabling the Brent Cross redevelopment.

4.11.6. Capacity gap expected on the peak additional services via Kent House, which will be remapped into the Southeastern franchise (from May 2018) and not allocated Class 700 rolling stock. Since trains are already the maximum length, this would require an additional path. This capacity gap could be solved by the introduction of high-capacity stock such as Class 700 in 2024, but not 2044.

Figure 4.8 - London Blackfriars capacity in 2024

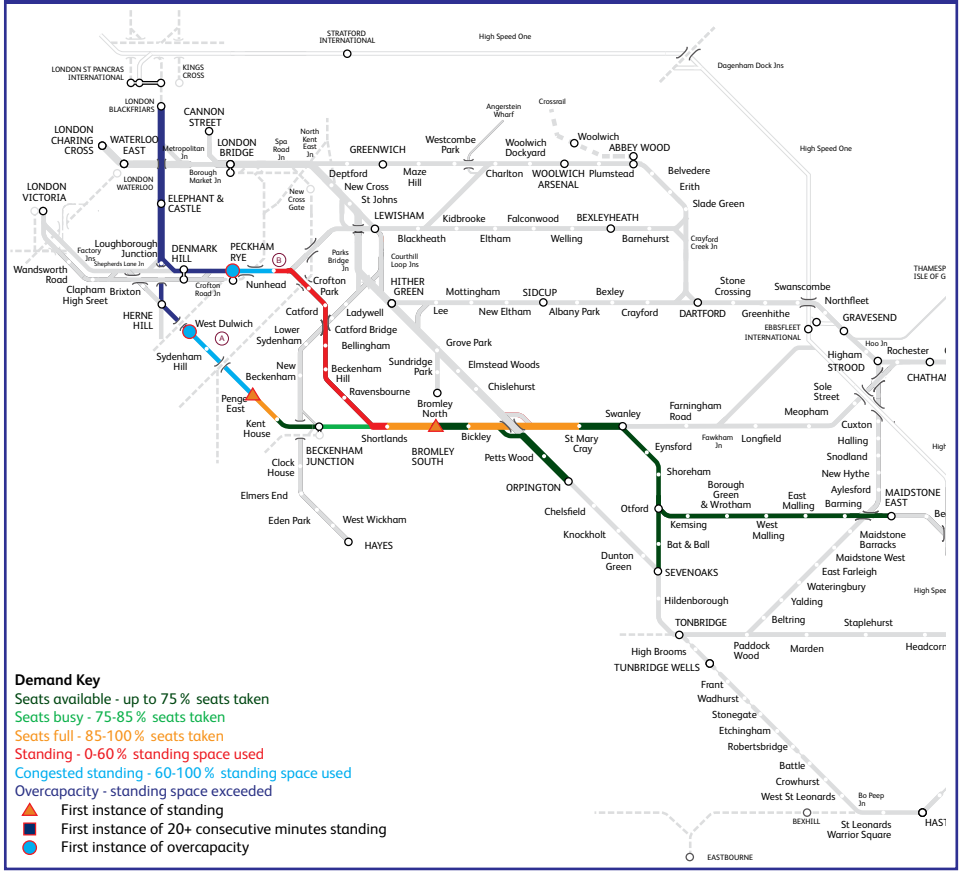


Table 4.7 - London Blackfriars vehicle gaps*

Corridor	Map ref	Number of vehicles in 2014	Number of vehicles in 2018	Forecast additional vehicles in 2024	Forecast additional vehicles in 2044
Via Kent House	A	16	16	8	12
Via Catford Loop*	B	40	32*	8	12

*2018 ThamesLink timetable specifies 4tph

4.12 London Bridge and London Victoria Main Lines (CO5 & CO11)

4.12.1. London Bridge and Victoria Main Lines service group is split into the following routes (as shown in **Figure 4.9 and Table 4.8**):

A Via Chatham & Swanley

B Via Tonbridge

C Via Maidstone East & Swanley

4.12.2. Up to 2024, the capacity gap on the Maidstone East and Chatham corridors could be met by extending all services to 12-car length if operated by Electrostar units due to some platforms requiring SDO. However, on the route via Tonbridge, the analysis indicates that train lengthening options alone will not be sufficient to meet the expected demand and an additional path would be required. Also a power supply upgrade will be required on the Tunbridge Wells to Hastings line for more 12-car trains.

4.12.3. As already noted in the London Bridge Metro section, Charing Cross and Cannon Street stations are effectively full in the high peak hour.

4.12.4. The Victoria Metro section has highlighted the issue with capacity at Shortlands Junction and the conflict between fast service and stopping service, which restricts capacity. In addition, Victoria has a mix of 8-car and 12-car platforms restricting the number of longer trains that can be run.

4.12.5. Lengthening trains on the Maidstone East line will require platform lengthening at most stations as selective door opening at successive stations can be a performance risk. As noted in **section 4.11 Blackfriars services**, choices for funders based on platform extensions are being developed for ThamesLink services.

Figure 4.9 - London Bridge & London Victoria Main Line capacity in 2024

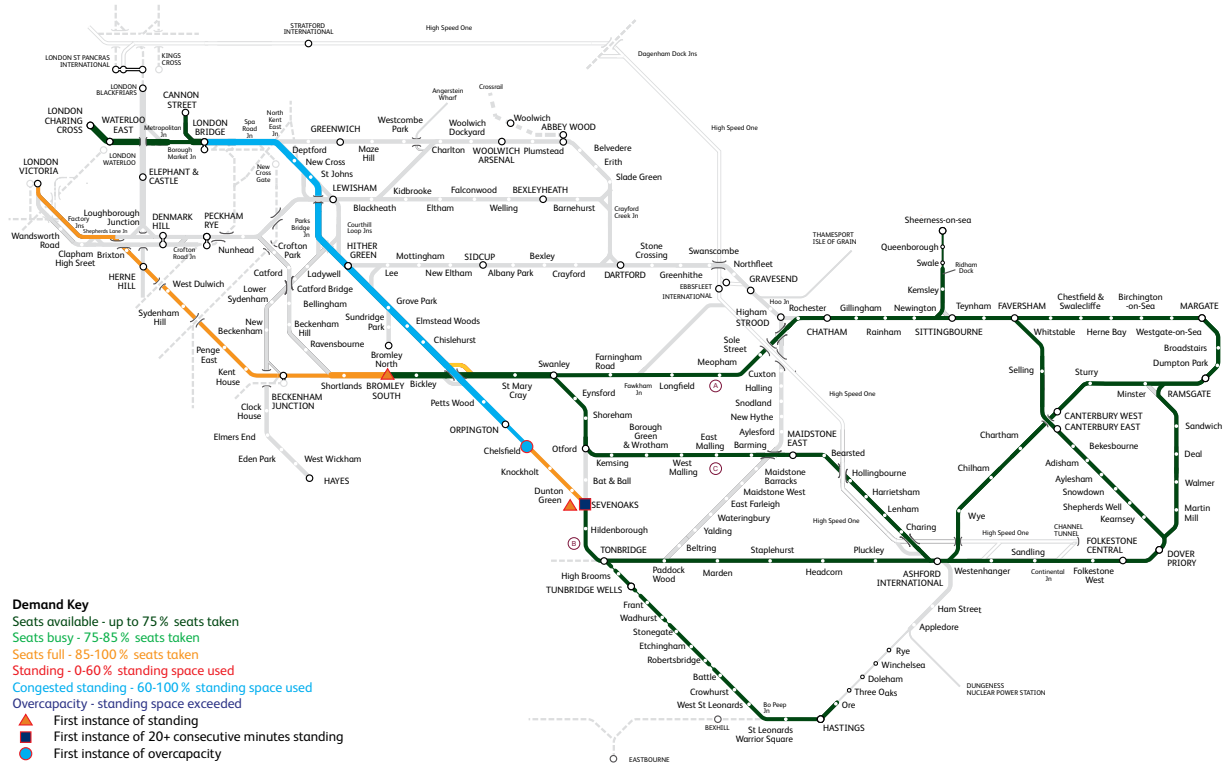


Table 4.8 - London Bridge and Victoria Main Line vehicle gaps

Corridor	Map ref	Number of vehicles in 2014	Number of vehicles in 2018	Forecast additional vehicles in 2024	Forecast additional vehicles in 2044
Via Chatham	A	73	70	0	2
Via Tonbridge	B	135	138	9	32
Via Maidstone East	C	18	24	1	8

4.12.6. There are specific capacity issues with the route from Tonbridge, where there is expected to be the highest passenger growth:

- Conflicting moves from the various routes that converge at Tonbridge
- Two-track route between Tonbridge & Orpington with a mix of fast and stopping services

4.12.7. The passenger growth predicted to 2044 indicates that seven additional paths will be required:

- Five paths via Tonbridge
- One path via Maidstone East
- One path via Chatham.

4.12.8. Due to the restrictions highlighted above, the additional paths from Tonbridge could not be accommodated in the timetable.

4.12.9. However, it is anticipated that passengers who currently drive from towns and villages close to the Maidstone East line, to use stations on the Tonbridge line to catch fast trains to London, will return to their local stations once they are served by the new Ashford International/Maidstone East to Cambridge service in December 2019. This will provide a faster link to London Bridge and beyond, therefore the growth should be reassessed after the introduction of the services.

4.12.10. **Chapter 6** will identify choices for funders to meet the capacity challenge.

The booking hall at Ramsgate

4.13 Orbital services - East & South London Lines (CO6 & CO12)

4.13.1. These corridors include the Arriva Rail London services operating on the South London Line from Clapham Junction and the East London Line from New Cross through to Dalston Junction. This group does not include East London line services to/from Crystal Palace or West Croydon, which were included in the Sussex Route Study.

4.13.2. The forecast growth for the services is also split by direction – west to east services (**Figure 4.10**) and east to west (**Figure 4.11**).

4.13.3. TfL strongly advocates the move from 4tph to 6tph on the South London Line. Although train lengthening could be an alternative to provide extra capacity, this would not be a viable option because platform lengthening on the core East London Line route would be challenging. Platforms at stations, such as Canada Water, are not long enough and would require extensive tunnel alterations to cater for longer trains.

Figure 4.10 - London Orbital services capacity - Eastbound in 2024

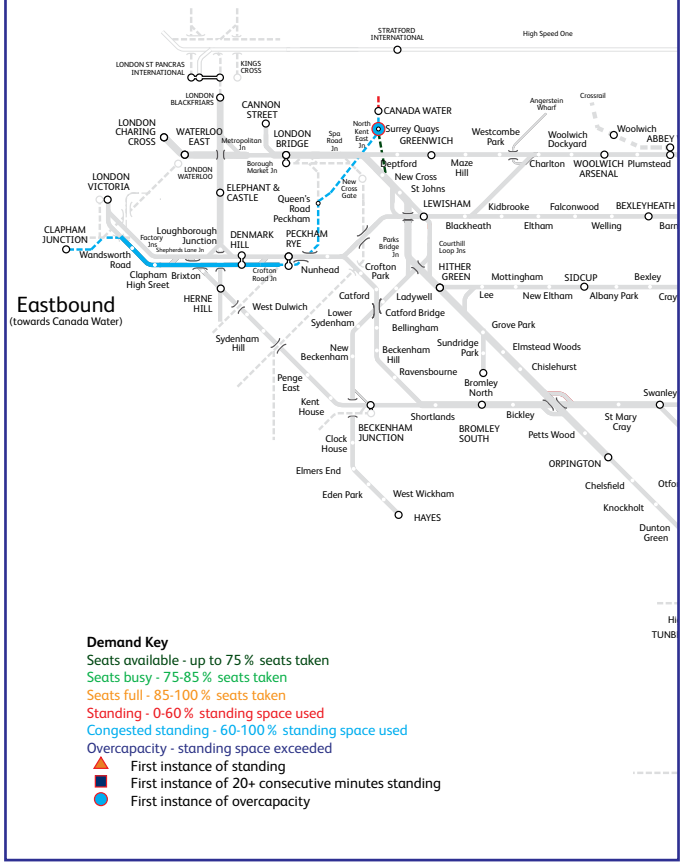


Figure 4.11 - London Orbital services capacity - Westbound in 2024

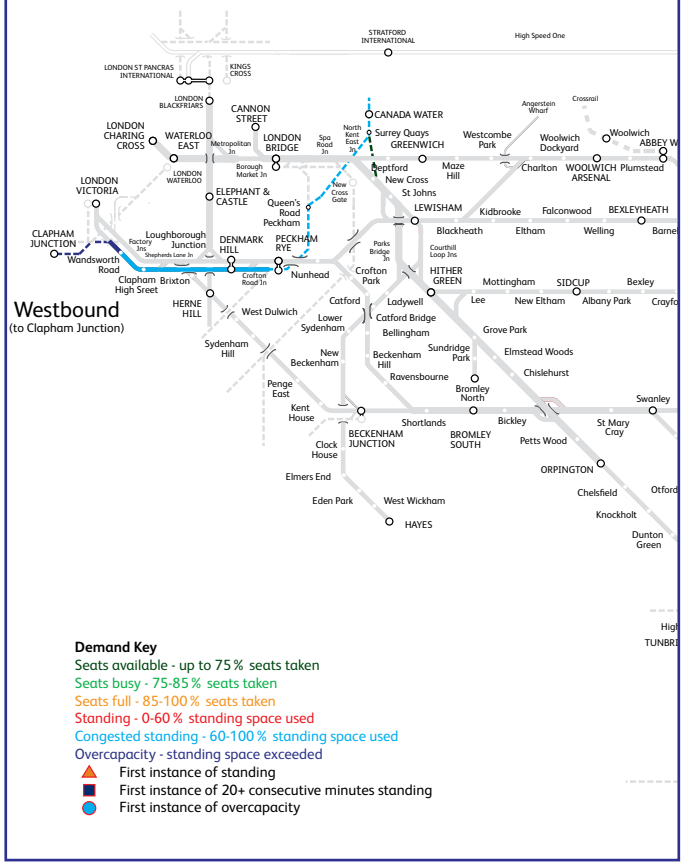


Table 4.9 - London Orbital vehicle gaps

Corridor	Number of vehicles in 2014	Number of vehicles in 2018	Forecast additional vehicles in 2024	Forecast additional vehicles in 2044
Westbound (East to West)	16	20	5	11
Eastbound (West to East)	16	20	11	20

4.14 Brighton to Ashford Capacity (CO13)

4.14.1. Brighton to Ashford International (Marshlink) is key regional route connecting the communities of Brighton, Eastbourne, Hastings, Rye and Ashford. The route between Hastings and Ashford is not electrified and is therefore operated with a 2-car diesel train. They are the busiest regional services in the route study area. The demand is most concentrated between Hastings and Brighton. This output links with the connectivity conditional output 'CO15 Improving generalised journey times from Hastings to London'.

4.14.2. Following the proposed changes to the Govia Thameslink Railway timetable to split the service into two separate trains the forecast has been revised.

4.14.3. The new service will be formed of a 4-car electric unit forming the Brighton - Hastings service (where demand is highest) and a 2-car diesel service between Eastbourne and Ashford International.

4.14.4. The resultant 2-car service experiences standing in the peak in both directions but will not be overcapacity by 2024 or 2044.

4.14.5. The choices for funders for improvements on Marshlink are highlighted in **Chapter 6**.

Two Southeastern trains wait to return to London at Hastings, whilst a Southern service arrives from Ore en route to Brighton

Figure 4.12E - Brighton to Ashford International capacity in 2024 (average over the whole day) - Eastbound

Figure 4.12W - Brighton to Ashford International capacity in 2024 (average over the whole day) - Westbound

Table 4.10 - Brighton - Ashford International vehicle gaps

Corridor	Number of vehicles in 2014	Number of vehicles in 2018	Forecast additional vehicles in 2024	Forecast additional vehicles in 2044
Brighton - Ashford International	42	42	0	0

FAST FACTS

Nationally, in 2017/18, there were 165,445 commercial freight service in England, Scotland and Wales.

Of these 6,681 services operated over the South East Route, that's 4.18% of the national total.

FAST FACTS

New traffic has been confirmed to and from the Isle of Grain with petroleum to Heathrow Airport.

New aggregates services to Cricklewood from South East Route for the new Brent Cross residential development of 8-9k homes and new station.

4.15 Providing sufficient capacity for freight services (CO20)

4.15.1. The United Kingdom is currently a member of European Rail Freight Corridor 'North Sea-Mediterranean 4', under which the national infrastructure managers establish a 'pool' of pre-arranged paths for international freight services. At present, this Corridor applies to three 'classic' rail routes between the Channel Tunnel and London shown as Routes 1, 2 and 6 in **Figure 4.13**.

4.15.2. In the 1987 Usage Contract, there is a commitment to provide the infrastructure to accommodate 5,200,000 tonnes of non-bulk freight and 2,900,000 tonnes of bulk freight per year between London and the Channel Tunnel, which Network Rail honours.

4.15.3. A minimum of 35 specified paths per day in each direction between the Channel Tunnel and Wembley Freight Operating Centre have been protected by Network Rail for the duration of the Channel Tunnel/Railways Usage Contract up to 2052. This capacity is safeguarded under a 1996 Back to Back agreement between Eurotunnel, British Railways Board, the Secretary of State for Transport, Railtrack (now Network Rail), Eurostar and EWS (now DB Cargo).

Figure 4.13 - Channel Tunnel freight routes through Kent

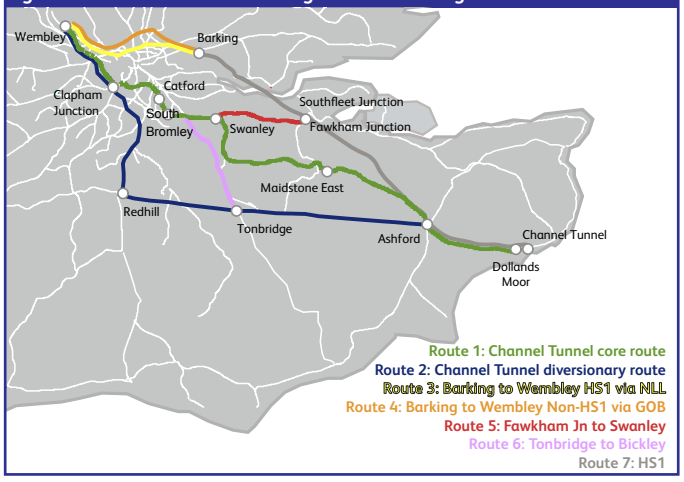
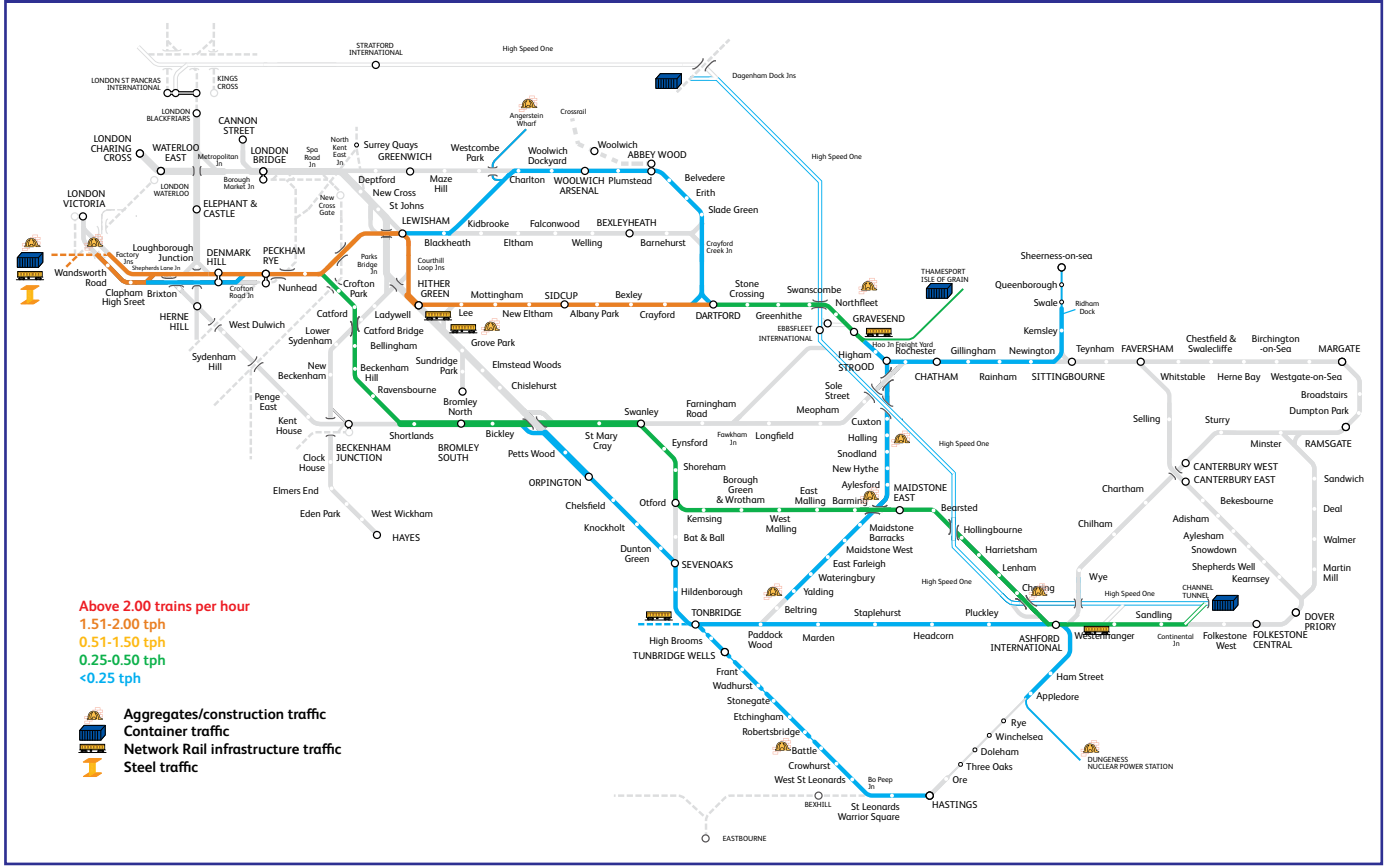


Figure 4.14 - Freight capacity requirements in 2024



4.15.4. The 35 daily paths in each direction provide sufficient infrastructure capacity to handle at least 8.1m net tonnes per annum, as required by the Railways Usage Contract, signed between Eurotunnel, BRB and SNCF in 1987.

4.15.5. In 2012, 18 per cent of Channel Tunnel freight paths were utilised. With forecast freight growth, this utilisation rises to 38 per cent by 2044. Therefore it can be assumed the paths already protected in the existing timetable are sufficient to satisfy conditional output CO20. The Route Study notes there is no requirement to propose active interventions. Instead, the approach taken has been to ensure that this level of freight capacity is protected in all options to improve passenger services referenced in this document. There are no additional capacity constraints elsewhere on the Route given the off-peak nature of most freight movements.

