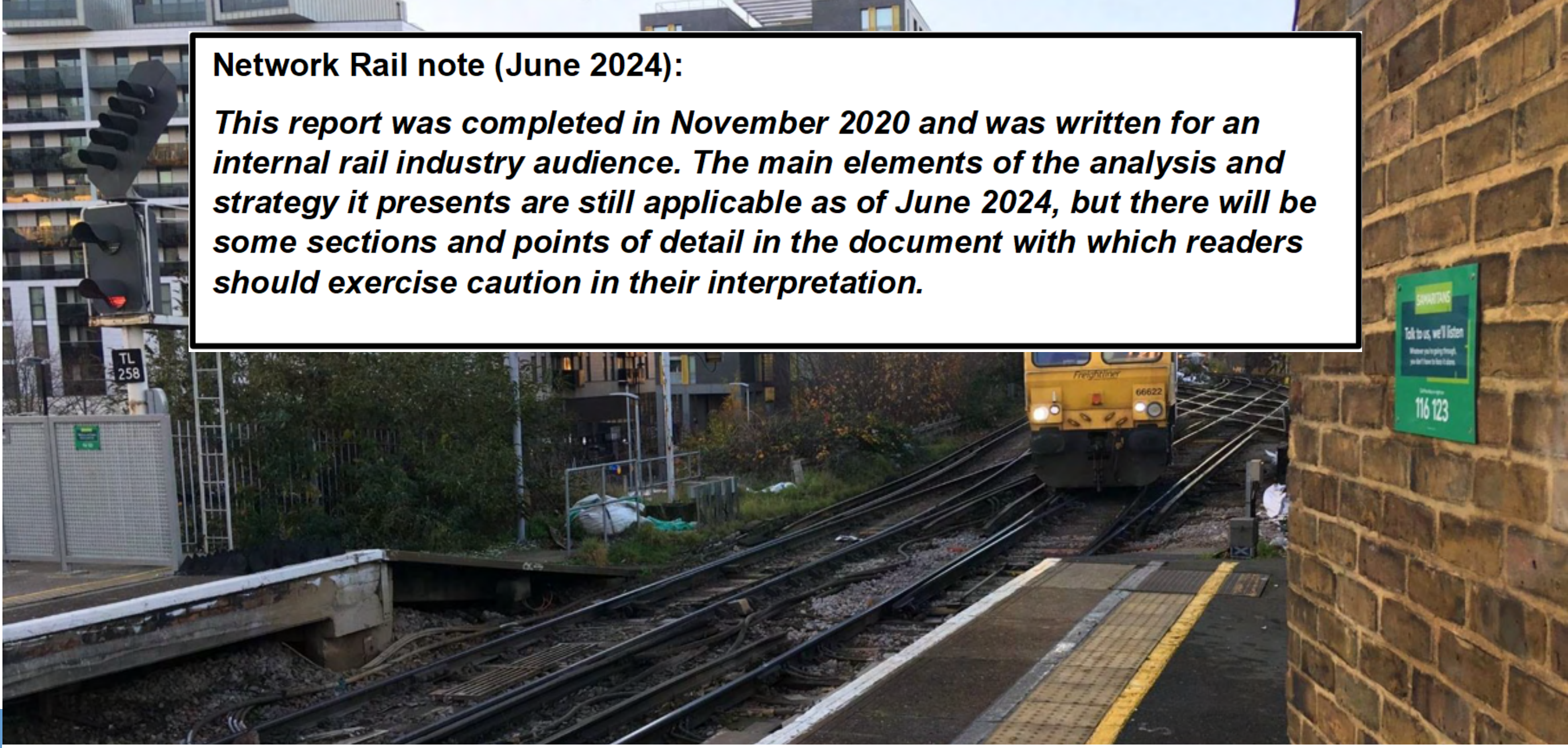
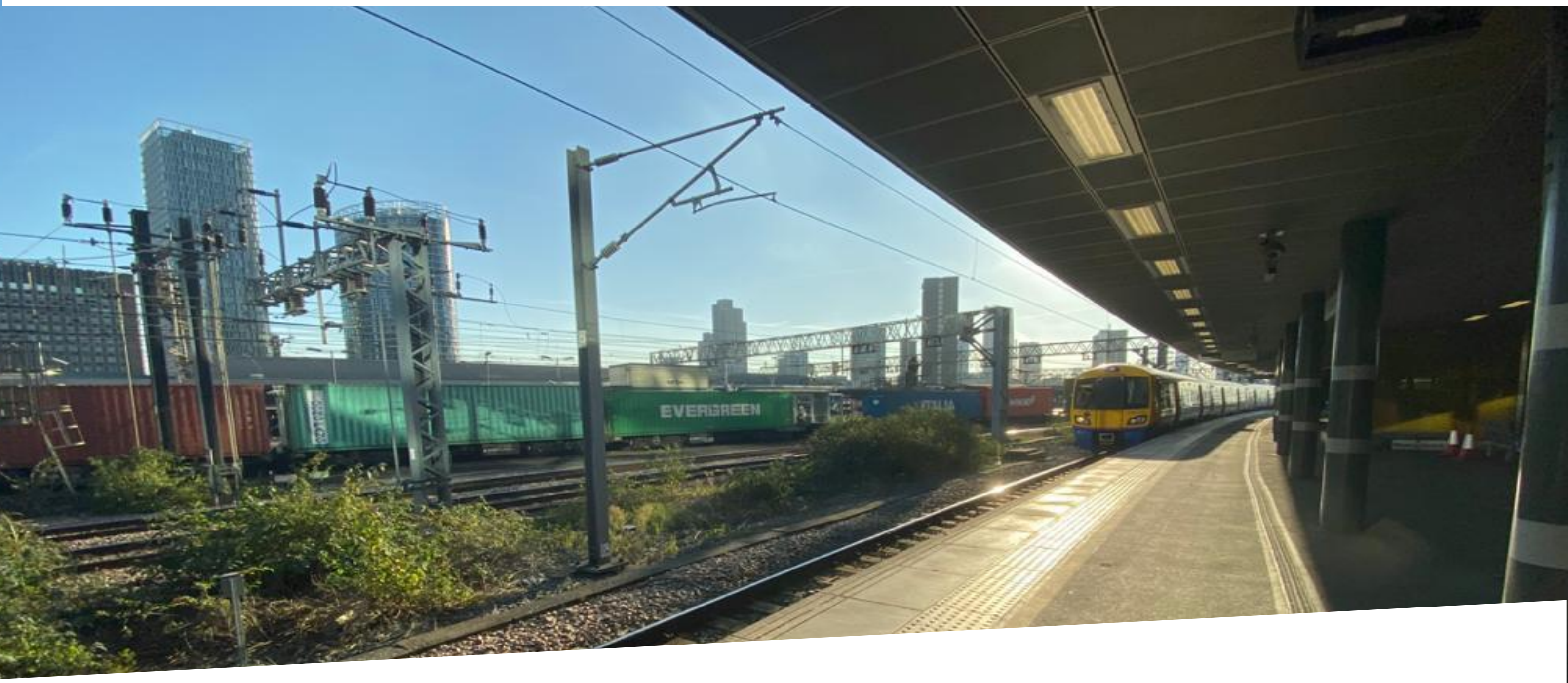