4.15.6. There are choices for funders, for example on gauge clearance, which would benefit freight, even though there is not a direct capacity requirement.

4.15.7. It could be argued that due to the normal 30 minute recurring frequency of train services, even a requirement for 0.25 trains per hour (one train every four hours) equates to one pathway every half an hour. Therefore 2tph which is a large over-provision, but on a predominantly passenger network with a clockface timetable, it is difficult to identify how to resolve this issue.

Freightliner's 66 585 passes under Beaver Road bridge at Ashford International

You said...

Transport for London stated that:

'We believe there is little justification for retaining the 35 paths a day, given that the actual level of utilisation is so low and is still forecast to be less than 50% in the 2040s.

'Presumably this utilisation is contractually (i.e. at least one per 13 weeks) rather than average daily as well – the latter being considerably lower. This contrasts with the urgent need to exploit the capacity for other purposes i.e. enhanced Overground services.

'At the very least we should have more flexibility i.e. the volume of paths required by the 2040s should be what is reserved, not the current level with paths being moved to the less busy times of day.

'We understand the RFC [Rail Freight Community] currently only requires the reservation of two paths per day and there appears to be little appetite for more capacity at the moment from the FOCs concerned.'

David Lock Associates wrote in on behalf for Northfleet Property LLP with this response:

'Northfleet LLP has an interest in the existing rail terminal at Northfleet, which provides an important multi-modal interchange for aggregates and construction traffic. The rail link is operational and therefore it should be shown on all diagrams of the current rail network. The operation of this terminal should be safeguarded within any future proposals for the area, including extending Crossrail to Ebbsfleet.'

The Chartered Institute of Logistics and Transport comment: 'The recent problems with Lewisham flyover demonstrated the crucial importance of Cross-London freight routes and how vulnerable they are to infrastructure failure at key locations.

'We believe that these facilities are every bit as important to UK plc as, for example, London Bridge is for commuters and, accordingly, should be given much more attention than they currently receive, in both an analytical and a practical sense. Lack of resilience is a major concern for customers and the Lewisham - Nunhead - Factory Junction corridor (and its continuation along the West London Line) is absolutely vital for freight and should be considered a priority route.

'Robust contingency plans are also required to cater for blockage of key freight route sections e.g. temporary diversion via Tonbridge, Redhill and Clapham Jn.'

The diversionary route via Redhill and Guildford would require a flyover at Redhill, tunnel improvements at Guildford and identification of robust pathways on the North Downs Line, through Guildford and through Reading.

An alternative could be a new underground freight only line under part of London which could serve Channel Tunnel, North Kent and North London Line freight traffic. A freight-only line releasing pathways on the North and West London Lines could be provided at reduced cost as there would be no stations and only the requirement to evacuate traincrews rather than thousands of passengers.

Table 4.12 - Conditional Output CO21

Conditional Output Reference	Conditional Output
CO21 (2024)	Provide sufficient capacity to accommodate passenger circulation at stations within the Kent route

4.16 Stations – passenger circulation

4.16.1. It is recognised that station capacity is an important factor to be considered as part of the Long Term Planning Process on the Kent 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 journey times can be increased and greater inconvenience to passengers incurred 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.

4.16.2. The Route Study has identified which stations on the Kent Route need to be assessed for potential future passenger capacity issues that will require some level of intervention during CP6 (up to 2024).

4.16.3. 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 and improvement to station façades, station ambience etc.) are generally not included under station capacity.

4.16.4. Whilst it may be beneficial to assess and fund these, they are not taken into direct consideration in this review unless there is an opportunity to improve access and safety or increase capacity, for example as part of a 'Renewal', through 'NSIP – National Station Improvement Programme' or 'AfA - Access for All' funding, which seeks to create step-free access from station entrances to platforms.

4.16.5. In order to generate a station capacity base scenario, a review of current station operations was undertaken across the route. A shortlist of stations in need of enhancements 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 baseline 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 can be analysed as part of a more detailed station capacity assessment.

4.16.6. The short list of stations that are a priority up to 2024 and 2044 are shown in **Figure 4.15**.

Figure 4.15 - Passenger circulation

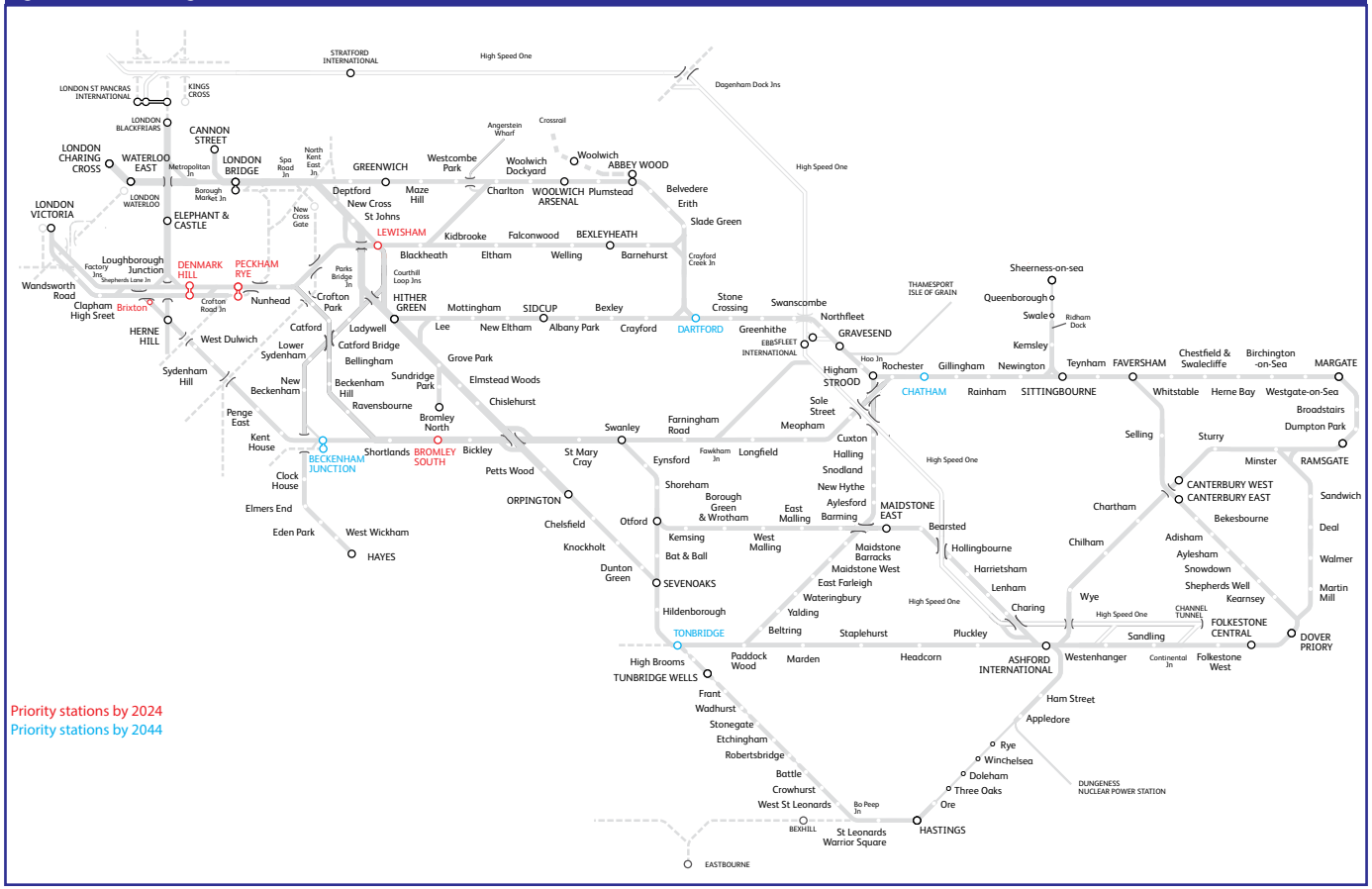


Table 4.13 - Conditional Output CO22

Conditional Output Reference	Conditional Output
CO22	Provide sufficient capacity to accommodate passenger demand during week day evenings and at weekends

4.17 Other conditional outputs

4.17.1. The greatest strain on the network in Kent is during the high peak hour between 08:00 and 08:59. The track capacity and train lengths are optimised to accommodate these weekday flows. Outside this time, the reduced off-peak demand allows train operators to clean and prepare their fleets of trains ahead of the evening peak, to check critical systems and to undertake maintenance.

4.17.2. The more intensive peak hour train service can also put a strain on equipment, such as that which supplies the electrification. This may not be designed to operate at the peak hour power demand for extended periods.

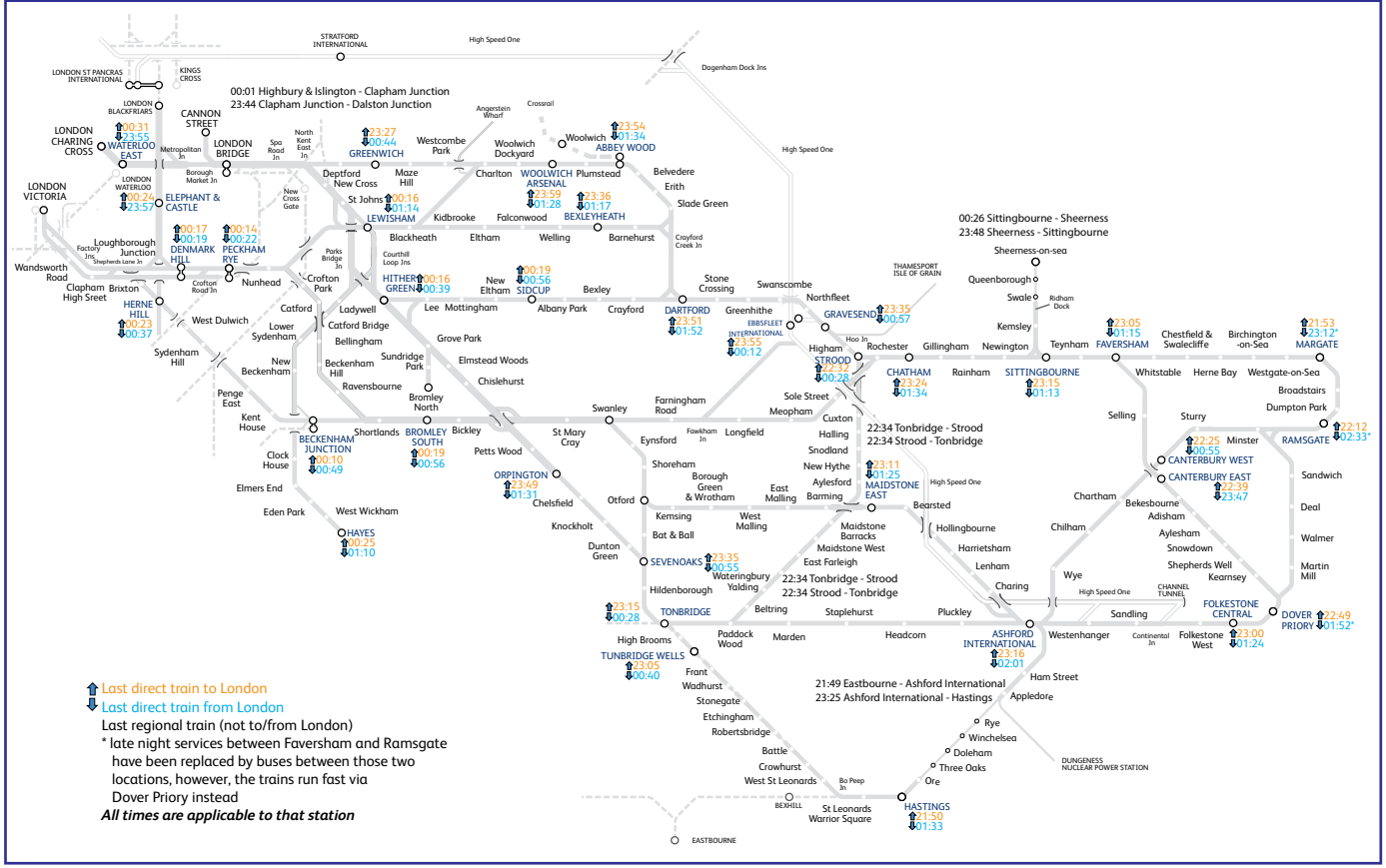
4.17.3. Agreements on additional or reduced services in the off-peak periods, including earlier and later services could form part of a future franchise agreement.

4.17.4. **Figure 4.16** shows the last trains to and from London on a Wednesday night as well as last services on the Sheerness Branch, Medway Valley Line, Marshlink and London Overground. Some routes will see later last trains on other weekdays.

4.17.5. The service changes, Monday to Wednesday, enable additional engineering access to allow Network Rail engineers and contractors to carry out essential maintenance and renewal work overnight rather than at weekends. These are the days when fewer people are travelling on these later trains

4.17.6. This approach has been used recently on the Tonbridge - Hastings line where the focus on maintenance saw a reduction in failures and improvement in performance.

Figure 4.16 - Last trains (May 2018 timetable, Wednesdays)



5 Improving connectivity

This chapter sets out:

- **where the market studies identify opportunities to improve journey times, frequency and ease of interchange**
- **the connectivity conditional outputs**

WHAT IS... GENERALISED JOURNEY TIME?

The impact of rail service improvements on quality of life for individuals and communities are assessed to determine the service level conditional outputs. The assessment quantifies the impact of service improvements on the value of time spent on travelling to existing and new rail passengers.

Improvement in rail service provision is reflected through changes in the generalised journey time (GJT) for travel between places in London and the South East.

The GJT takes into account time spent in a vehicle, service frequency and interchange. The assessment compares the current GJT experienced by rail passengers with the GJT associated with different levels of generalised speed (distance divided by GJT).

Values of time were sourced from the Department for Transport's transport appraisal guidance and were then applied to calculate the benefits in time saving, which then represents the quality of life improvement to rail passengers.

5.0.1. The Long Distance and London and South East Market Studies established a number of conditional outputs relating to the level of connectivity provided by passenger rail services. Connectivity covers several aspects of the passenger timetable, with the principal components being:

- Train service frequency between stations
- Timetabled journey times
- The provision of direct journeys which do not require an interchange.

5.0.2. The Market Study sets out in detail how conditional outputs for connectivity have been developed. The connectivity conditional outputs focus around improving the generalised journey time between two locations. 'Generalised' journey time is a measure of rail connectivity which combines both the speed and frequency of rail services, including the impact of any interchange.

5.1 Conditional outputs from the London and South East Market Study

5.1.1. The London and South East Market Study sets out conditional outputs that improve connectivity between major locations across the south east and London. These conditional outputs have been set out in terms of providing minimum average journey speeds and improvements to train service frequency both subject to affordability and value for money considerations, see Table 5.1.

Table 5.1 - Passenger connectivity conditional outputs

Conditional Output Reference	Conditional Output
CO14	Provide a minimum of 3-4tph to/from central London during off peak hours from stations within 30 miles of London: Stone Crossing, Swanscombe, Northfleet, Higham, Sole Street, Farningham Road, Eynsford, Shoreham, Kemsing, Chelsfield, Knockholt, Dunton Green and Hildenborough
CO15	Provide a Generalised Journey Time (GJT) of 40 – 100 minutes to significant centres of population over 30 miles from central London: Hastings
CO16	Provide a Generalised Journey Time (GJT) of 40 – 100 minutes to significant centres of population over 30 miles from central London: Ramsgate
CO17	Provide total JT of less than 60 minutes within Kent or significantly less than 100 minutes within south east (connectivity between urban centres): Brighton – Ashford Intl.
CO18	Provide total JT of less than 60 minutes within Kent or significantly less than 100 minutes within south east (connectivity between urban centres): North Kent – South Kent

5.2 Off-peak trains to London from stations within 30 miles (CO14)

5.2.1. Providing a regular off-peak frequency to London of three or four trains per hour is a conditional output of the market study. Owing to the relatively dense operation of the network, most stations within the route study area already provide for or exceed this frequency.

5.2.2. There are eighteen stations that currently do not meet the output. However, five of these are expected to see a service increase as part of the 2018 timetable and would then meet the output.

5.2.3. A number of these stations have additional services in the peak hours, when most people travel.

5.2.4. **Figure 5.1** shows the stations that have been identified in Condition Output 14. **Table 5.2** lists the stations with details of numbers of trains per hour in the peak and off-peak and the estimate of annual station entries and exits. This table has been updated to included the 2016/17 data.

5.2.5. Following analysis as part of the Route Study, it is not proposed to stop additional services at these stations in the off-peak. This is because it would extend journey times for other passengers and in most cases there are other stations with faster services in close proximity. For example, the busiest station on the list is Chelsfield. This station has two trains per hour (tph) in the off-peak hours, but 6tph in the peak hours. It is situated approximately one mile from the village and is on a busy two-track section of the network. Orpington station is around two miles from Chelsfield village and has six fast trains per hour to London in the off-peak.

Figure 5.1 - Off-peak trains to London from stations within 30 miles with fewer than 3tph

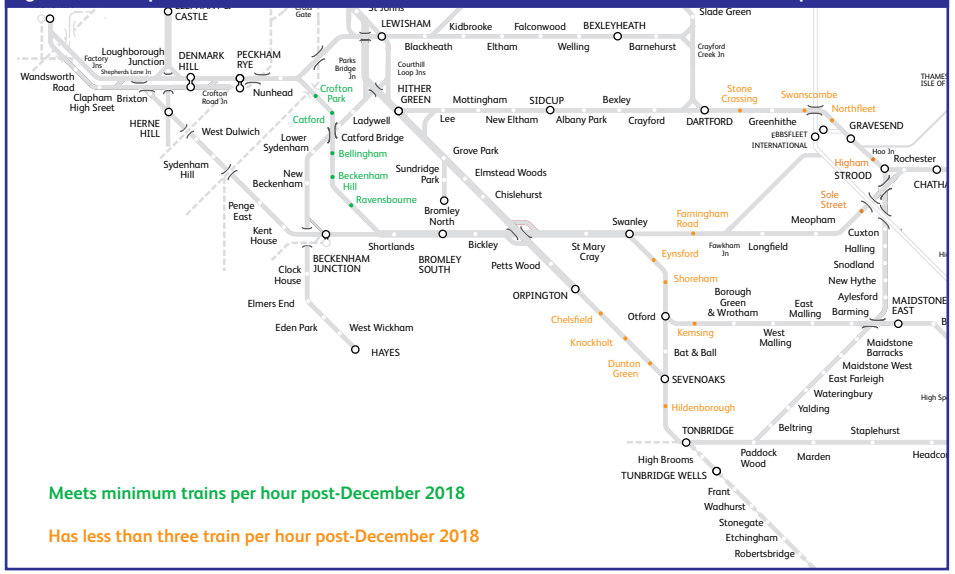


Table 5.2 - Stations within 30 miles of London with less than three trains per hour

Station	Route/Corridor	Off-peak trains per hour	High peak trains per hour	Estimate of station usage 2016/17 entries & exits	Estimate of station usage 2017/18 entries & exits
Stone Crossing	North Kent Line	2	2	180,384	194,608
Swanscombe	North Kent Line	2	2	166,564	173,558
Northfleet	North Kent Line	2	2	104,468	111,350
Higham	North Kent Line	2	2	186,956	194,226
Sole Street	Chatham Main Line	1	1	59,572	68,620
Farningham Road	Chatham Main Line	1	1	203,588	210,476
Eynsford	Maidstone East Line	2	3	174,410	182,484
Shoreham (Kent)	Maidstone East Line	2	3	40,812	44,294
Kemsing	Maidstone East Line	1	2	25,362	25,440
Chelsfield	Tonbridge Main Line	2	6	944,166	920,538
Knockholt	Tonbridge Main Line	2	3	287,418	272,732
Dunton Green	Tonbridge Main Line	2	3	225,046	229,046
Hildenborough	Tonbridge Main Line	2	5	596,680	601,984

5.3 Longer distance to and from Central London

5.3.1. The London and South East Market Study identified a conditional output to reduce the 'generalised' journey time (significantly less than 100 minutes, and as close to 40 minutes as possible) between London and the major generators of demand on the route. This can be achieved by providing a minimum average speed of 50-55mph.

5.3.2. In Kent, one station that fits into this category (Ashford International) currently has this level of off-peak connectivity to central London. There are two significant centres of population within the route that do not currently meet this conditional output.

Table 5.3 - Key longer distance stations (over 30 miles from London)

Significant centre of population	Destination	Total direct journey opportunities per hour	Journey Time	Average miles to London	Average Generalised Journey Time (minutes)	Average generalised speed (miles per hour)
Ashford International	London St Pancras	1	~40 mins	54	60	54
	London Victoria	2	~90 mins			
	London Charing Cross	2	~80 mins			
Hastings	London Victoria*	1	~120 mins	61	117	31
	London Charing Cross	2	~95 mins			
Ramsgate	London St Pancras	1	~75 mins	76	101	45
	London Victoria	1	~120 mins			
	London Charing Cross	1	~125 mins			

*via Eastbourne, Lewes and Gatwick Airport

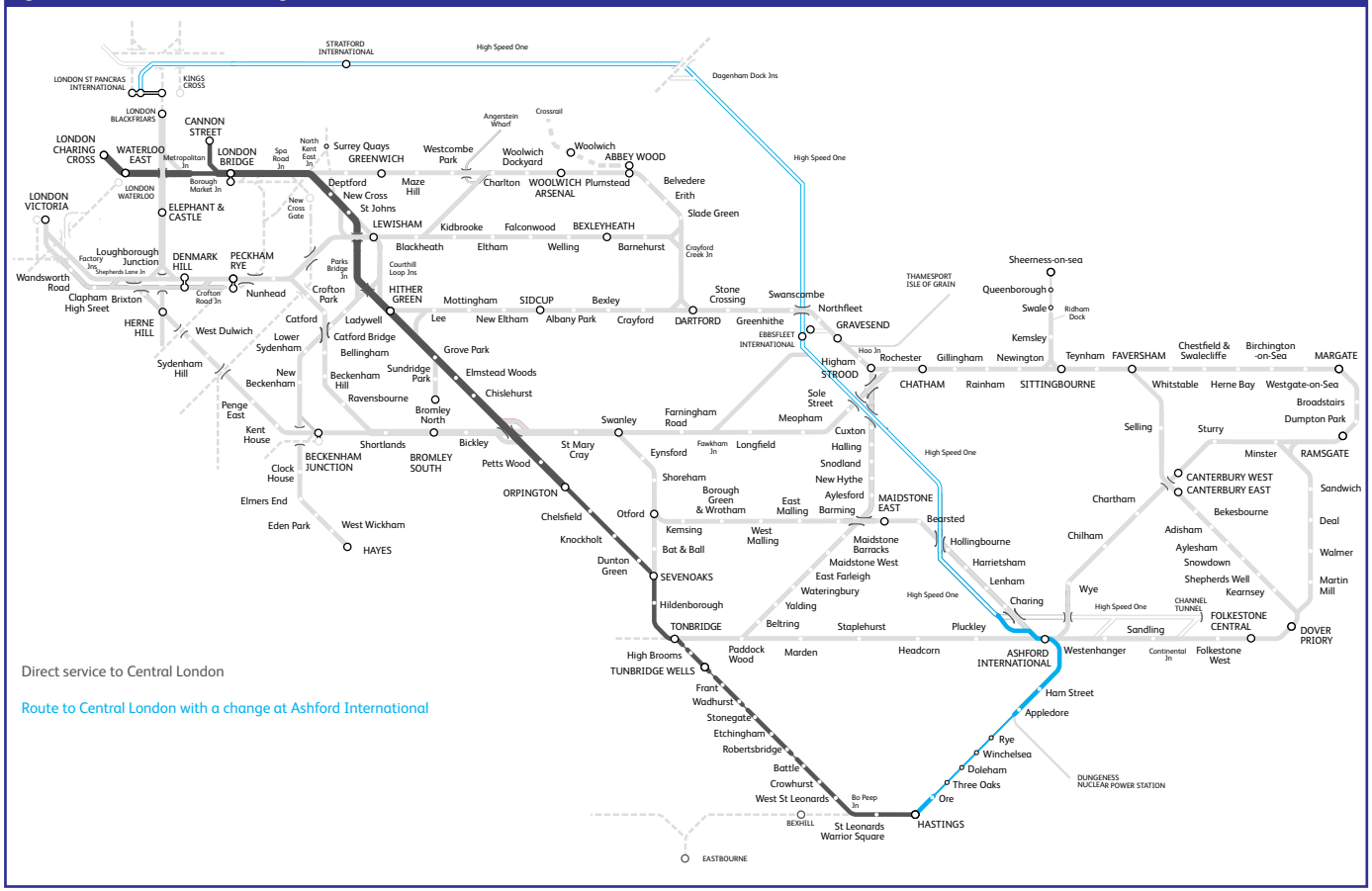
Hastings seafront

5.4 Generalised journey time from London to Hastings (CO15)

5.4.1. Hastings has a population of circa 90,000 and is 53 miles from London. There are three trains from Hastings that run via Tonbridge and arrive into London in the high peak hour, taking around 1 hour 50 minutes. In the off-peak there are two trains per hour to London taking between 1 hour 35 minutes and 1 hour 45 minutes. The route between Tonbridge and Hastings is constrained by slow line speeds and has single line sections through a number of tunnels. There are also direct services that operate via Eastbourne and Gatwick Airport to London Victoria with a journey time of over two hours.

5.4.2. Some passengers from Hastings choose to travel to Ashford International on Marshlink and change onto a High Speed train to London St Pancras International. In the off-peak, the journey time, which includes the connection at Ashford International, is around 1 hour 45 minutes and thus comparable to the direct route via Tonbridge.

Figure 5.2 - Services to Hastings



5.5 Generalised Journey time to from London to Ramsgate (CO16)

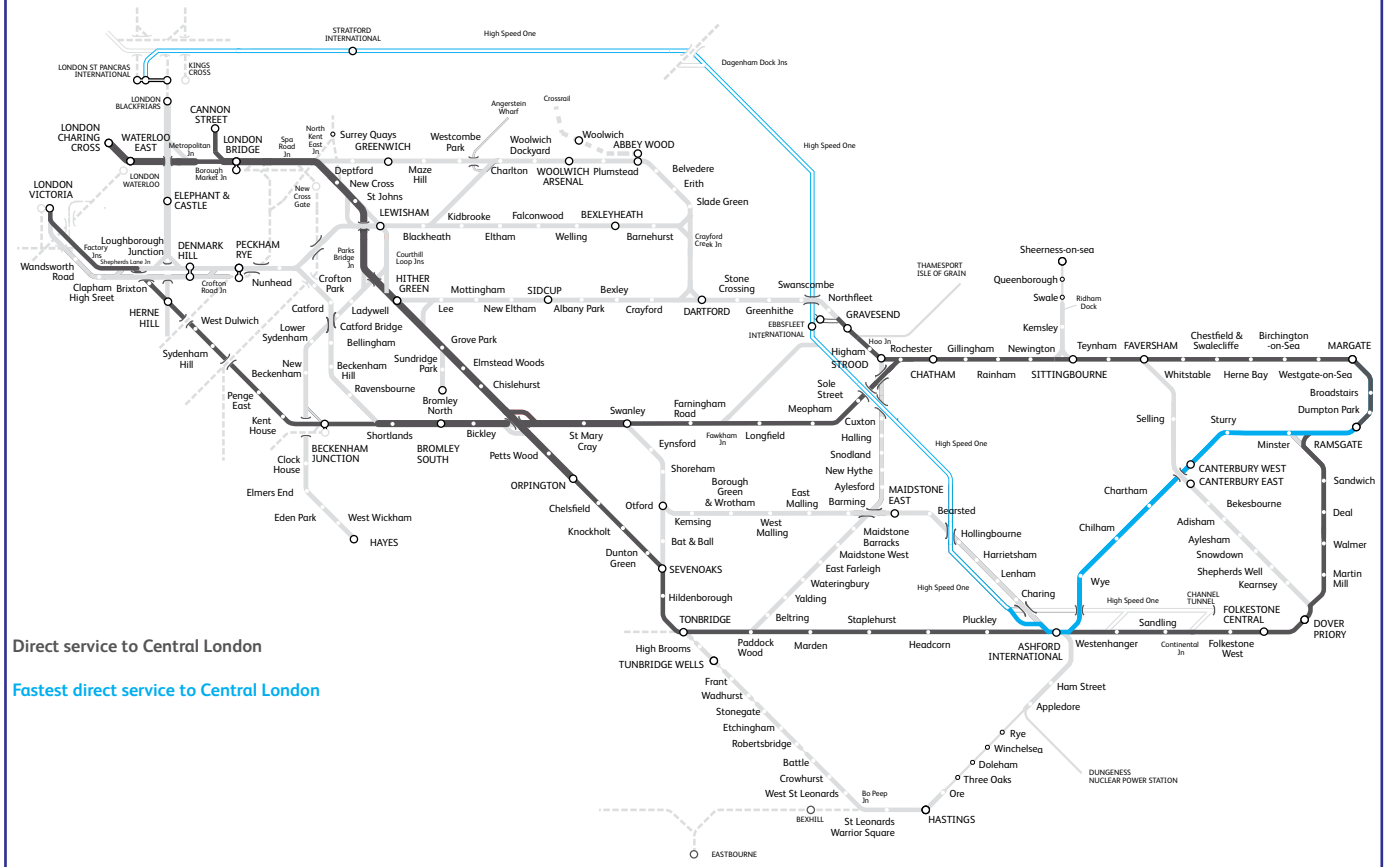
5.5.1. Ramsgate has a population of circa 40,000 and is 78 miles from London. The town has services to London St Pancras via HS1, the journey time being around 75 minutes in addition to services to London Victoria and Charing Cross, taking around two hours.

5.5.2. The connectivity conditional output will be delivered through the Ashford to Ramsgate Journey Time Improvement project, which is funded in the most part by Kent County Council, but also the Network Rail Journey Time Improvement Fund. The line speed improvements are being delivered in two phases:

- **Phase 1** – delivered by December 2018, is estimated to reduce the running time between Ashford and Canterbury West by two minutes
- **Phase 2** – delivered by December 2020, is estimated to reduce the journey time between Canterbury West and Ramsgate by a further minute. This phase is currently in GRIP Stage 3 'Option Selection'.

A Class 375 Electrostar unit at Dover Priory

Figure 5.3 - Services between London and Ramsgate



5.6 Rail connectivity between large regional centres within Kent and the South East of England

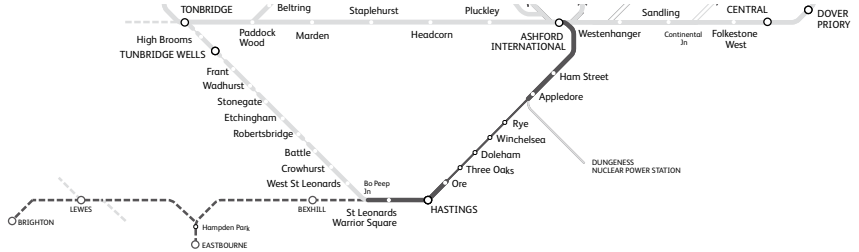
5.6.1. The London and South East Market Study developed a conditional output for large (non-London) regional centres which are in close proximity to each other within Kent and also within the South East region. The Conditional Output addresses incremental improvements to journey times, with the aim of delivering a total journey time of less than 60 minutes within Kent and 100 minutes within the South East.

Brighton to Ashford (CO17)

5.6.2. Marshlink services connect Brighton, Eastbourne, Hastings and Rye with Ashford International. The route between Hastings and Ashford International is not electrified and so requires the service to operate diesel trains. The route has 62 level crossings and also has relatively low line speeds. When the route between Eastbourne and Bo-peep Junction was resignalled in 2014, the signals were spaced to allow higher line speeds, but further work is needed to implement these improvements. The future operation of the service forms part of the ongoing Govia Thameslink Railway 2018 Timetable Consultation. This conditional output and CO15 are linked to CO13 in **Chapter 4**.

Figure 5.4 - Services between Brighton and Ashford International

Direct services between Brighton and Ashford International



A direct Southern service from Brighton shortly after arriving at Ashford International. The 2-car Class 171 diesel unit operates this train throughout.

North to South Kent (CO18)

5.6.3. The connectivity between North and South Kent is poor by both road and rail. While east to west connectivity is provided by both the M2 and M20 motorways as well as the HS1, Kent Coast and Tonbridge rail lines, the north to south options for commuters and leisure travellers are limited.

5.6.4. Ashford and Faversham are 14 miles apart. The A251 that connects them is a single carriageway with slow journey times. The most direct route by train between these regional centres involves either changing between Canterbury East & Canterbury West stations, which are one mile apart leading to an overall journey time of more than one hour or travelling over 60 miles and 75 minutes via Ebbsfleet International.

5.6.5. As noted in **4.10.11**, the Ebbsfleet area is due to see significant growth in the future. There are good connections to the area via HS1 and services to Northfleet station. However, from areas in South London, such as Bromley, journey times are slow and via a circuitous route to Rochester.

You said...

Highways England said: 'Route strategies are one of the key steps of research required for developing the Department for Transport's Road Investment Strategy for Road Period 2, covering the period 2020-2025 and will be the foundation for much of the thinking about where to invest in the strategic road network after 2020.

'Route strategies will bring together information from motorists, local communities, construction partners, environmental groups and others such as Network Rail. We will use this information to help us better understand the performance of our roads, shape our investment priorities to encourage economic growth and to improve the service we provide to road users and our neighbours. The strategies will help government decide where investment is most needed to improve the economic prosperity of the country.

'We are already working with colleagues within Network Rail seeking to ensure that our respective strategies, plans and programmes are suitably joined-up.'

Figure 5.5 - North-South connectivity

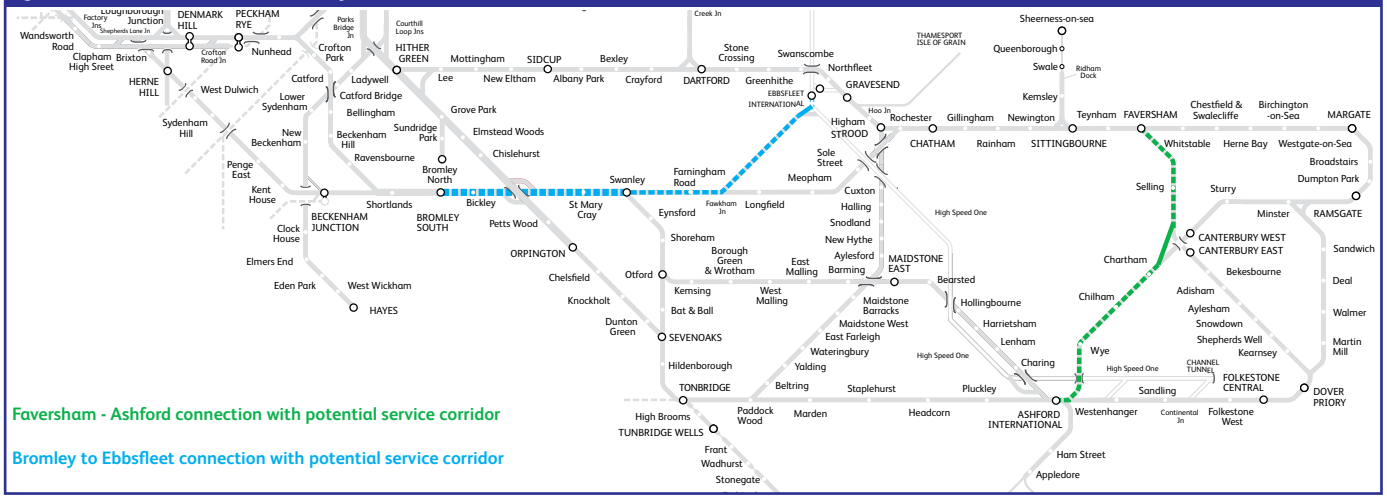
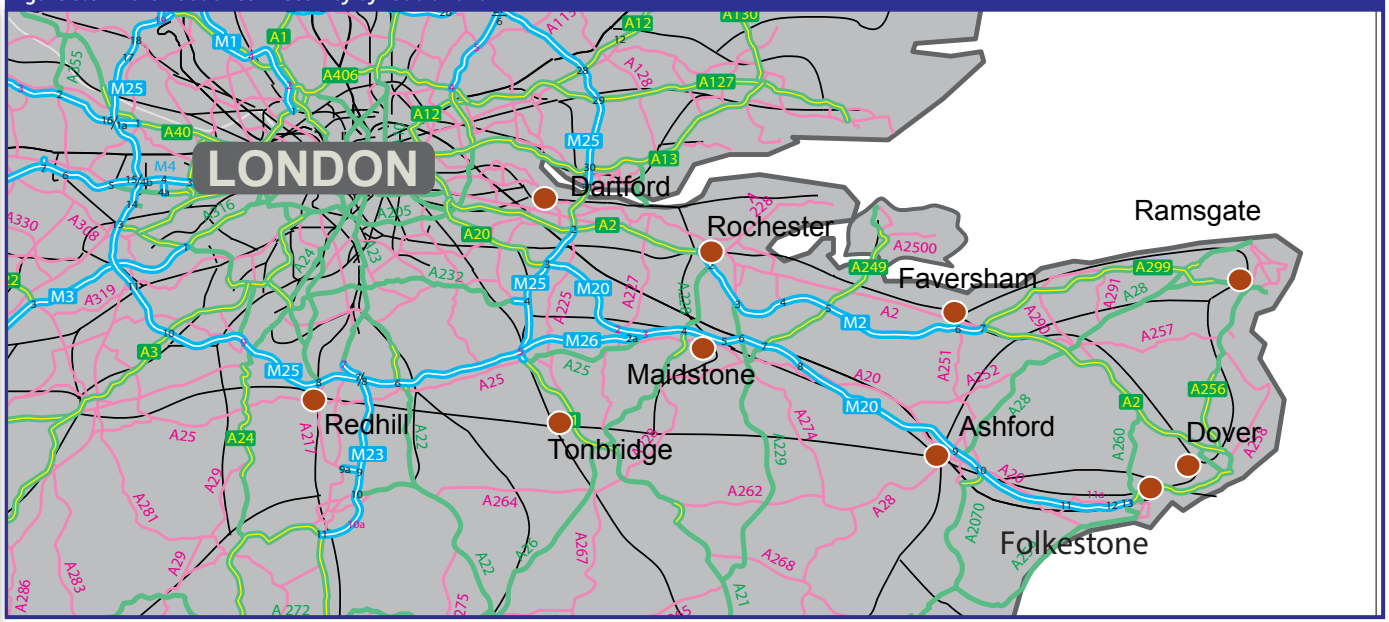


Figure 5.6 - North-South connectivity by road and rail



5.7 Other Conditional Outputs

5.7.1. Table 5.4 details the remaining five conditional outputs.

Table 5.4 - Other conditional outputs

Conditional Output Reference	Conditional Output
CO23	Provide connectivity to International Gateways including ports and airports – Airports
CO24	Provide connectivity to International Gateways including ports and airports – Dover Port
CO25	Provide connectivity to HS2
CO26	Provide connectivity to Crossrail
CO27	Provide connectivity to social infrastructure, for example: hospitals, educational establishments etc.

Airport connectivity (CO23)

5.7.2. Airport connectivity from the Kent Route is generally good. Gatwick Airport is located in West Sussex and is adjacent to Gatwick Airport station situated on the Brighton Main Line. The airport is well connected with direct services to London and the south coast. The December 2018 ThamesLink timetable provides an exceptional level of connectivity between Gatwick Airport and central London.

5.7.3. Passengers travelling from Kent (from Tonbridge) can connect to services calling at Gatwick Airport at Redhill. This service was extended to Gatwick Airport in the past, but it was discontinued owing to low usage levels. National Express operated a coach service from Ashford to Gatwick Airport, but this has also been withdrawn. Though the level of connectivity from Kent is lower than that from central London, the analysis undertaken as part of the Kent Area Route Study has concluded that there is no specific connectivity gap between Kent and Gatwick Airport. This remains, however, a direct service that consultees have highlighted in their response to the draft Route Study. If a bidder for the South Eastern franchise sees a case to run a service, they could propose it to DfT.

5.7.4. With the opening of Crossrail, there will be direct services to Heathrow Airport from Abbey Wood with onward connections to the Dartford area and interchange at Farringdon .

5.7.5. There is also a direct connection to Luton Airport Parkway via ThamesLink from stations on the Rainham via Greenwich corridor.

5.7.6. There are direct connections to London City Airport from Woolwich Arsenal via the Docklands Light Railway.

Dover Port (CO24)

5.7.7. Dover Priory station has regular services to London Victoria, London Charing Cross and London St Pancras International. The station is situated in close proximity to Dover Town Centre. Since publication of the Draft for Publication, we have become aware that the bus service between Dover Priory station and the Port has been withdrawn so there is no access to the Port by public transport, other than through coach services from London. Taxis are available from the station to the Port.

HS2 connectivity (CO25)

5.7.8. HS2 will provide a step change in railway capacity between London, the Midlands, North of England and Scotland. HS2 services will terminate at Euston station, and also stop at a new station at Old Oak Common in west London. Services from Kent operate to London St Pancras International via both Thameslink and HS1. It is expected that there will be improved pedestrian access between London St Pancras and London Euston stations, enabling convenient interchange between the two.

5.7.9. The HS2 station at Old Oak Common will also provide an interchange with Crossrail services that will be operating through to Abbey Wood. It is therefore considered that the conditional output has been met.

Crossrail/Elizabeth Line connectivity (CO26)

5.7.10. Connecting to Network Rail infrastructure at Abbey Wood, Crossrail will create many new journey opportunities from the north Kent area. It is expected that this will lead to contra-peak flows from stations on the Greenwich, Sidcup, Bexleyheath and North Kent Line. The demand analysis takes account of the expected number of people that will use the new Crossrail to access central London instead of existing services to London Bridge.

5.7.11. Passengers will also be able to connect into Crossrail services at Farringdon from ThamesLink services.

Improving capacity and connectivity for the leisure markets and social infrastructure (CO27)

5.7.12. The busiest times for travel to and from urban retail and tourism centres are often at weekends and during weekday evenings. This is in contrast to the typical weekday peak for commuting and business travel, when the highest levels of train service frequency and capacity are required.

5.7.13. Leisure demand is typically highest during the summer months, and declines in the winter. However, around the Christmas period, central London sees a sharp increase in passenger demand.

Dover Priory station frontage

This is due to an increase in retail activity in the build up to Christmas and various activities taking place in central London attracting additional passengers both on weekday evenings and at weekends.

5.7.14. The leisure market is important to the economy as well as to passengers; therefore the London and South East Market Study has identified a conditional output to provide opportunities to travel, sufficient capacity to avoid suppression of demand, and to reduce potential on-train crowding. This involves consideration of the potential trade-offs resulting from maintaining and renewing the railway in a different way (for example reducing the number of weekend blockades), including relevant safety considerations and an assessment of the affordability and value-for-money.

5.7.15. **Chapter 4** looked at the impact on capacity from the potential introduction of the London Resort Theme Park. If this goes ahead, a strategy will need to be developed on how to cater for the additional demand, in terms of both rolling stock and infrastructure (i.e. power supply and berthing sidings). This is because it is expected to require services from across Kent all year round and will see peak flows when the rest of the railway network is traditionally quieter, such as bank holidays and throughout August. These are times when maintenance is usually carried out to both the railway infrastructure and the trains themselves.

5.7.16. Improving accessibility to higher education establishments and social infrastructure such as health care and community facilities is important to the strategic goal of improving quality of life for communities and individuals.

5.7.17. Providing sufficient capacity and connectivity for this market is a choice for funders, train operating companies and franchise authorities. Conditional outputs to improve connectivity to many of these locations, either by enhanced service frequencies or journey time improvements, have been identified.

5.7.18. There are various higher education establishments across the Kent area, including Canterbury University, the University of Kent, which has facilities at Chatham and Tonbridge, Goldsmiths College in New Cross, the University of Greenwich and University of Brighton which has a campus at Hastings with students and staff travelling across the route to access these establishments.

5.7.19. **Table 5.5** shows the major hospitals in the Kent Route Study area.

5.7.20. The service pattern in the Route Study Area is generally regular enough to provide good access to social infrastructure and the work has not identified any additional gaps.

5.7.21. Kings College NHS Trust has undertaken a survey of staff, patients and visitors to understand how they access the hospital. Public transport and the rail service to Denmark Hill is significant as the site is less accessible by car than others within the Trust. There are choices for funders that would benefit Denmark Hill summarised in **Chapter 6.**

Table 5.5 - Major hospitals in the Kent Route Study area

Hospital name	Town	Closest station(s)
Darent Valley	Dartford	Dartford/Ebbsfleet International
Great Ormond Street	London	Farringdon/St Pancras International
Guy's	London	London Bridge
Kent & Canterbury	Canterbury	Canterbury East/Canterbury West
King's College	London	Denmark Hill
Maidstone	Maidstone	Barming
Maudsley Hospital	London	Denmark Hill
Medway Maritime	Gillingham	Gillingham
Princess Royal University	Farnborough Common	Orpington
Queen Elizabeth	London	Woolwich Arsenal/Eltham
Queen Elizabeth The Queen Mother	Margate	Margate
St Bartholomew's	London	City Thameslink/Farringdon
St Pancras Hospital	London	St Pancras International
St Thomas'	London	Waterloo East
Tunbridge Wells	Tunbridge Wells	Tunbridge Wells
University College Hospital	London	St Pancras International
University Hospital Lewisham	London	Ladywell
William Harvey	Ashford	Ashford International

6 Strategy and choices for funders

This chapter sets out:

- The strategy for the South East Route: Kent Area
- Choices for funders
  - To meet forecast demand to 2024
  - To improve connectivity across Kent
  - To meet longer-term demand conditional outputs

Ramsgate station frontage

6.1 Prioritisation

6.1.1. Choices for funders have been prioritised based on a number of criteria that have been agreed across Route Studies. There are:

- Accommodating passenger and freight demand to 2024
- Taking advantage of any potential synergies with planned renewals
- Aligning capacity works with major programmes
- Affordability
- Value-for-money.

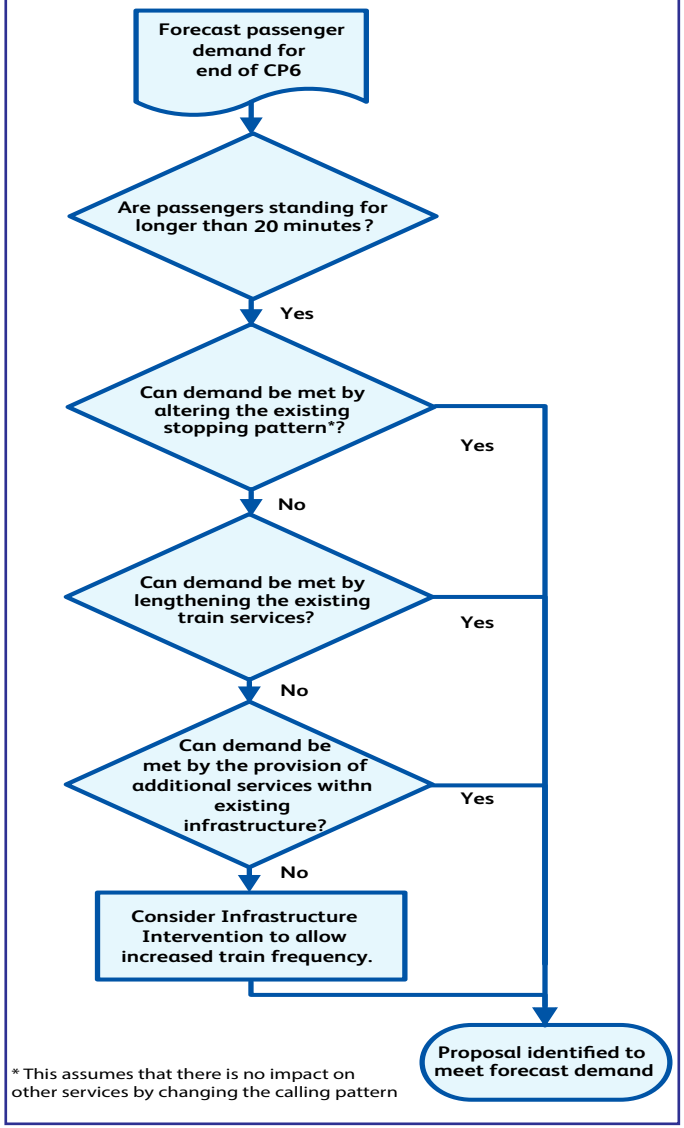
Figure 6.1 is an example flowchart showing the process for meeting passenger demand.

6.1.2. The strategy for the Kent area comprises two main policy areas; accommodating future demand into London and improving connectivity between key population centres in Kent. The demand is broken down by service corridor looking at requirements for 2024 and up to 2044. The strategic narrative for each is set out, followed by a series of choices for funders. There are a number of proposals being developed by Route Study partners, such as Transport for London (TfL), and these are also described to give as full a picture as possible of options for the Kent network.

6.2 Electrification

6.2.1. The Route Study area is largely electrified. The only passenger line that is not electrified is the Marshlink and options for this are included in the strategy. There is a long term aspiration to convert the 750 Volt DC third rail system to 25 kV OLE, but this has not been analysed further as it is outside the scope of the Route Study.

Figure 6.1 - Example prioritisation flowchart to meet passenger demand



6.3 Digital Railway

6.3.1. The strategy incorporates the Digital Railway Programme, which is developing a deployment approach to accelerate the roll-out of the next generation of signalling, command and control systems across the UK rail network.

6.3.2. At its core is the phased national delivery of the European Train Control System (ETCS) and the removal of lineside signalling, which brings together the other systems and required changes in the wider business to deliver the key benefits. The configuration states include Traffic Management and Connected Driver Advisory Systems to deliver improved operational decision-making and disruption management, operational costs/energy savings and performance benefits.

6.3.3. The Thameslink Programme introduces Traffic Management onto the routes in Kent that were controlled by London Bridge Area Signalling Centre when control is transferred to Three Bridges Rail Operating Centre (TBROC). This will provide a 20 minute decision horizon for trains entering the London Bridge area allowing regulating decisions to be made in good time improving performance and information to passengers.

6.3.4. The ITT for the next South Eastern franchise includes a requirement for bidders to introduce a Traffic Management system on the remaining routes in Kent (see Figure 3.10 in Chapter 3).

6.3.5. Ashford IECC is due to be renewed in CP6 and a decision will need to be taken as to whether control stays there or is integrated with TBROC or Gillingham.

6.3.6. In addition, the Thameslink Programme is introducing Automatic Train Operation (ATO) in the core area between London Bridge and St Pancras, where although a driver is present in the cab, the signalling system controls the acceleration and braking of the train.

6.3.7. Beyond the incremental changes to the railway, highlighted within this chapter, there is the opportunity to investigate more of the benefits of ETCS for example improving headways and reducing junction margins.

6.3.8. However, the fundamental constraints of terminal capacity and junctions will still need to be mitigated.

6.4 Kent Strategy

6.4.1. The rail industry working group has developed a strategy that meets the conditional outputs to 2024, which will be outlined in this chapter.

6.4.2. Beyond this period, the passenger demand up to 2044 is expected to continue to grow and there will be a requirement to address a number of capacity constraints. These have been examined at a conceptual level and will be outlined, but further development will be required through CP6. The railway network into London from Kent does not have the capability to operate additional services due to major issues such as the terminal capacity at Charing Cross and Cannon Street stations, the number of flat junctions on the approaches to London and the mix of fast and stopping services on two-track railways. Once the opportunities to lengthen existing services have been exhausted, there are no obvious or clear infrastructure solutions to meet the capacity conditional outputs.

A GB Railfreight train passes through Denmark Hill

6.5 London Bridge Metro (CO1)

6.5.1. The London Bridge Metro area covers the services that operate from London Charing Cross and London Cannon Street, through London Bridge via the three Dartford lines and to Hayes, Sevenoaks (via the Main Lines) and the Bromley North branch. The services are operated by 4-car Class 465 and 2-car Class 466 units, which can be coupled together to form 6-, 8-, 10- or 12-car services, or by 5-car Class 376 units, which can be coupled together to form 10-car services. The units do not have an operational 'selective door opening' facility, which means they cannot call at stations with platforms too short for the trains. It should be noted that the strategy is based on the Baseline as set out in **Chapter 3, Figure 3.7**

A strategy for 2024

6.5.2. The proposed strategy for 2024 to meet the peak capacity gap is to lengthen services that are not currently 12-cars long to that maximum length (excluding the Bromley North branch). The option to operate more services was considered by the Industry Working Group, but not supported as train paths could not be identified to operate the services robustly into the London Termini.

6.5.3. Although some services operate in 12-car formation at the moment, the Technical Working Group has identified some infrastructure upgrades that would be required to enable more services to operate at this length reliably. These are described later in this chapter.

6.5.4. It should be noted that the figures for additional vehicles are based on the high peak hour. The actual vehicle requirements for the franchise are expected to be higher in order to meet demand in the shoulder peaks. It also does not take into account rolling stock deployment.

6.5.5. As highlighted in **Chapter 4**, the Bexleyheath line would need four additional vehicles to meet the projected demand in 2024. This could be met from extending two trains that are currently planned to be 10-cars long to 12-cars. The appraisal results are shown in the **Technical Appendix**, it has a Benefit Cost Ratio (BCR) of 1.3-1.7.

You said...

[Southeastern is] supportive of the interventions at the Erith Loop and Up Crayford Loop Line.

Figure 6.2 - London Bridge Metro area with choices for funders

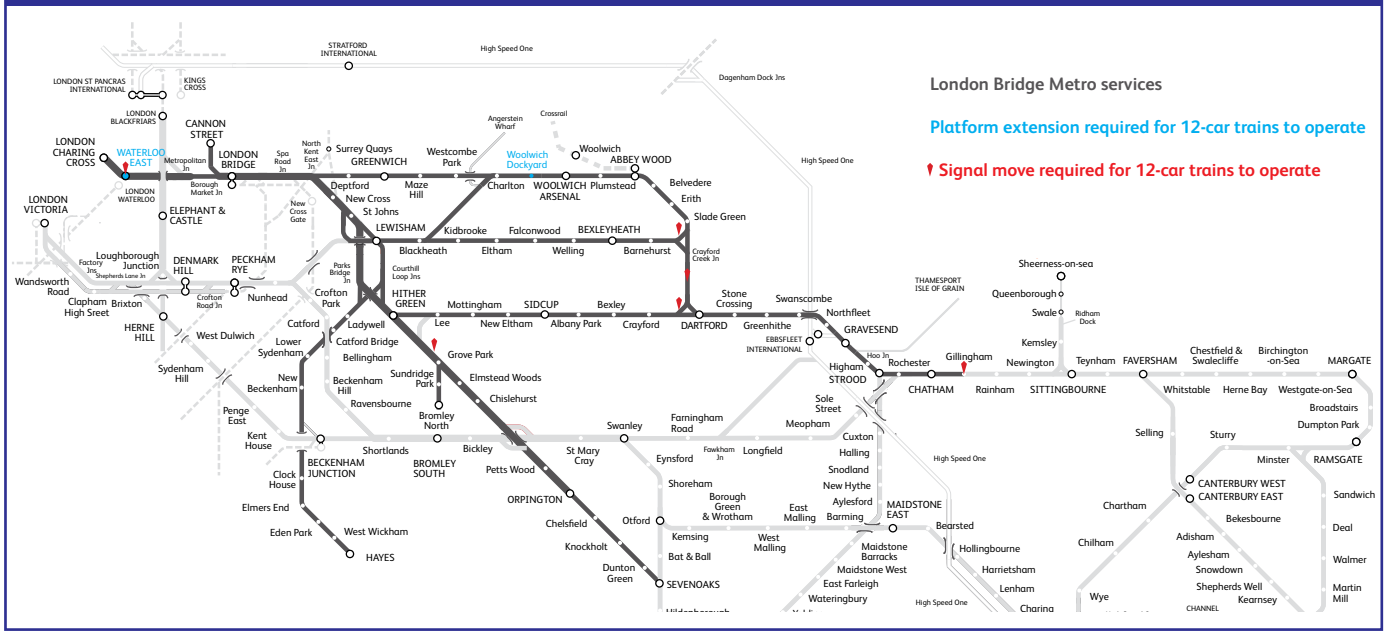


Table 6.1 - London Bridge Metro area platform lengthening

Summary of Intervention	Platform extensions and lineside infrastructure equipment enhancements to provide 12-car capability at: • Woolwich Dockyard (platform extensions from 10- to 12-car) • Erith and Crayford Loops and North Kent Line (signalling and track circuit alterations) • Waterloo East (signal move and platform extension in Platform B) • Gillingham and Grove Park (signalling alterations) • Slade Green Depot (12-car capability)
Output Assessment	• Provide platform lengths and operational equipment which could support train lengthening to 12-car on this service route (based on existing rolling stock) • Allow 12-car operation of Networker (Class 465) rolling stock on these routes • Increased capacity to enable forecast growth in passenger train numbers to be accommodated.
Indicative cost	£200-500M (total)
Prioritisation Assessment	Should be considered for delivery by 2024 to meet forecast demand
Benefit Cost Ratio (BCR)	0.9-1.4

You said...

'London TravelWatch supports the proposals for Metro area platform lengthening to support providing extra capacity into London Bridge. We would also support the reconfiguration or replacement of rolling stock to give more circulation space within the trains and to make them easier to get on or off.'

'Agree with option to extend all LB Metro to 12-car operation wherever this is practicable. This would deliver additional capacity to Dartford, Gravesend and Sevenoaks.' - Kent County Council

'We support this because of the clear need for additional capacity on the North Kent lines from London, to Lewisham, Greenwich, Dartford, Gravesend and beyond. This is of relevance to visitors and staff arriving at or departing from the London Resort, and using either Northfleet or Swanscombe station. While we expect that most visitors will arrive on HS1 services, the classic line service will be of particular importance to staff travelling to and from work at the resort.' - London Resort Holdings

6.5.6. The Sidcup line is forecast to need 12 additional vehicles, equivalent to lengthening six trains from 10-car length to 12-car. The third North Kent line, which is via Abbey Wood, is not forecast to need any additional vehicles as a result of the additional capacity provided by the introduction of Crossrail services. However, one of the major infrastructure interventions identified is the extension of the platforms at Woolwich Dockyard station to accommodate 12-car trains, which is on this route (although different rolling stock could resolve this issue and those at Charing Cross). The requirement for this is as a result of the circular nature of the operation whereby services departing from London Bridge via one route loop around and return via another. To enable these services to operate robustly, other infrastructure interventions are required on the link lines that connect the routes to ensure 12-car trains can stand without impeding other services. This generally involves moving the signals. All the service groups operate through Waterloo East, where the need to extend Platform B (Up Slow) has been identified. The appraisal results are shown in the **Technical Appendix**, it has a BCR of 1.5-2.0.

6.5.7. The services from Sevenoaks/Orpington are projected to require 14 additional vehicles. The direct infrastructure identified is the repositioning of Driver Only Operation (DOO) monitors and movement of a signal at Grove Park where the required signal gantry has already been provided. The appraisal results are shown in the **Technical Appendix**, it has a BCR of 1.5-2.0.

6.5.8. The lengthening of services from Hayes is expected to require six additional vehicles, but this will not drive any infrastructure interventions. The appraisal results are shown in the **Technical Appendix**, it has a BCR of 1.7-2.3.

6.5.9. The Bromley North branch operates between its terminus and Grove Park, where it connects with main line services. A three trains per hour shuttle service operates, utilising a single 2-car Class 466 unit. Passengers interchange at Grove Park for services into London and towards Orpington. The branch line services do not operate beyond Grove Park as it would mean a short train taking a valuable path on the main line. On this route, the running of an additional service to provide four trains per hour is preferred by stakeholders. An additional unit would be required due to the train running time and also the time required for driver to change ends. The appraisal results are shown in the **Technical Appendix**, it has a BCR of 0.4-0.6.

6.5.10. Southeastern has identified an alternative strategy for delivering four trains an hour through the provision of two drivers, one at each end of the train. This reduces the turnaround time at both ends.

6.5.11. Value-for-money cases have been assessed for train lengthening on each route and an additional one incorporating all of the London Metro extensions (excluding Bromley North) to recognise the fact that these services are interlinked and have shared infrastructure.

6.5.12. Stabling costs have been excluded from the business case in line with other Route Studies.

WHAT IS... ON-TRAIN CAPACITY?

On-train capacity is a measure of both seating provision and standing room based on Department for Transport metrics, which allows standing for up to 20 minutes.

The internal layout of the carriages varies depending on type and use of the vehicles. The pictures show various types of seating configuration.

London Overground

Class 378 metro-style side-on seating with lots of standing space

Elizabeth Line

Class 345 metro-style side-on seating with lots of standing space

Southeastern Metro

Class 465 3+2-style high density seating, provides seats over standing space

ThamesLink

Class 700/1 2+2-style low density seating, provides more standing space

Southeastern Main Line

Class 375 2+2-style low density seating, provides seats over standing space

Southeastern High Speed

Class 395 2+2 seating with larger seats, wheelchair bays and tip-up seats

6.6 Victoria Metro (CO2)

6.6.1. The Victoria Metro area covers the local services that operate to Orpington via the Herne Hill and Catford Loop routes. There are also services to Dartford via Lewisham and Bexleyheath. The services are operated by 4-car Class 465 and 2-car Class 466 units, which can be coupled together to form 6- or 8-car services. The Orpington services serve Brixton station, where there is interchange with the Victoria Line. Trains are limited to 8-car length due to platform length restrictions at stations, including London Victoria.

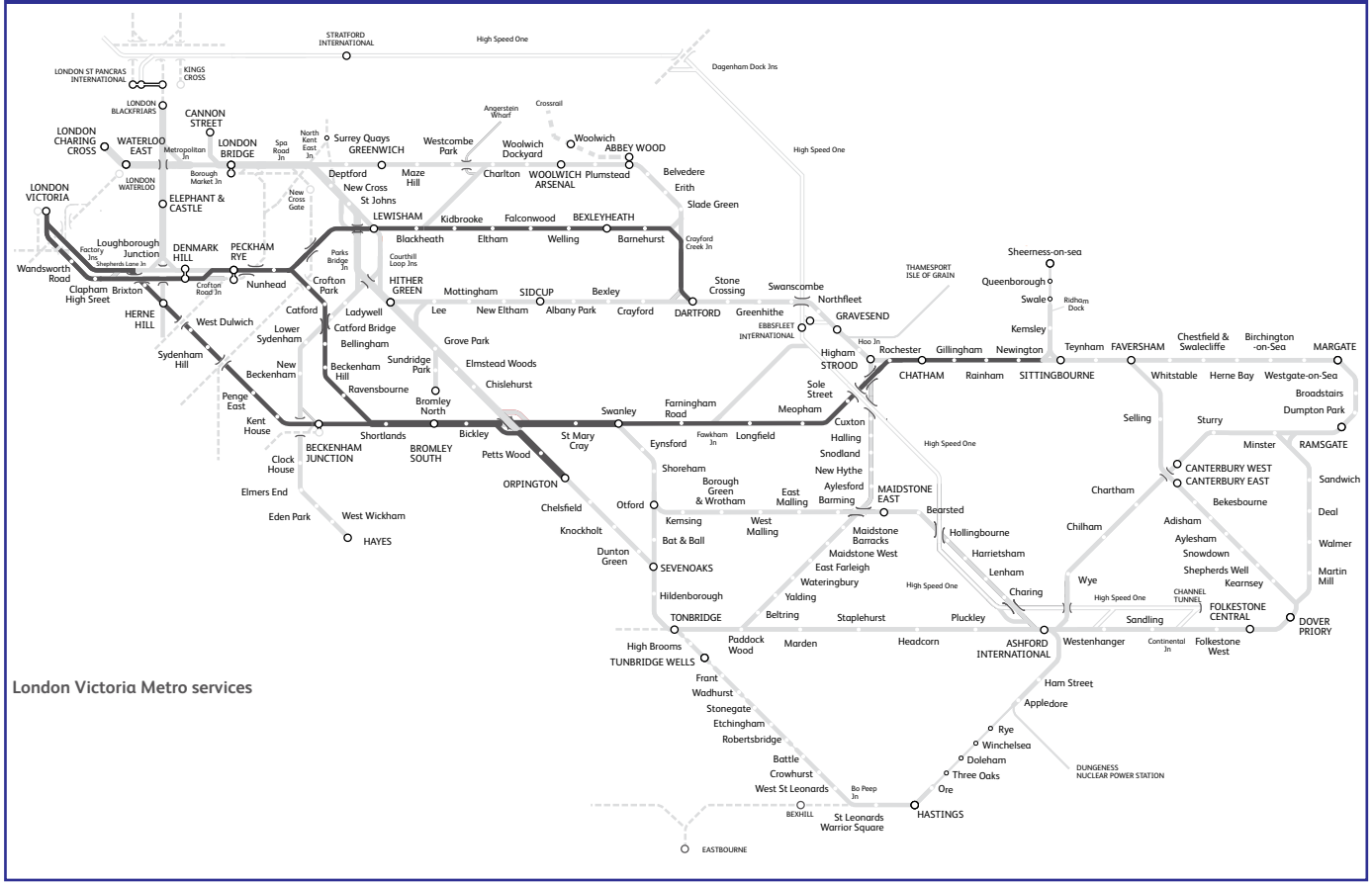
A strategy to 2024

6.6.2. An option to meet the 2024 expected demand is to extend some services to 8-car length. The Victoria services on the Catford Loop do not require any additional vehicles (this route is also shared with trains to Blackfriars). The services via Lewisham are forecast to need two additional vehicles and the services via Herne Hill, four additional vehicles. There are no direct infrastructure requirements required to deliver this as all platforms can accommodate up to 8-car trains.

6.6.3. However, it has been noted through analysis undertaken, the most popular services on the route are already at the maximum 8-car length, and therefore extending other services may not effectively deal with the crowding issue. An alternative option could see the services that are already 8-car length operated with high capacity rolling stock, such as those operating on ThamesLink services.

6.6.4. Value for money cases have been made for train lengthening on these routes and are shown in the **Technical Appendix**. The business case for lengthening via Herne Hill has a BCR of 0.4-0.6 and via Lewisham has a BCR of 0.3-0.5.

Figure 6.3 -Victoria Metro area



6.7 High Speed Domestic Services (CO3)

6.7.1. Domestic services on High Speed 1 operate from Dover/ Folkestone, Ramsgate/Canterbury West and Faversham to St Pancras International. Services commenced in 2009 and growth has been strong since then, providing fast journey opportunities from places such as Ashford International. Services are operated by 6-car Class 395 units that can couple together to form 12-car trains. The units are bespoke, needing to operate on 750V DC rail routes, 25kV AC High Speed 1, and different signalling systems.

A strategy to 2024

6.7.2. Network Rail has reviewed the growth rates since the services were introduced in 2009 with High Speed 1 Ltd and Southeastern. It is difficult to draw conclusions about a long term trend using a relative short series of data. However, the factors driving the high growth, i.e. higher than usual migration due to quick journeys to London are likely to continue for the next few years, so a higher growth rate to 2023/24 has been agreed. Beyond this period, growth is expected to return to normal levels, although this will be reviewed in future updates to the Market Studies.

6.7.3. The higher projected growth forecasts means that just lengthening of existing services to 12-cars will not meet the capacity gap. There are expected to be 24 additional vehicles required from Ashford, an increase of 80 per cent, six additional vehicles required via Faversham and six vehicles via Maidstone West.

6.7.4. The Faversham services can be lengthened to 12-cars without infrastructure being required, but a value for money case is expected to be low. The Maidstone West services call at Snodland before terminating at Maidstone and neither station can accommodate 12-car trains. It is proposed that there is selective door operation at Snodland. At Maidstone West, options have been developed to extend a platform to 12-cars (although power supplies would need to be checked). The appraisal results are shown in the **Technical Appendix**, it has a Benefit Cost Ratio (BCR) of 0.3-0.4.

Figure 6.4 -High Speed services area with choices for funders

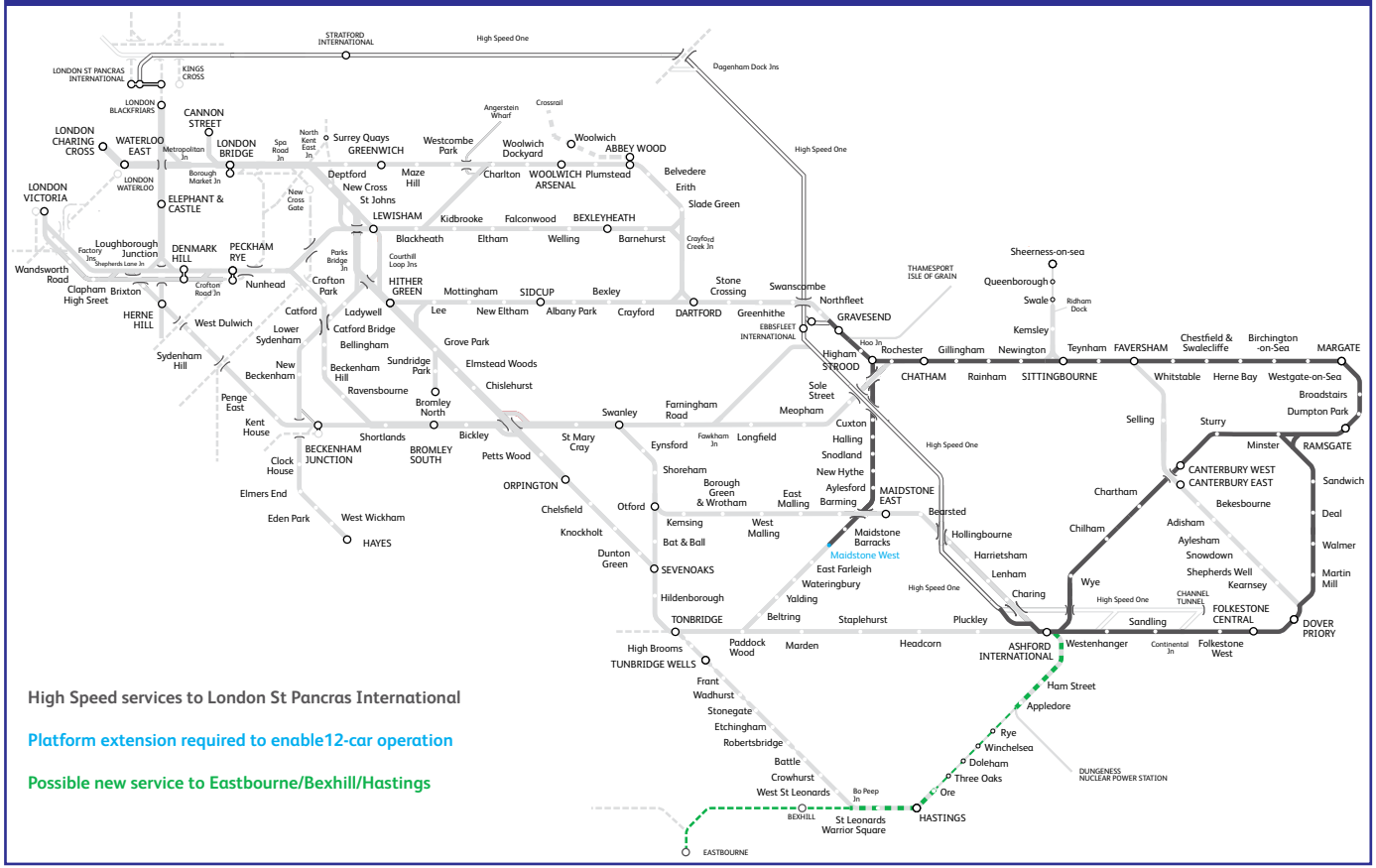


Table 6.2 - High Speed to Maidstone West train lengthening

Summary of Intervention	Platform extension to provide 12-car capability at Maidstone West station
Output Assessment	Provide platform lengths which would support train lengthening (6 additional vehicles) Allow 12-car operation of Class 395 rolling stock currently limited to 6-car on this route Increased capacity to enable forecast growth in passenger numbers to be accommodated
Indicative cost	£15-35m
Prioritisation Assessment	Should be considered for delivery by 2024 to meet forecast demand
Benefit Cost Ratio (BCR)	0.21-0.43

6.7.5. To meet the vehicle gap from Ashford International, as well as lengthening services, an additional service will be required. The appraisal results are shown in the **Technical Appendix**, it has a financially positive BCR. It should be noted that the timetable modelling has shown that this is only possible if minor retiming of Eurostar services is feasible.

6.7.6. For safety reasons, there is a restriction when running 12-car Class 395 units between Dover Priory and Folkestone through the Shakespeare Tunnels. As the units do not have a corridor end connection, it is current practice to lock the rear set out of use between these stations, which adds operational complexity. A strategy for new rolling stock could include rolling stock with the provision to move between units, such as fixed formation 12-car units.

6.7.7. Due to power supply restrictions, there are limitations to the power usage between Faversham and Ramsgate and Ashford International and Ramsgate via Canterbury West or Dover Priory which impacts on the potential journey time.

Class 375 and 395 units meet at Dover Priory

6.8 Blackfriars services (CO4)

6.8.1. The services from Blackfriars are predominantly ones that come through the Thameslink Core and operate via the Catford Loop to Orpington and Sevenoaks. There were also services that operated in the peak hours only via Herne Hill and Kent House but these were transferred to Southeastern in the May 2018 timetable. Blackfriars station was re-built with 12-car length platforms as part of the Thameslink Programme. However, all other stations on the route are 8-cars in length. Herne Hill is a critical junction, where the services to/from Blackfriars and Victoria cross.

A strategy to 2024

6.8.2. The strategy to 2024 assumes that high capacity Class 700 units are introduced onto these routes. These units in 8-car formation will meet the expected capacity requirement up to this date. However, as previously noted, the services will also operate on ThamesLink routes north of London, where there may be a requirement for 12-car trains to serve stations such as Brent Cross. The route study has identified options for 12-car platform extensions on these routes to meet this connectivity requirement.

*The above stations can be selected individually to provide platform extensions at critical stations only. Those not extended would require rolling stock with SDO capability.

Figure 6.5 -Blackfriars services with choices for funders

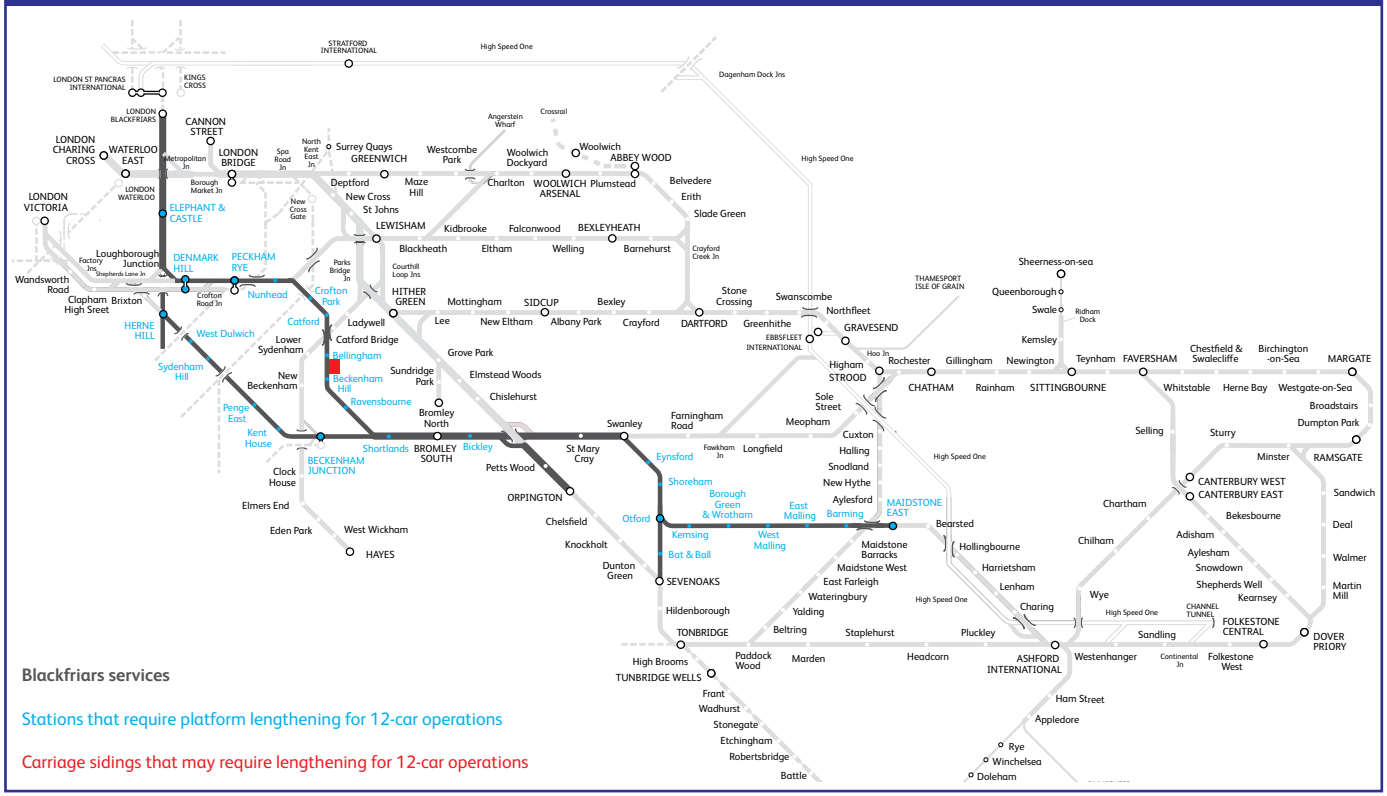


Table 6.3 - Blackfriars train lengthening

Summary of Intervention	• Platform extensions and lineside equipment enhancements to provide 12-car capability at the stations shown in Figure 5.4* • This scope also includes lengthening of Bellingham Carriage Sidings to accommodate stabling of 12-car formations
Output Assessment	Provide platform lengths which would support train lengthening to 12-car on this line of route, allow 12-car trains to serve Brent Cross and help mitigate the current capacity issues north of the River Thames
Indicative cost	£500-1,250m
Prioritisation Assessment	Should be considered for delivery by 2024 to meet forecast demand
Benefit Cost Ratio (BCR)	Depends on new demand from developments, such as at Brent Cross

6.9 London Bridge & Victoria Main Line (CO5)

6.9.1. The London Bridge and Victoria Main Line routes cover longer distance services from the Chatham and Swanley area, from the Maidstone East line and also the Tonbridge line. The Tonbridge route includes services from Ashford and Hastings (via Tunbridge Wells). Services generally operate in the peak using Class 375 rolling stock in 8- or 12-car formation. Some services, on the Maidstone East and Hastings lines, utilise Class 465/466 rolling stock although most of these have been cascaded to the Metro area due to Class 377/5 units being cascaded from Govia Thameslink Railway.

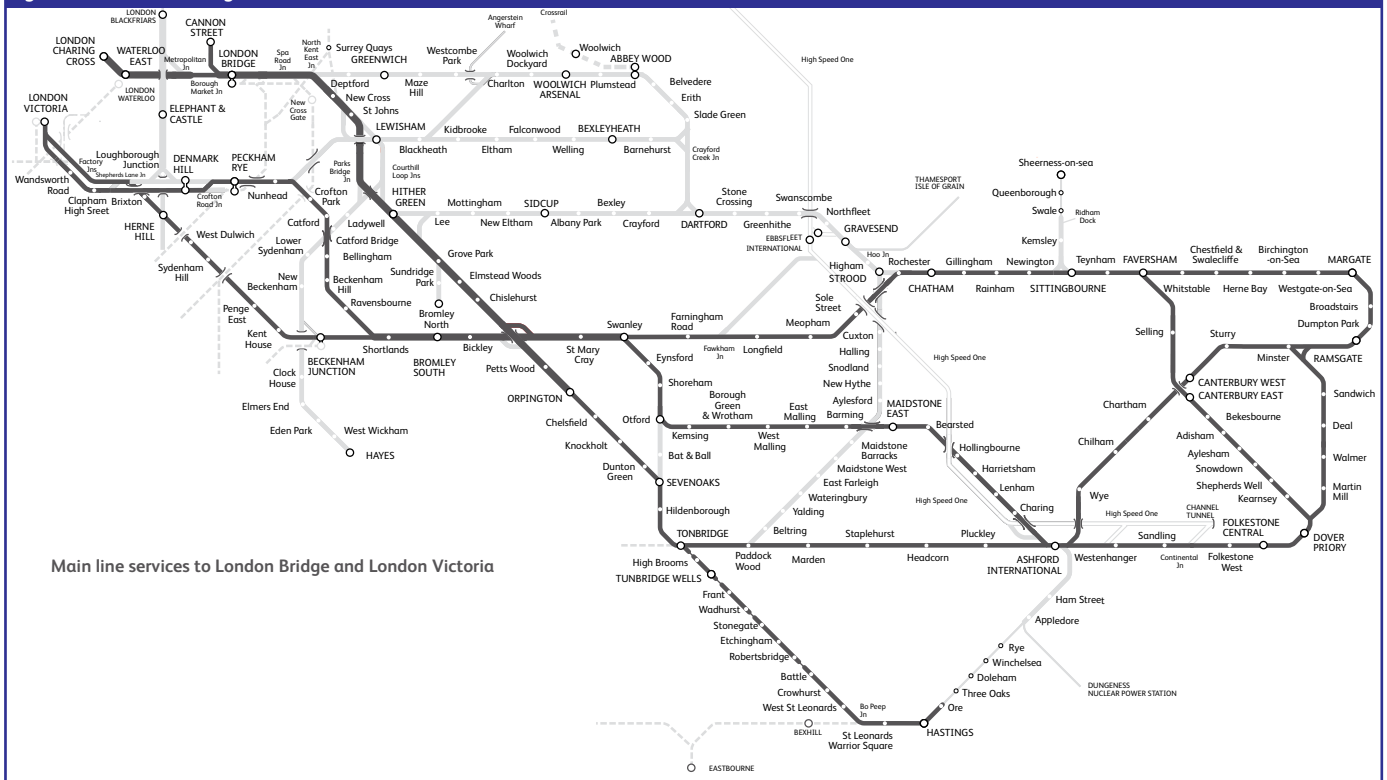
A strategy to 2024

6.9.2. As with other routes, the strategy for 2024 involves lengthening trains where possible to 8- or 12-car formation. However, on the Tonbridge route, an additional 20 vehicles are projected to be required, which cannot be accommodated through lengthening alone. High density rolling stock would not present a solution as it would increase the number of passengers standing for greater than 20 minutes. As noted previously, the routes into the central London terminals are extremely constrained, however a strategy has been developed that should enable an additional path to operate into Cannon Street.

6.9.3. The predominant issue with operating additional services to Cannon Street is that due to the platform layout at London Bridge, trains can get into the terminus but there is no path to get the train out again. In the past, this was managed through running trains from Cannon Street to Blackfriars by the alternative Metropolitan Reversible Line. Following the increase of ThamesLink services, this will not be feasible. A scheme has been identified that would convert the Metropolitan Reversible line into a 12-car siding, thus releasing the potential for an additional 12-car service to operate into Cannon Street. The engineering assessment has looked at the feasibility of retaining a through route, and all options will be developed further, including considering future maintenance.

6.9.4. As the first route on the network that requires an additional service to meet projected capacity, the strategy is that this should be a service from the Tonbridge area. A timetable rewrite in the Tonbridge area, including the two-track sections between Tonbridge and Orpington would be required to provide a robust path into Cannon Street. The appraisal results for all three routes on the London Bridge and London Victoria Main Line corridor are shown in the **Technical Appendix**. The BCR of lengthening via Chatham is 0.7-1.1, via Maidstone East is 0.6-0.8 and via Tonbridge is 3.0-4.4 (lengthening for nine vehicles).

Figure 6.6 -London Bridge and Victoria Fast Line services area



6.10 A strategy to 2044 - Capacity

6.10.1. Beyond 2024, a strategy for providing additional capacity for Kent services is far more challenging. Without the opportunity to lengthen trains, further additional paths will be required to allow the predicted additional passengers to travel into London. The capacity work undertaken for the Route Study has shown that in many areas, there is capacity available on individual sections of route. However, connecting these together to form robust paths has not been possible. The pedestrian flows will also be challenging at a number of stations if additional services or units with higher passenger capacity were able to run.

6.10.2. A number of steps need to be undertaken over the next funding period to determine the appropriate strategy for Kent including identifying where additional terminal capacity can be provided and where the identified bottlenecks can be relieved. The benefits of Traffic Management on the Kent Routes will need to be examined further and where digital solutions provide a cost-effective alternative.

6.11 Longer Term Options

London Cannon Street

6.11.1. The terminal capacity at Cannon Street is constrained by the track layout in the area and the only way to increase the capacity would be through additional stabling or platforms in the station area. A scheme has been developed to convert the Metropolitan Reversible Line into a single 12-car siding, which will support one additional train in both the morning and evening peak. Although the viaduct that carries the Metropolitan Reversible previously had two tracks, it is on a severe curve and the creation of two 12-car sidings would require a major rebuild of the viaduct or the remodelling of Cannon Street throat to provide the required length. These options should be investigated further.

A view of the Metropolitan Reversible line from the window of a passing train. Although it appears as though there is room for a second track, to the left, the severe curvature and track layout at the Cannon Street-end prevents a second line within the existing footprint. An adjacent development prevents further widening.

London Charing Cross

6.11.2. Charing Cross has just six 12-car platforms and Platforms 4, 5 and 6 are very narrow, leading to operational restrictions. Class 465 units cannot operate as 12-cars into these platforms and selective door operation is used on Class 375 units. A major rebuild of the station could allow it to be extended south over the river, like Blackfriars, providing compliant platforms and greater passenger circulation. At concept level, a new link to Waterloo from a southern entrance to Charing Cross may supersede Waterloo East allowing the station area to be used for additional track capacity, but there are likely to be many issues with a project on this scale.

6.11.3. The relieving of terminal capacity constraints at Cannon Street and Charing Cross will then move the bottleneck to other locations on the route, including North Kent East Junction, Lewisham, Parks Bridge Junction and the two track section between Orpington and Sevenoaks.

You said...

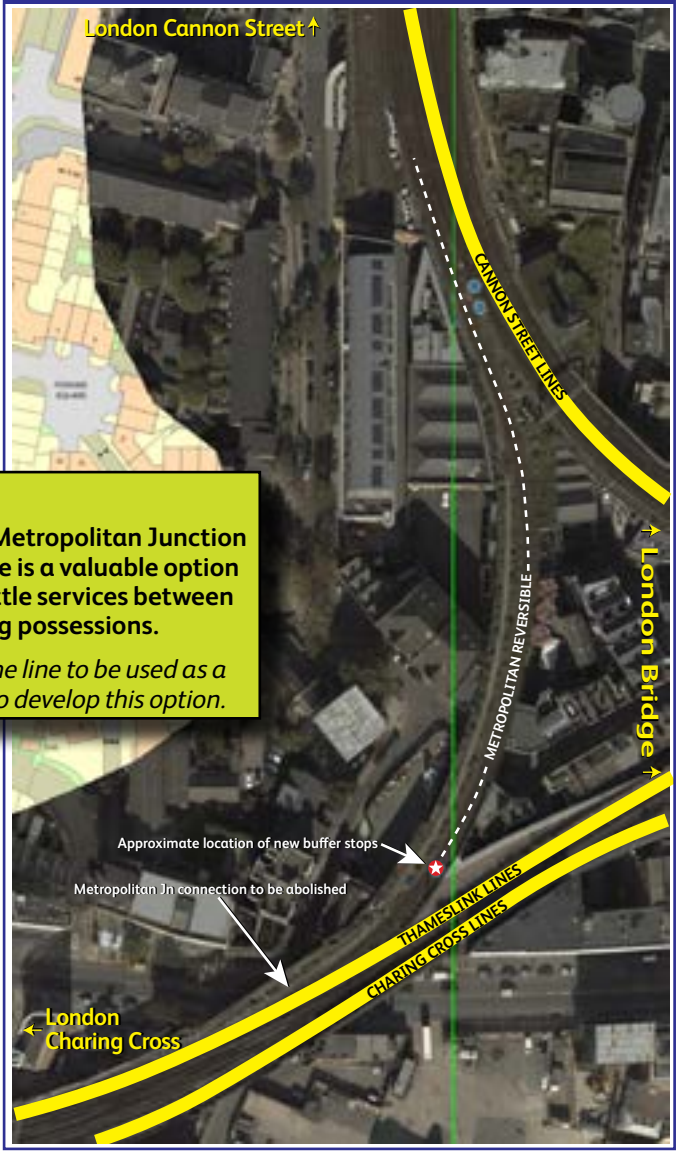
Southeastern does not support the scheme to develop the Metropolitan Junction Reversible Line into a single 12 car siding. The section of line is a valuable option enabling empty coaching stock movements as well as shuttle services between Charing Cross and Cannon Street during engineering possessions.

It should be possible to provide a derailing device, enabling the line to be used as a through line and a siding but further work would be needed to develop this option.

Table 6.4 - Metropolitan Reversible berthing siding

Summary of Intervention	Replace the Metropolitan Reversible line with a single 12-car siding to serve London Cannon Street
Output Assessment	• 12-car siding to support AM and PM Peak service provision in and out of London Cannon Street • Increased capacity to enable forecast growth in passenger numbers to be accommodated
Indicative cost	£0-10M
Prioritisation Assessment	Should be considered for delivery by 2024 to meet forecast demand
Benefit Cost Ratio (BCR)	1.2

Figure 6.7 - Metropolitan Reversible proposed berthing siding



London Victoria

6.11.4. The Eastern side of Victoria station has fewer services in the peak than Cannon Street or Charing Cross. There is potential to increase the station capacity, however there are number of constraints that would need to be overcome. The station has not been upgraded for many years and suffers from passenger flow issues. The CP5 congestion relief scheme has been deferred to CP6 as part of the review of Network Rail's enhancement portfolio.

6.11.5. The additional capacity could come from remodelling of the platforms, which are of differing lengths (five 12-car and three 8-car), reducing flexibility. There is a vacant track bed on Grosvenor Bridge, which could be reinstated to provide a 4-track approach. Better use could also be made of the Stewarts Lane lines on the approach to the station.

6.11.6. There are also bottlenecks further out from the station. There are two routes into Victoria Eastern, via Herne Hill and the Catford Loop. Both are only two tracks with a mix of fast and stopping services and have flat junctions.

6.11.7. The flat junction at Herne Hill is where services from Blackfriars to the Wimbledon loop and Victoria towards Kent House cross over each other. In addition to the platform extension scheme at Herne Hill station, a flyover scheme has been looked at, which would unblock this bottleneck. Towards Kent House, the option for some four tracking has been examined.

6.11.8. These schemes together potentially show a way of getting more capacity into London from Kent after 2024 and further development is recommended.

Other Capacity requirements

6.11.9. The capacity analysis work highlighted that the terminating platforms at Hayes station could not accommodate additional services predicted to be required in 2044 and infrastructure modifications would be required. This would form part of a wider upgrade strategy, although it is noted that the Bakerloo Line extension could take over the Hayes line from Lewisham.

East – West flows through South London

6.11.10. The aspiration to increase passenger services on the South London Line is challenging to accommodate with the number of assumed freight paths. As a result of passenger services operating on a recurring 30 minute pattern, trade-offs would have to be made to allow freight paths to run within the regular pattern.

6.11.11 There is the potential to provide a passing loop at Nunhead (see later in this chapter).

Resignalling

6.11.12. **Figure 2.8** showed the number of signal boxes and signalling centres in the Kent Route Study area. The majority of the area is signalled using colour light signalling controlled by track circuit block (a signalling system using a train detection system that enables the signaller to see which section of track a train is occupying) and there are still some signal boxes using the absolute block system (the traditional signalling system involving bells and block instruments although not necessarily mechanical, semaphore signals). In the Canterbury West area, the length of the signalling sections restricts the timetable to four trains an hour.

6.11.13. Ideally one would resignal these areas first but the condition of the more modern equipment usually drives the renewals as modern signalling has to be renewed every 30 years or so. When this happens, there is the opportunity, subject to funding, to provide an enhancement to the network, which could address a capacity constraint.

6.11.14. The current plan for signalling renewals sees the 'modern' signalling areas being recontrolled or resignalled to Three Bridges Railway Operations Centre with the traditional signalling following later so they could potentially last until the late-2020s.

6.11.15. However, there are some key routes that would benefit from being resignalled earlier if funding permits:

- **Ashford International to Ramsgate*** – to enable 6tph on this route
- **Bo-peep Jn to Ashford International** – to enable the traffic management system to operate trains over the single line sections effectively
- **Tonbridge to Bo-peep Jn*** – to enable the traffic management system to operate trains over the single line sections effectively.

6.11.16. Network Rail has an aspiration to close as many level crossings as possible and is working with local authorities, Local Enterprise Partnerships and stakeholders to identify which can be closed or upgraded to improve safety.

*a power supply upgrade will also be required

Semaphore signals outside Hastings Signal Box

6.12 Third Party Proposals

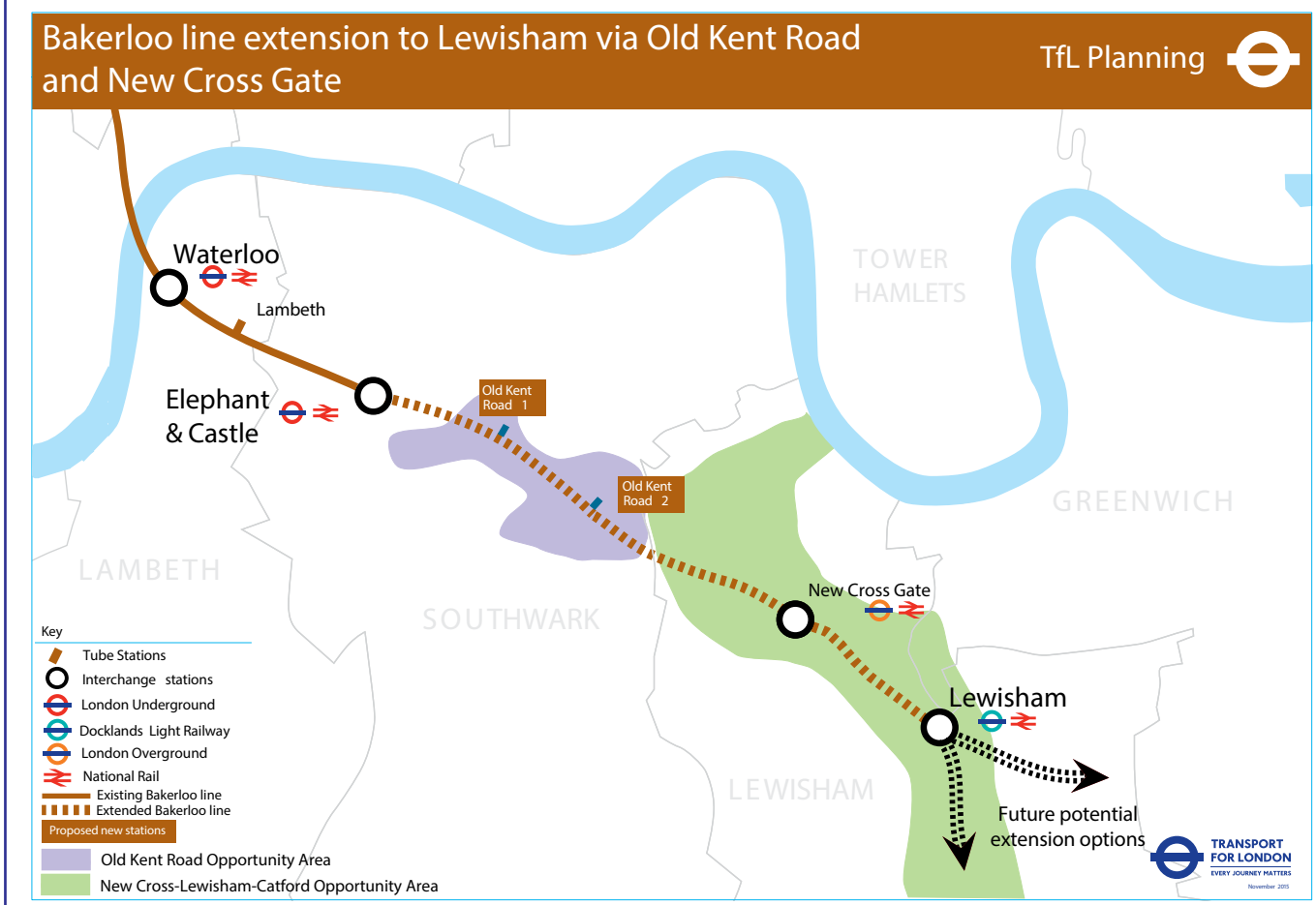
Bakerloo Line Extension

6.12.1. Transport for London (TfL) has consulted on a proposal to extend the London Underground Bakerloo Line from the current terminus at Elephant & Castle to Lewisham, with a potential further extension onto the Hayes branch. Since the consultation, TfL has undertaken and published the outcome of an assessment of the route options, indicating that a route to Lewisham via the Old Kent Road is currently the preferred route for an initial extension and that a potential extension beyond Lewisham has not been ruled out.

6.12.2. Network Rail supports the principle of the extension and does not object to the concept of converting the Hayes line to an alternative mode. However, further work is required to understand the impact on the wider transport network of this option including the impact at Lewisham station.

6.12.3. If the Hayes branch is removed from the National Rail network, there is the potential to reallocate the paths into Charing Cross and Cannon Street to services from other routes in Kent. This could contribute to meeting the capacity projected to be required to 2044, noting that constraints on other parts of the network may need to be resolved to release the capacity,

Figure 6.8 - TfL's proposed Bakerloo Line extension



Transport for London's South East London Metroisation Concept

6.12.4. Metroisation is a Transport for London (TfL) concept which facilitates significant improvements to train length, frequency and customer experience on London's suburban rail network. North London has a dense network of London Underground routes in addition to suburban rail services, whereas few Underground lines reach into the Kent Route Study area, resulting in a greater dependency on rail services.

6.12.5. Despite this dependency, there is evidence to suggest that the Underground network in south and south east London experience higher use than would otherwise be expected. The few Underground stations in south east London are substantially busier than equivalent suburban rail stations, with large volumes of bus demand between rail-served areas and Underground stations. These stations include Brixton, North Greenwich, Canada Water and Elephant & Castle.

6.12.6. TfL believes that by bringing the simplicity and dependability of the Underground to the suburban rail network, capacity could be increased, helping to accommodate the expected growth in passenger demand. To do this, the TfL Metroisation concept addresses six key areas:

- Predictable services on identifiable 'lines' that operate all day, every day at frequent, regular intervals with consistent stopping patterns
- Better connections with 'turn up and go' frequencies meaning there is no need to plan ahead and upgraded interchanges to boost connectivity at key stations, such as Lewisham.
- More capacity, with metro style rolling stock on inner suburban services and infrastructure investment to relieve key bottlenecks.
- Shorter journey times with higher performance trains that accelerate and brake faster and staff actively managing station dwell times at key locations
- Reliability with simplification of service patterns to reduce conflicts at junctions.
- Better customer service through all day station staffing, improved information provision and more modern station facilities and stops.

6.12.7. The complexity of the Kent network mean that passengers from some suburban stations currently have services to multiple London terminals, albeit at lower frequencies to each. The trade-off to the benefits of metroisation is that some of these passengers could lose that ability and be forced to change trains to reach their destination. Metroisation does not require any changes to longer distance Kent services.

Class 376 and 465 units await their next working at the carriage sidings at Dartford

More information can be found in the Technical Appendix

Crossrail/Elizabeth Line extension towards Ebbsfleet

6.12.8. The corridor from Bexley Riverside to North Kent has been identified as an area to support growth and regeneration, providing up to 55,000 new homes and 50,000 new jobs. The Greater London Authority and local authorities believe that to help fully unlock this potential, improvements to the transport network are required with enhancements to rail services and infrastructure which are seen as key enablers.

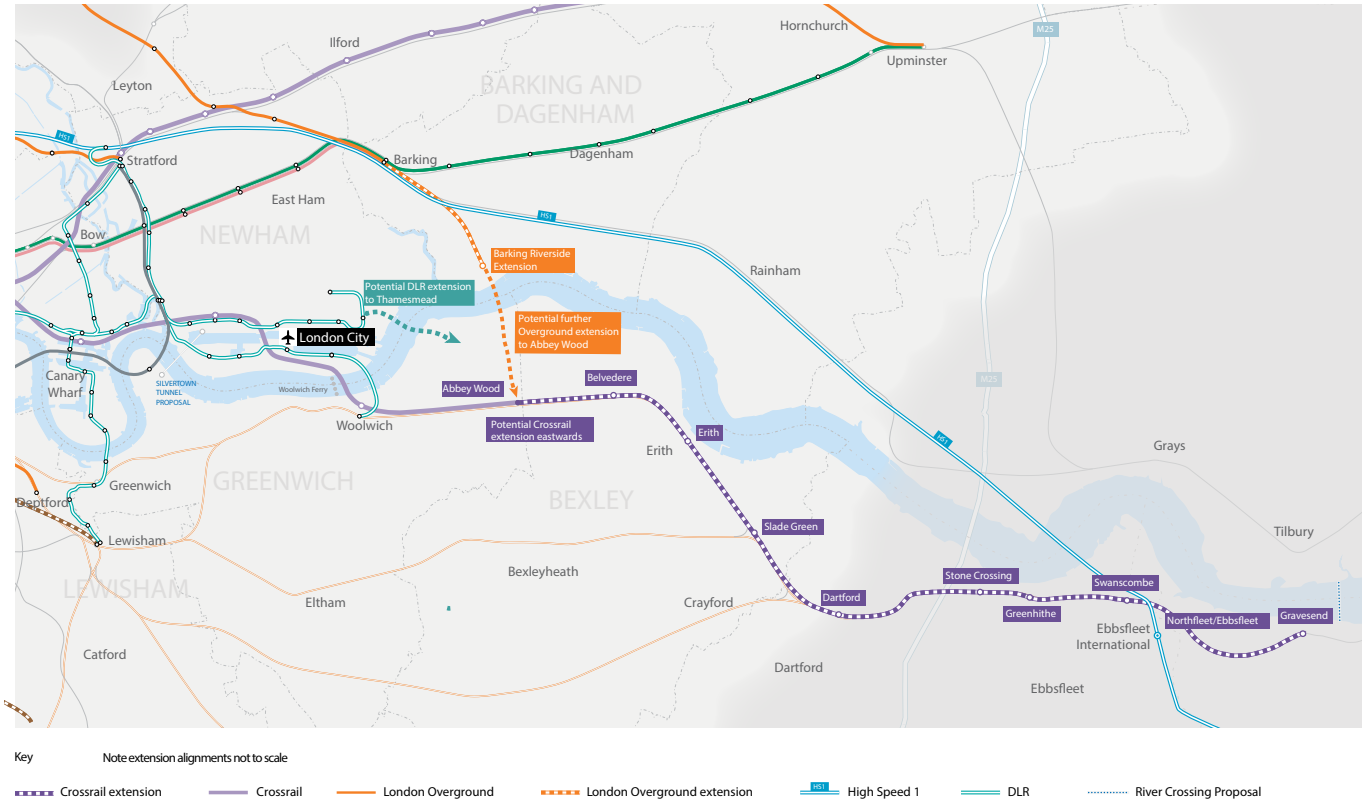
6.12.9. An extension of Crossrail/Elizabeth Line services from Abbey Wood towards Ebbsfleet has been identified as an option. Work to understand the technical viability, value-for-money and potential to support growth is currently underway. A Safeguarding Direction is already in place for an extension between Abbey Wood and Hoo Junction following the existing alignment of the North Kent Lines.

6.12.10. A solution for a segregated alignment has been identified which runs to the north of the existing North Kent lines. Four-tracking of the railway has been proposed in order to overcome identified technical and operational concerns with performance, capacity and integration between rolling stock and railway systems.

6.12.11. Along with new track and railway systems, new and replacement structures would also be required along the route. This is likely to involve extensive redesign of existing railway infrastructure around Slade Green depot, junctions near Crayford and Dartford station. There is also an opportunity to align the extension to facilitate a better interchange between mainline and high speed services at Ebbsfleet International. The extension is anticipated to take up to 10 years to design and build and is estimated to cost in the region of £1.5bn (excluding optimism bias and any land acquisition costs).

6.12.12. The proposal is being promoted by local and strategic authorities through which the extension would pass. A Strategic Outline Business Case is currently being developed and outputs will also be fed into the Thames Estuary 2050 Growth Commission which has been tasked with developing a delivery plan for North Kent, South Essex and East London up to 2050.

Figure 6.9 - Potential Crossrail Extension to Ebbsfleet



Source: Transport for London

6.12.13. The additional capacity provided in the North Kent area could potentially draw away demand from services into Charing Cross and Cannon Street, thus relieving the projected requirement for additional services and consequential expensive terminal capacity works required.

6.13 Connectivity

Marshlink

6.13.1. At the beginning of the Kent Route Study process, Network Rail was asked by the Department for Transport to examine options for the electrification of the Marshlink line between Ore and Ashford International.

6.13.2. The improvement of generalised journey times from London to the Hastings area forms a conditional output of the study and there will be choices for funders identified that would meet the output. Network Rail has been working with stakeholders on proposals that include:

- New connection at Ashford International that allows trains from HS1 to access the Marshlink line
- Electrification of the Marshlink line from Ashford to Ore
- Journey time improvements and/or redoubling of the route.

6.13.3. Since the publication of the Draft Route Study, it has been identified that Network Rail is planning to renew a crossover in the Ashford station area in CP6. It has been proposed that the connection from HS1 to Platform 2 at Ashford International is installed at this time, thus making best use of the line closure already required.

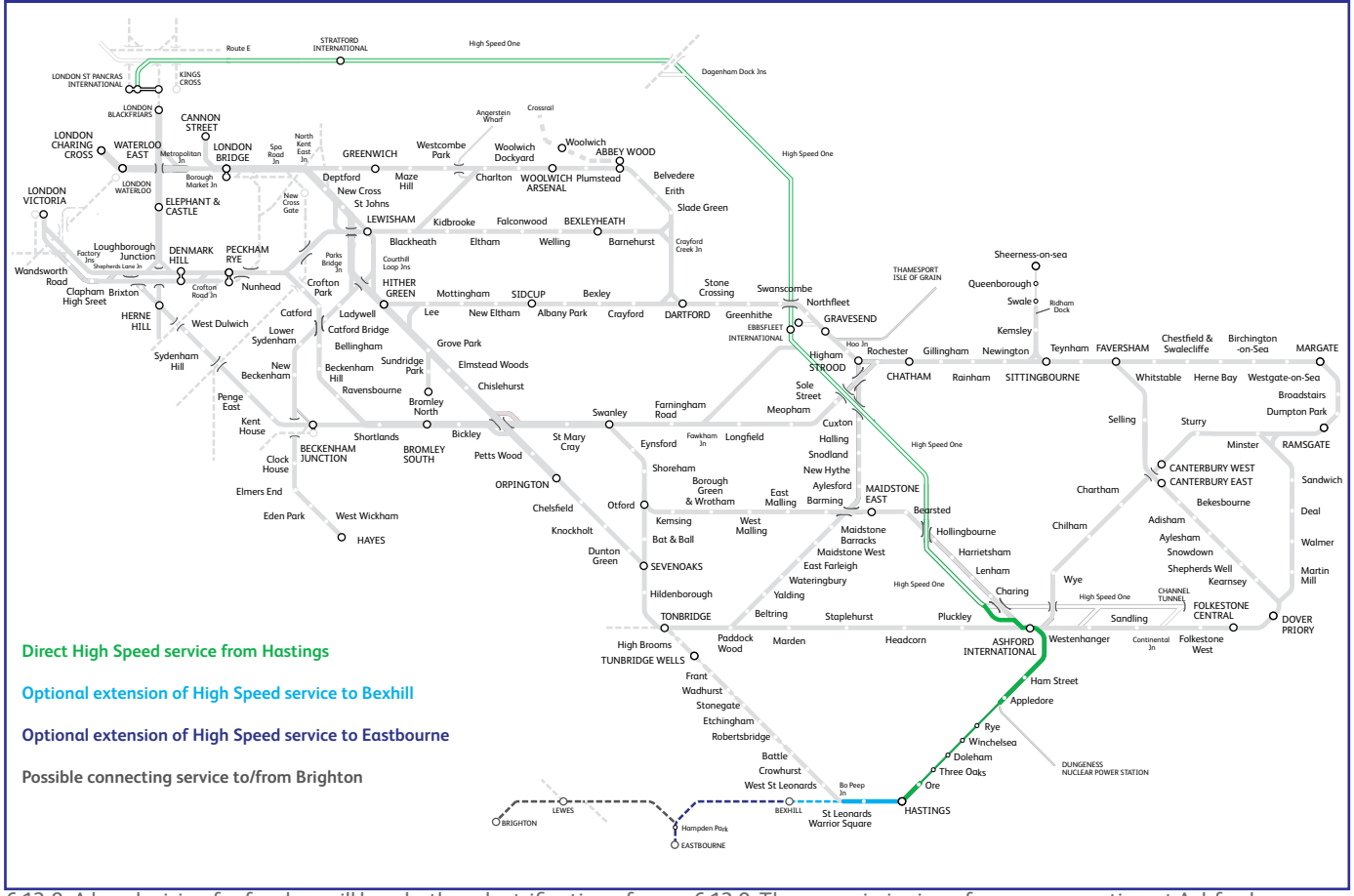
6.13.4. A funding package has been agreed for the incremental development costs to GRIP 3 development stage.

6.13.5. Funding would then be required for the implementation costs (estimated to be between £10m and £25m).

6.13.6. The new crossover would provide immediate benefits, allowing cross platform interchange between Marshlink and HS1 services and improved flexibility for the operation of Ashford International station.

6.13.7 Network Rail produced a feasibility report into the electrification and associated options for linespeed improvements. The cost of electrification is significant at £250m-£500m for 25kV AC overhead or £100m-£250m for 750V DC third rail.

Figure 6.10 - Marshlink High Speed



6.13.8. A key decision for funders will be whether electrification of the route is pursued at this stage or whether the DfT and franchise bidders opt for a self-powered (diesel or battery) train and an incremental programme of improvements, which is likely to be a more cost effective way forward. It would provide a versatile fleet that would be able to operate over routes where the power is isolated (either planned or unplanned).

6.13.9. The commissioning of a new connection at Ashford International would best be aligned with the delivery of new rolling stock. However, the line speed enhancements could be delivered in an incremental way providing early benefits to users of the route, rather than a 'big bang' scheme to upgrade the line.

6.13.10. The route has 45 level crossings over the 25 miles from Ashford to Ore. Network Rail is keen to continue to work with local stakeholders on the closure and diversion of footpaths and roads at level crossings, which will improve safety and reduce the cost of upgrading the route. The interaction so far on this has been positive.

6.13.11. Network Rail has undertaken a high-level timetable study to ensure a robust operational performance can be delivered that also meets the aspirations of local stakeholders. There will be choices on where the HS1 services would terminate and a decision on this will need to take into account business case as well as operational and service robustness considerations.

6.13.12. Modelling has shown that the incremental approach delivers journey time improvements to existing services as well as a new fast service. **Table 6.5** shows the estimated journey time improvement for a train calling at Eastbourne, Bexhill, St Leonards Warrior Square, Hastings, Rye and Ashford International, although other permutations have been modelled and can be found in the **Technical Appendix**. The headline figure is that the journey time to Ashford could be 5-9 minutes faster than today. If one factors in the interchange time (five minutes in the peak, 25 minutes in the off-peak) which would no longer be required, the journey time improvement is significant.

6.13.13. The High Speed service offers several advantages to East Sussex and South Kent by providing an additional service calling at key stations, a new link to London and reduced passenger crowding on the Hastings Line.

6.13.14. The destination of the services needs to be considered:

- **Hastings** – easy to achieve by using Platform 1
- **Bexhill** – infrastructure required for trains to turnback but results in the train sitting in the platform for about seven minutes
- **Eastbourne** – would require an additional unit.

6.13.15. The advantage of running to Eastbourne is to reduce the operational risk of turning back in Bexhill and create additional capacity between Eastbourne and Hastings.

6.13.16. There could be an opportunity to connect into Brighton services at Hampden Park, in the longer term, to provide a faster journey from Ashford International – this could be enhanced by reconstructing the station to provide a cross-platform interchange.

6.13.17. There is also the opportunity to investigate the use of battery technology by converting a 4-car Class 377 for use on the existing Brighton – Ashford International service. The acceleration may be constrained to that of a Class 171 diesel unit to reduce the drain on the batteries.

6.13.18. The **Technical Appendix** and **Table 6.5** shows the baseline and proposed incremental approach journey time profiles between Eastbourne and Ashford International. The modelled trains are:

- **Class 171 2-car** – this is the existing train operating on Marshlink
- **Class 377 4-car** – a third rail powered train (possibly a battery-electric train is retrofitted, although acceleration may be constrained in battery mode)
- **Class 395 6-car** – High Speed unit running on overhead power
- **Class 802 5-car (diesel mode)** – this is a new-build train currently being built for Great Western and is designed for running beyond the wires into Devon and Cornwall, in electric mode it will have the same top speed as a Class 395 (140 mph).
- Note that the linespeed reduces to 55 mph over Winchelsea level crossing (currently 25 mph) but it is hoped to get this up to full 90 mph as part of this option.

6.13.19. **Table 6.6** details the combined cost of the scheme based on infrastructure improvements such as third rail electrification and line speed improvements.

6.13.20. **Table 6.7** details the connection from Platform 2 at Ashford International to HS1.

Table 6.5 - Journey time improvements

Route section	Potential journey time improvement*
East Coastway	0.35-1.37 minutes
Ore - Doleham	1.48-2.11 minutes
Doleham - Rye	1.42-2.34 minutes
Rye - Appledore	0.59-5.02 minutes
Appledore - Ashford International	0.57-2.28 minutes
Total	**6.01-13.52 minutes**

*based on the RouteRunner model

Table 6.6 - Option table: High Speed services to Hastings and beyond

Summary of Intervention	Ashford International Platform 2 to connect high speed services to the Marshlink Line, third rail electrification, level crossing modifications and closures, Appledore junction improvements
Output Assessment	• Provide additional crossovers at Ashford International which would support provision of high speed services from Hastings, via Marshlink Line, to St. Pancras. • Provide a journey time improvement for services travelling from Hastings into London. • Allow 6-car operation of Class 395 rolling stock between Hastings and Ashford International (if electrification of this route is also implemented).
Indicative cost	£210-270m
Prioritisation Assessment	Should be considered for delivery by 2024 to meet forecast demand
Benefit Cost Ratio (BCR)	Poor under central case; Low under higher growth scenario and Wider Economic Impacts

6.13.21. The Technical Appendix includes a breakdown of the projection of future demand for these services. It has been calculated that passenger demand will rise as follows:

- Hastings: 25 per cent
- Bexhill: 54 per cent
- Eastbourne: 6 per cent.

6.13.22. The wider economic benefits as calculated by Mott MacDonald and updated assuming a 69 minute journey time to Hastings totals £123.7m over 60 years.

6.13.23. It should be noted that rolling stock costs remain the responsibility of the Department for Transport and the successful bidder of the South Eastern Franchise.

Table 6.7 - Option table: Ashford International connection from Platform 2 to HS1

Summary of Intervention	Additional crossovers to connect London St. Pancras International High Speed services to Hastings via Marshlink
Output Assessment	• Provide additional crossovers at Ashford International which would support provision of High Speed services from Hastings via Ashford to HS1 • Provide a journey time improvement for services travelling from Hastings into London • All 6-car operation of Class 395 rolling stock between Hastings and Ashford International (if electrification of this route is also implemented)
Indicative cost	£15-35M
Prioritisation Assessment	Should be considered for delivery by 2024 to meet forecast demand
Benefit Cost Ratio (BCR)	Not assessed separately

INNOVATION CHALLENGE

Network Rail met with the Office for Rail and Road to discuss the extension of the third rail power supply to currently non-electrified routes.

Due to the 1989 Electrical Safety at Work Act, the third rail power supply cannot be used at new sites as it is an exposed power source that can be easily accessed leading to injury or death. The ORR subsumed Her Majesty's Railway Inspectorate and is now enforcing this Act for new schemes, as existing electrification has 'grandfather rights'.

The alternatives are overhead electrification, which still has an electrocution risk, arguably worse than third rail or train-borne power such as diesel, battery or hydrogen.

The challenge is to develop an electrification solution that would be acceptable to the ORR. Given the large number of trains powered by third rail and to reduce the cost of electrification by not overhead electrifying the line, solutions need to be found to prevent staff, passengers and trespassers from coming into contact with the third rail.

This could be, but is not limited to:

- A new style third rail that is mostly insulated apart from a contact strip on the top, possibly colour changing or illuminated when the power is on
- A power distribution network that energises the third rail when a train needs it and is off at all other times
- Additional physical level crossing protection, possibly additional barriers, to stop trespassers straying on to the line
- Affordable physical barriers, similar to above, but for foot crossings and occupational level crossings
- Improved intruder detection
- Between track fencing to reduce the desire to cross tracks in stations.

Resolving these issues could see the third rail network safely extended and some components could be rolled out across other parts of the network to ensure compliance with the Act.

Trains too, could be purchased that include a battery or capacitor power capture unit so that all trains running on the third rail network could accelerate at maximum amperage as the stored power makes up for the shortfall from the third rail. This storage would be recharged when the train is stopped, coasting or braking.

This functionality would enable:

- Improve acceleration and point-to-point running times
- Trains to operate on non-electrified lines such as Marshlink or the Grain Branch
- Trains to operate despite being unable to pick up electricity due to ice on the conductor rail
- Trains to operate under special arrangements during an incident or engineering works where the isolation sections normally prevent trains from operating
- On board services such as lighting and heating to last for a longer period during times of disruption and power isolation.

Ebbsfleet Southern Link

6.13.24. As noted in **Chapter 4**, there are significant development proposals in the vicinity of Ebbsfleet International station which have the potential to attract a large number of people to the area for leisure and commercial purposes (approximately 24,000 staff and 60,000 visitors per day).

6.13.25. Ebbsfleet International station has a direct connection to central London and the South East via High Speed 1, but not from south London. With High Speed 1 services already experiencing high growth in the peak period, an alternative route to Ebbsfleet could encourage visitors to travel by rail rather than road.

6.13.26. A scheme has been developed that provides a connection to Ebbsfleet International from the route from Swanley via Fawkham Junction, which was used by Eurostar services when they served Waterloo. The options include:

- **Option 1:** New terminating platform adjacent to existing operational lines (car park location identified)
- **Option 2:** Provide a connection into the existing domestic platforms.

6.13.27. There is more detail on this proposal in the **Technical Appendix.**

Figure 6.11 - North-South connectivity

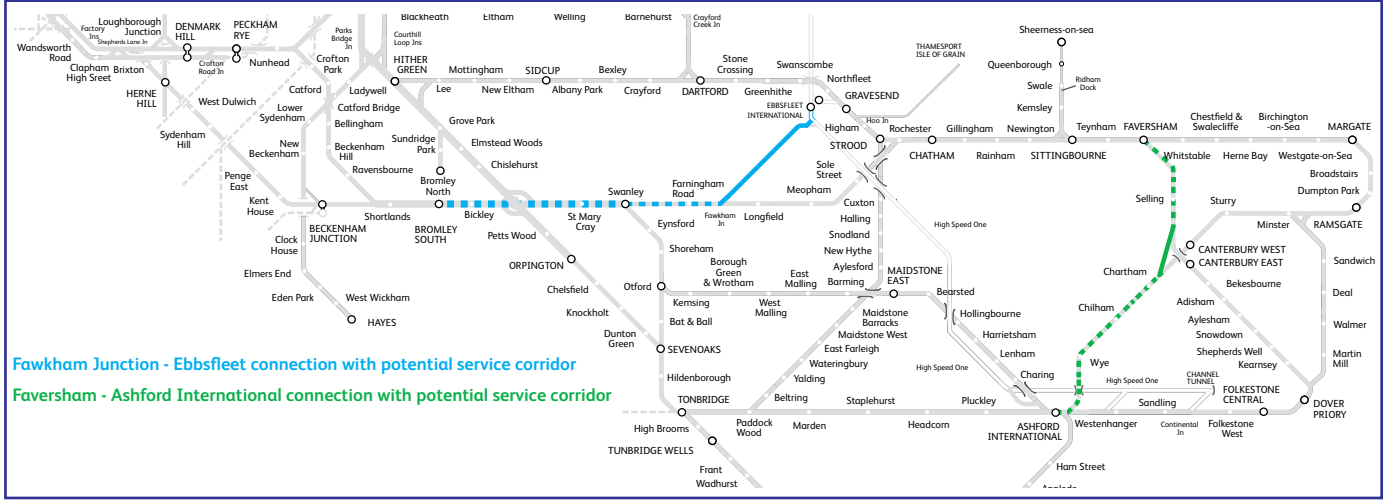


Table 6.7 - Option table: Swanley - Ebbsfleet International connection

Summary of Intervention	Provide a new connection between Swanley and Ebbsfleet International to support predicted passenger uplift demands due to the proposed Ebbsfleet Garden City and London Resort Theme Park developments
Output Assessment	New rail link and platforms at Ebbsfleet International station which would support 12-car services from South London to Ebbsfleet International Increased capacity to enable forecast growth in passenger numbers to be accommodated and support local developments in the immediate vicinity
Indicative Cost	Not assessed for this long term connectivity proposal
Prioritisation Assessment	Should be considered as a longer term aspiration linked to future housing growth and London Resort Theme Park
Value for Money Assessment	Not assessed for long term proposals

North Kent to South Kent (CO18)

6.13.28. A scheme has been identified that would greatly enhance the connectivity between north and south Kent to meet Conditional Output 18 in the long term. The journey from Ashford to Faversham is 14 miles by road via the single carriageway A251, which runs through small villages and is known for congestion. A good train service could provide competitive journey times, improving connectivity across the county. However, the high level commute demand analysis suggests that there is poor demand between the Faversham and Ashford areas currently so a rail link would be poorly patronised. **Figure 6.12** shows the employment areas; the greater the density the more employment.

6.13.29. A long term option could involve building a spur line between the Ashford to Canterbury West line and Faversham to Canterbury East line in the Chartham area. It is known that the gradients in the area would make this scheme challenging.

6.13.30. An alternative could be a new interchange station where the Canterbury East and West lines intersect. Being close to the A2 and current Park & Ride Car Park, it could be an opportunity to provide a multi-modal interchange and reduce the number of cars driving into central Canterbury to park.

Figure 6.12 - Distribution of jobs around North and South Kent; note the higher concentration of jobs in Canterbury (Source: 2011 Census)

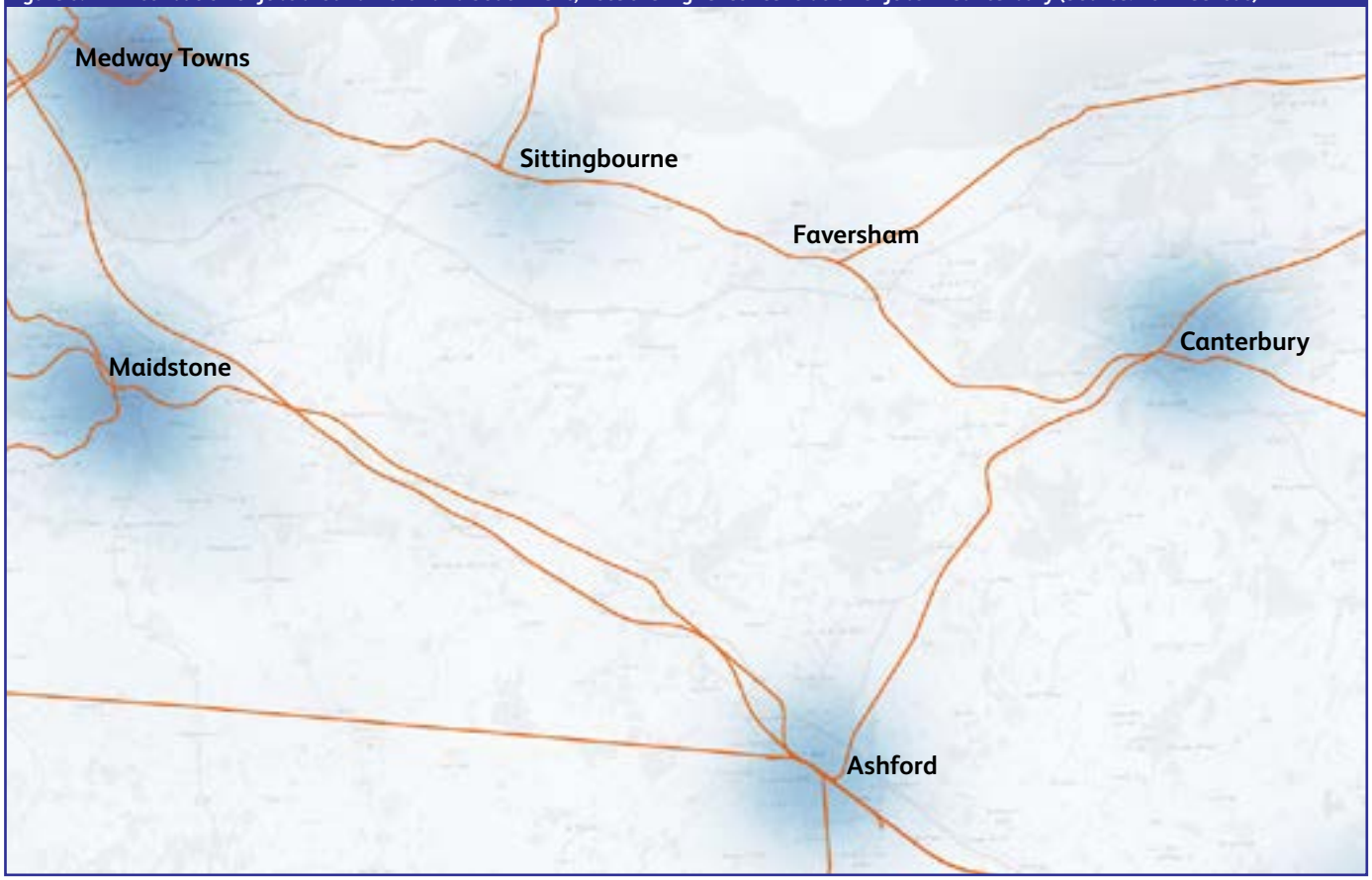


Table 6.8 - Option table: Faversham - Ashford International connection

Summary of Intervention	Provide a new connection chord between Faversham and Ashford to improve north south connectivity in Kent.
Output Assessment	Provide greater level of north to south connectivity in Kent and the South East.
	Provide a journey time improvement between Faversham and Ashford International.
Indicative Cost	Not assessed for this long term connectivity proposal.
Prioritisation Assessment	Connectivity improvement opportunity for delivery by 2044.
Benefit Cost Ratio	Not assessed for long term proposals.

Canterbury Chord – Resilience

6.13.31. The resilience of the Kent network has been brought into sharp focus in the past year following the collapse of the sea wall between Folkestone and Dover, severing the railway between the towns for nine months. This caused disruption for passengers and harmed the local economy. Around £40m has been invested in repairing the line, however, other parts of the route remain vulnerable to extreme weather in the future.

6.13.32. The technical working group proposed that the feasibility of a new chord between the Canterbury East and Canterbury West lines was reviewed. If implemented, this could allow trains to operate between Dover and Ashford even in the event of a catastrophic failure of the sea wall.

6.13.33. This is a complex scheme, similar to the Arundel Chord proposal that was examined in the Sussex Route Study. Arundel Chord was estimated to cost up to £75m.

6.13.34. This is a longer term proposal, which should be considered for development by funders.

Figure 6.13 - Canterbury Chord

Table 6.9 - Option table: Canterbury Chord

Summary of Intervention	Provide a new connection between the Canterbury East and Canterbury West Lines.
Output Assessment	Provide a new resilience connection from Dover to Ashford via Canterbury, in the event of the Dover to Folkestone line being blocked.
	Provide greater level of connectivity in Kent and the South East.
Indicative Cost	Not assessed for long term proposals.
Prioritisation Assessment	Connectivity improvement opportunity for delivery by 2044.
Benefit Cost Ratio	Not assessed for long term proposals.

6.14 Freight

Angerstein Wharf

6.14.1. Angerstein Wharf is a busy freight terminal with trains arriving and departing every day with construction and aggregates materials. The only access to the terminal is via a tightly curved connection on the Blackheath tunnel line, which freight trains approach from the Charlton direction. This requires the trains towards West London to be routed via Abbey Wood, Sidcup, Hither Green, Lewisham and then via the South London Line.

6.14.2. A connection into the terminal from the Lewisham direction would remove around 16 miles of running, reducing wear and tear to the network, fuel usage and benefiting the environment. It would also provide additional capacity gaps in the timetable.

6.14.3. In 2016/17 approximately 1,700 freight trains operated to and from the Wharf.

6.14.4. The construction of the new connection would require the purchase of third party land, but potentially land could also be released through the abandonment of the existing connection.

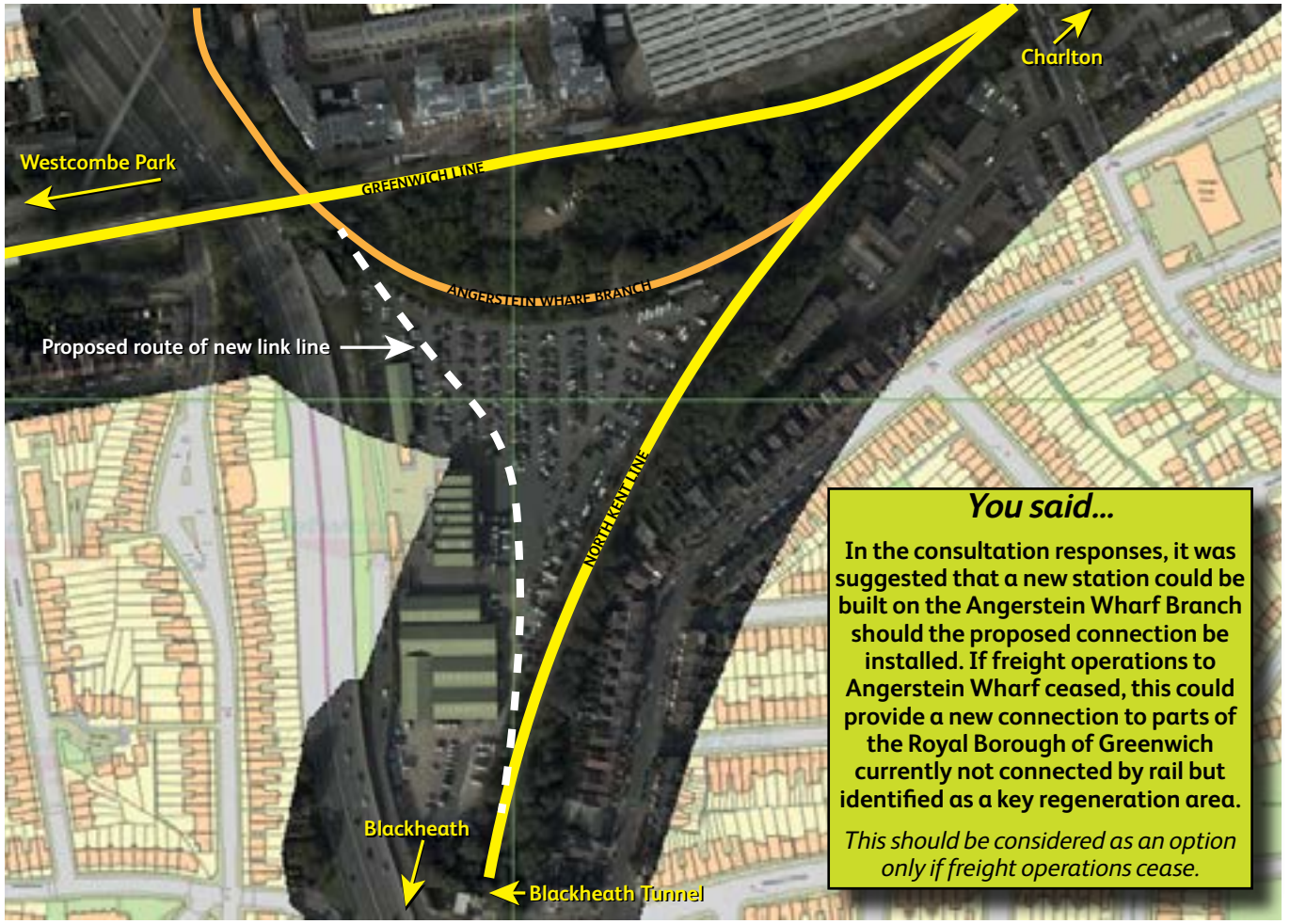
6.14.5. The connection could reduce the journey time by about an hour and save approximately 500 tonnes of carbon dioxide emissions per year just from the reduction in rail miles. There would also be significant savings through reduced HGV traffic on congested London streets.

6.14.6. The potential benefits have been calculated at £7.8m (£m PV, 2010 prices) from reduced running miles alone. The impact of reduced road use would further improve the business case.

Table 6.10 - Option table: Angerstein Wharf link

Summary of Intervention	Provide a new connection between Angerstein Wharf and North Kent Lines.
Output Assessment	Provide a new resilience connection between Angerstein Wharf and Blackheath to enable freight operations to travel towards central London while avoiding the current route via Abbey Wood and Sidcup to Lewisham and the West London Line.
	Reduce mileage and wear on infrastructure caused by heavy rail operations.
Indicative Cost	Not assessed for this long term proposal.
Prioritisation Assessment	Distance and journey time improvement opportunity for delivery by 2044.
Benefit Cost Ratio	Not assessed for long term proposals.

Figure 6.14 - Angerstein Wharf link



Nunhead Passing Loop

6.14.7. The Freight Network Study Draft for Consultation, which was published in September 2016 highlighted the opportunity for a new loop in the Nunhead area, which could allow for freight regulation. Further development has confirmed that a 775m loop, which is the future aspiration for freight traffic, could not be accommodated; however, most freight trains are not currently operating at this maximum length, see **Figure 6.15**.

6.14.8. A scheme is conceivable that rebuilds Nunhead station with two platforms on the outside of the running lines, with a third track through the middle of the alignment. This could be used to allow fast trains to overtake stopping trains or recess freight trains. However, the length (approximately 600m) would mean that only trains shorter than 775m would be able to be held in the loop. Similarly, passenger trains could be regulated here to reduce delay.

Figure 6.15 - Nunhead passing loop

Howbury Park Freight Terminal

6.14.9. Network Rail is working with a third party developer to develop a scheme for a connection to a 149 acre Strategic Rail Freight Interchange (SRFI) at Howbury Park. The proposed site is on third party land located adjacent to Slade Green depot and station. A connection to the network would be established to the south of the depot with access to the North Kent Line, see **Figure 6.16**.

6.14.10. This project is currently at an early stage of development, however Network Rail consider it to be a viable proposal and one that is compatible with other future aspirations including the extension of Crossrail/Elizabeth Line. Network Rail will continue to work with the developer to progress the scheme and have completed feasibility work as well as a study into available freight paths to and from Wembley Yard.

6.14.11. The project was refused planning permission by Dartford Borough Council, however, the developer is working to achieve this on appeal.

Figure 6.16 - Howbury Park Freight Terminal

Gauge Clearance

6.14.12. In order to make rail more attractive to the freight market, it is essential that the right container gets to the right destination, regardless of size and shape.

6.14.13. In recent years there has been a growth in 'high cube' container traffic but this causes issues across the Kent Route Study area as none of the routes, other than HS1, can cater for these 9ft 6in high boxes. These require specialist 'pocket' wagons that hold the containers between the bogies (wheels) of the wagon, cost more to hire and require logistical planning to ensure they are in the right place, at the right time.

6.14.14. Tunnels, bridges and other overline structures restrict the height of the trains that can pass under them and the shape of the sides of the structure can also result in gauge restrictions.

6.14.15. The preferred routes (see **Figure 6.17**) to undergo enhanced gauge works to enable container trains from the Channel Tunnel to run to the West London Line are:

- Channel Tunnel to Swanley via Maidstone East
- Fawkham Jn (near Farningham Road) to Swanley
- Swanley to West London Line via the Catford Loop and Atlantic Lines.

6.14.16. These would be the initial routes for clearance. The other routes (via Tonbridge and Redhill or Sevenoaks) would follow later.

6.14.17. A full tables of structures is available in the Technical Appendices but a summary is shown in **Table 6.11**.

6.14.18. Not all structures in the list will require further examination because they may be clear of all gauging restrictions owing to their height over the railway line.

6.14.19. The bridge over the River Medway at Maidstone East is included as its construction includes beams that cross the track and angled bracing adjacent to the track that may require gauge clearance assessment.

6.14.20. The Network Rail Strategic Freight Network team are identifying which of the 154 structures need a gauge clearance assessment.

Figure 6.17 - Freight gauge assessments

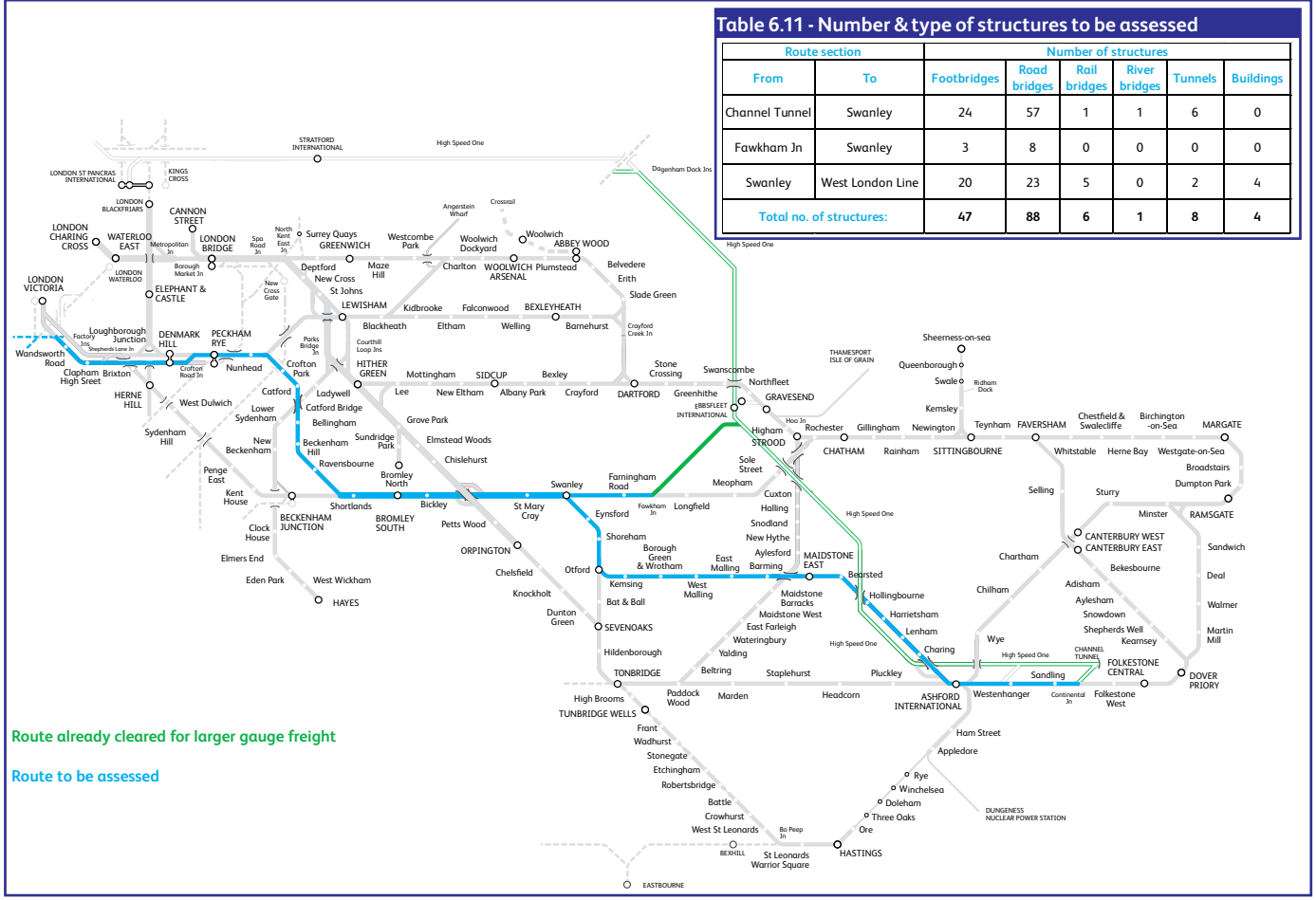


Table 6.11 - Number & type of structures to be assessed

Route section		Number of structures					
From	To	Footbridges	Road bridges	Rail bridges	River bridges	Tunnels	Buildings
Channel Tunnel	Swanley	24	57	1	1	6	0
Fawkham Jn	Swanley	3	8	0	0	0	0
Swanley	West London Line	20	23	5	0	2	4
Total no. of structures:		47	88	6	1	8	4

6.14.21. Carrying out the gauge clearance will enable trains to operate with any container carrying wagon with any size containers. This will reduce the operating costs of these freight trains and reduce the requirement to transport high cube containers by road in the Route Study area.

6.14.22. Further work may be required for Grain Branch freight services which are currently being developed.

6.15 Stations

Upgrades

6.15.1. Continued growth in the rail passenger market has resulted in a number of stations being congested in the peak hours. This can make movements through stations to platforms slow and possibly difficult, potentially increasing the risk of accidents such as slips, trips and falls.

6.15.2. Busy stations on the route have been considered, to identify whether there are currently concerns over passenger circulation, and identify stations where forecast passenger growth will be putting increased pressure on station facilities. For stations identified with potential issues, options have been developed to improve passenger circulation and relieve congestion.

6.15.3. At Lewisham, one of the busiest non-terminal stations in the Route Study area, passenger crowding in both the morning and evening peaks has been identified. The station is constrained in a number of areas and improved layouts and facilities have been considered to improve passenger flows. Network Rail, Transport for London and London Borough of Lewisham are working together to produce a longer term vision for the station and surrounding areas. Finding a solution to these challenges remains an industry priority and options are being investigated to increase capacity to meet current and future forecast growth.

6.15.4. At Denmark Hill, the main issues identified are congestion on the platforms, stairs and interchange footbridge, and at station entrance / exit gatelines, both in the morning and evening peaks. By implementing the proposed interventions, it is anticipated that there will be reduced queuing at the bottom of the platform access staircases and decongestion at the main gate lines, with improved passenger safety and reduced passenger walk times; particularly to and from Kings College Hospital.

6.15.5. At Peckham Rye, crowding and congestion have been identified in both the morning and evening peaks on platforms, access stairs and at the main station entrance/exit gateline. The options identified will inform choices for funders in the short/ medium term, and input into wider regeneration schemes being master-planned for the area.

Table 6.12 - Option table: Station enhancements

Location	Lewisham	Denmark Hill	Peckham Rye	Bromley South
Summary of Intervention	Additional gates on existing entrance/exit gatelines.	Additional gates on existing entrance/exit gatelines.	Additional gates on existing entrance/exit gatelines.	Remove buildings on Platforms 3 & 4.
	Widen existing or provide additional staircases to interchange subway.	Provide a new station entrance onto Windsor Walk, linked to the AfA footbridge.	Widen existing or provide additional platform access staircases.	Construct a transfer deck above the station to connect existing station building and platforms via new access staircases.
	Widen existing interchange subway or provide new interchange subway/ footbridge.	Encourage increased passenger use of the AfA footbridge by:	Provide accessible link between platforms and street level.	
	Provide canopies along platforms to encourage passenger distribution.	Relocating existing station entrance nearer to the AfA footbridge.	Remove buildings on Platforms 3 & 4.	
		Lengthen platforms to terminate services closer to the AfA footbridge.	Provide canopies along platforms to encourage passenger distribution.	
		Provide cover to the AfA footbridge.		
Output Assessment	Increased capacity to enable forecast growth in passenger numbers to be accommodated without increased safety risk.			
	Passenger walk times will be kept to a minimum level and overcrowding will be effectively managed.			
Indicative Cost	Options in early stage development			
Prioritisation Assessment	Should be considered for delivery by 2024 to meet forecast demand.			
Benefit Cost Ratio	TBC	TBC	TBC	TBC

6.15.6. At Bromley South, passenger crowding in both the morning and evening peaks has been identified on the station platforms and interchange bridge. Removal of buildings on Platforms 3 & 4 will aid in short/medium term decongestion in these areas, but consideration of longer-term congestion relief options should be made to resolve future capacity concerns.

6.15.7. At Brixton, passenger crowding occurs with passengers leaving the station from Platform 1. The only exit is a metal staircase to the ground level. There is no access to Platform 2 either. Passengers queue back from the staircase onto the platform making train dispatch difficult as passengers wait on the wrong side of the yellow line or struggle to alight the train.

3rd party new stations

Thanet Parkway

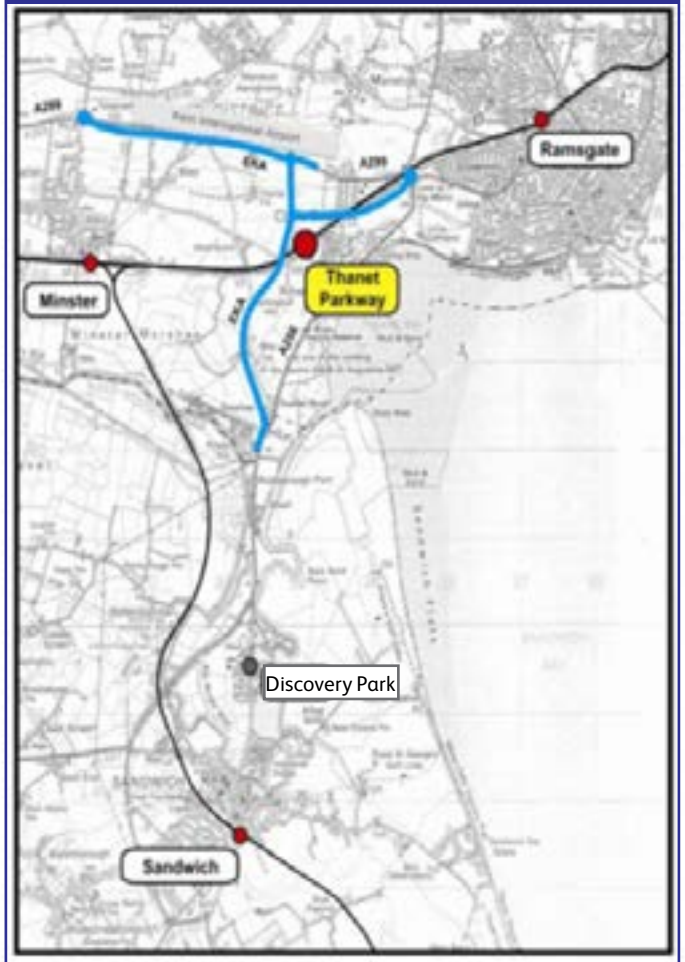
6.15.8. In 2014, Kent County Council commissioned a Business Case Study to assess proposals for a new Thanet Parkway station at Manston. It would be located on the Ashford to Ramsgate line between Ramsgate and Minster stations, south of the Manston Airport site. The development funding to date has come from the South East Local Enterprise Partnership Growth Deal.

6.15.9. The purpose of the station is to support potential new development at the Discovery Park Enterprise Zone, Manston Park and EuroKent Business Park and the Westwood Cross Retail and Shopping Centre. It would also provide car parking for park and ride to supplement existing provision at Ramsgate station.

6.15.10. It is proposed that all the Southeastern High Speed and Main line services which are routed either via Canterbury West or via Dover Priory call at the new station. Although an additional station stop would normally extend journey times, the realisation of the line speed improvements, should allow existing times to be improved.

Artists impression of Thanet Parkway station

Figure 6.18 - Location of the proposed Thanet Parkway station



Source: Kent County Council

Camberwell

6.15.11. There was a station at Camberwell on the four-track railway between Elephant & Castle and Denmark Hill/Loughborough Junction. The station was open between October 1908 and April 1916. It was closed during the First World War, as a consequence of low levels of use due to the popularity of the electric trams in the area. The station site sits within the London Borough of Southwark, although it is very close to the border with the London Borough of Lambeth. There have been numerous calls from local stakeholders to reopen the station over the years. The latest initiative has come from Transport for London (TfL) and the London Borough of Southwark, who suggested building the station as an alternative to the Bakerloo Line Extension serving the area.

6.15.12. TfL is leading a review of the business case for the new station, including an analysis of the expected level of demand. Southwark Council are supporting the process by identifying the capacity for additional development in the station's catchment area (covering both housing and employment) that would improve the viability of the station. Network Rail is working with TfL and Southwark Council on the business case analysis and associated timetable modelling which is expected to be commissioned once the initial business case has been completed.

6.15.13. The introduction of an additional station call would extend journey times for existing users. This trade-off and any mitigation will need to be considered.

6.15.14. The original Camberwell station had platform faces on all four lines; a central island platform and single platforms on the outside lines. However, all were relatively short (less than 8-cars long) and would not meet modern compliance standards for platform widths. A new station must also conform to the latest accessibility requirements. 8-car platform lengths would be required, initially with provision for extension to 12-car if the services on the route are extended to this length.

6.15.15. The demand forecasting analysis undertaken for the Route Study does not take into account passenger generation. With forecast congested standing in 2024 on the Catford Loop into Elephant & Castle, it is vital to consider additional capacity from a station at Camberwell.

6.15.16. TfL is due to publish its initial Business Case in 2018.

East Brixton

6.15.17. East Brixton station, on the route between Denmark Hill and London Victoria, closed in 1976. The station site sits within the London Borough of Lambeth.

6.15.18. As with Camberwell, there have been numerous calls from local stakeholders to reopen the station over the years. The London Borough of Lambeth was keen to reopen the station to improve the connectivity of Brixton town centre to orbital rail routes, building on the success of the London Overground route to Clapham Junction which opened in 2012. If reopened, the station would be served solely by London Overground services operating to and from Clapham Junction via the East London Line.

6.15.19. The London Borough of Lambeth led a review of the business case and demand for East Brixton station with support from Transport for London and Network Rail. This review will include consideration of the impact of a new station on local development opportunities.

Hoo (Deangate)

6.15.20. Medway Council have formally approached Network Rail to understand the impact and costs of adding a station on the Grain Branch called Hoo (Deangate) to support the circa 10,000 new homes planned for that area. More details can be found in the **Technical Appendix section 1.2.3**.

6.15.21. There are several technicalities that will need to be resolved for the extension of electric services to the new station, see the Innovation Challenge box on **Page 75** of this document.

Other aspirations

Otterpool Park – Garden Town

6.15.22. Folkestone & Hythe (formerly Shepway) District Council is proposing a garden town in the broad area surrounding Otterpool Manor Farm. The council believes that 12,000 new homes could be built over the next 30 years. The area is in the proximity of Westenhanger station, south of Ashford, which currently has an hourly service to London Charing Cross. High Speed services do not regularly call at the station.

Gillingham Stadium

6.15.23. Gillingham Football Club are looking to move to a new stadium between Gillingham and Rainham stations providing housing, leisure and business opportunities and have proposed a new station to serve this development.

6.15.24. The station would be operated with usual opening hours, rather than at event times although the operation of the station may be adjusted to suit the flow of passengers.

6.15.25. Although this adds another station in the Medway Towns, it could space the stations between Rainham and Rochester more evenly and would provide a new station and new journey opportunities to parts of Rainham and Gillingham.

6.16 Choices for Funders

6.16.1. **Table 6.13** summarises the Choices for Funders by Conditional Output, timescale and type of option.

Table 6.13 - Choices for Funders summary table

Conditional Output no.	Conditional Output	Choice for Funders	By 2024								2024 - 2044							
			More trains	Longer trains	Platform extensions	Station improvements	Linespeed Improvements	Power Supply Enhancement	Significant Infrastructure Enhancement	Berthing Siding Improvements	More trains	Longer trains	Platform extensions	Station improvements	Linespeed Improvements	Power Supply Enhancement	Significant Infrastructure Enhancement	Berthing Siding Improvements
CO1 & CO7	London Bridge Metro	12-car services: Dartford Lines		✓	✓					✓	Further development work required							✓
		12-car services: Hayes Line		✓						✓								✓
		12-car services: Orpington & Sevenoaks		✓						✓								✓
CO2 & CO8	Victoria Metro	8-car trains		✓							Further development work required							
CO3 & CO9	High Speed	12-car services: Medway		✓						✓								✓
		12-car services: Maidstone		✓	✓			✓		✓								✓
		12-car services: Ashford International	✓	✓				✓		✓								✓
CO4 & CO10	Blackfriars	12-car services		✓	✓					✓		✓	✓					
CO5 & CO11	London Bridge & Victoria Main Line	12-car services		✓						✓	Further development work required		✓	✓			✓	✓
		Ashford - Ramsgate additional services							✓	✓								✓
CO1, 2, 4, 5, 7, 8, 10 & 11	Third Party Proposals	TfL's Bakerloo Line Extension															✓	
		TfL's Metroisation									✓			✓			✓	
		Crossrail towards Gravesend									✓			✓			✓	
CO13 CO15 CO17 CO18	Various Conditional Outputs	Marshlink High Speed					✓	Option			✓	✓	✓			Option	✓	✓
CO18	North to South Kent Connectivity	Ebbsfleet Southern Link									✓						✓	
		North Kent to South Kent									✓						✓	
CO20	Freight	Angerstein Wharf Connection									✓						✓	
		Nunhead Passing Loop									✓						✓	
		Howbury Park Freight Terminal									✓							
		Gauge Clearance									✓						✓	
CO21	Improved passenger circulation at stations	Lewisham				✓												
		Denmark Hill				✓												
		Peckham Rye				✓												
		Bromley South				✓												
		Brixton				✓												
		Beckenham Junction												✓				
		Dartford												✓				
		Chatham												✓				
		Tonbridge												✓				
CO28	Resilience	Canterbury Chord														✓	✓	

7 Next steps

7.1 Making a choice

7.1.1. **Chapter 6 and the Technical Appendix** detail the various 'Choices for Funders' based on current thinking. To take projects forward, it should be remembered that all details shown in these documents are based on pre-GRIP or GRIP0 estimates and are not extensive GRIP3 options.

7.1.2. It may be pertinent to carry out a further modular route study to examine all the options for a particular location, perhaps to provide more focus than can be delivered in the wide-ranging Route Study.

7.1.3. The first point of contact should be **sestrategicplanning@networkrail.co.uk** - on receipt we will pass the email on to the relevant people.

7.2 Business Development

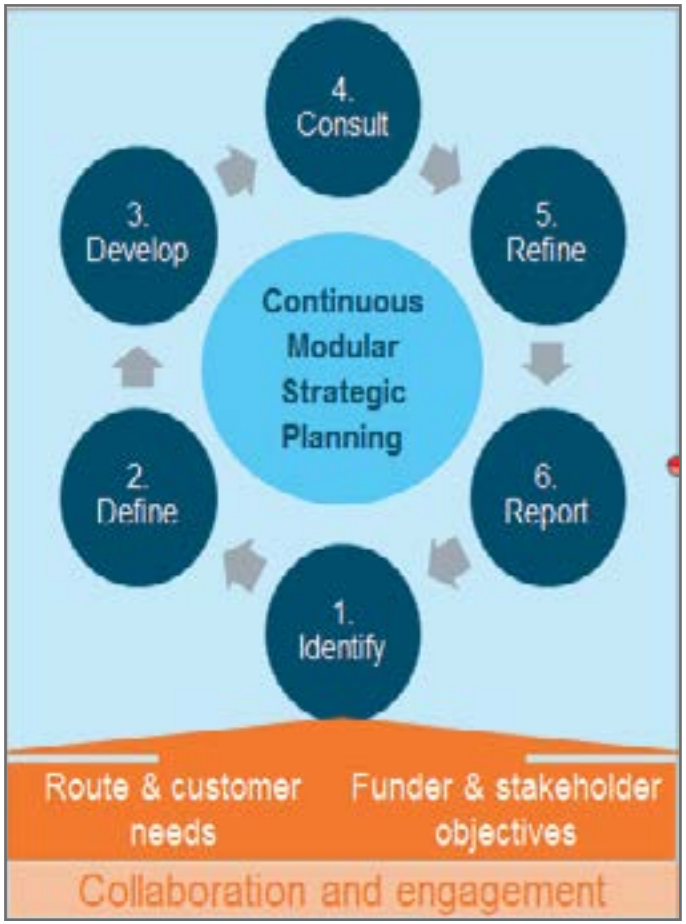
7.2.1. Network Rail has recently introduced a new Business Development team to make it easier for outside parties to invest on the railway network. The Business Development team shall be able to discuss any investment aspirations that external parties may have including any opportunities that have not been identified within this Route Study.

7.2.2. Many railway projects to enhance passenger experience, train and freight performance are not delivered or are pushed down the priority list due to a lack of funding. Network Rail believes that by pursuing outside sources of funding and looking for ways to innovatively adapt the business model for the future, that it will be beneficial to both taxpayers and the travelling public.

7.2.3. Network Rail shall therefore be particularly interested in working with outside parties on any externally funded proposals that add value to the railway network or provide socio-economic benefits to the local community. The Business Development team shall be able to provide guidance to allow outside parties to take initial concepts through to the creation of a railway project as well as hold discussions on the funding of projects.

7.3 Modular Route Studies

This is not the end of the line for the Route Study, these documents will be 'living' with further continuous modular strategic planning in the pipeline.



7.4 Thank you

We would like to thank everyone for their input to the Kent Route Study and will continue with regular meetings of the Regional and Wider Stakeholder Group meetings to maintain our relationships.

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