Network Rail note (June 2024):

This report was completed in November 2020 and was written for an internal rail industry audience. The main elements of the analysis and strategy it presents are still applicable as of June 2024, but there will be some sections and points of detail in the document with which readers should exercise caution in their interpretation.



THE LONDON RAIL FREIGHT STRATEGY

NetworkRail

November 2020

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GLOSSARY

AC	Alternating Current
ARL	Arriva Rail London
BML	Brighton Main Line
CCTV	Closed Circuit Television
CMSP	Continuous Modular Strategic Planning
CO_2	Carbon Dioxide
CP	Control Period
CSM	Common Safety Method
DC	Direct Current
ECML	East Coast Main Line
ELL	East London Line
EMU	Electric Multiple Unit
ETCS	European Train Control System
F2M&N	Felixstowe to the Midlands and North
FNPO	Freight & National Passenger Operators
FOC	Freight Operating Company
GDP	Gross Domestic Product
GEML	Great Eastern Main Line
GLA	Greater London Authority
GOB	Gospel Oak-Barking line
GRIP	Governance for Railway Investment Projects
GTR	Govia Thameslink Railway
GWML	Great Western Main Line

HAW	Heavy Axle Weight
HS2	High Speed 2
ITSS	Indicative Train Service Specification
LOCAP	London Overground Capacity
LRFS	London Rail Freight Strategy
LRS	London Rail Strategy
LTPP	Long-Term Planning Process
MML	Midland Main Line
mph	miles per hour
NDC	National Distribution Centre
NLL	North London Line
NR	Network Rail
OAP	Ove Arup & Partners
OLE	Overhead Line Equipment
RA	Route Availability
RDC	Regional Distribution Centre
RNEP	Rail Network Enhancements Pipeline
ROG	Rail Operations Group
RSSB	Rail Safety & Standards Board
SDT	Scheme Design Team
SFN SG	Strategic Freight Network Steering Group
SLL	South London Line
SO	System Operator
SOBC	Strategic Outline Business Case
SRT	Sectional Running Time
TDNS	Traction Decarbonisation Network Strategy
TfL	Transport for London
TOC	Train Operating Company
TPRs	Timetable Planning Rules
WAML	West Anglia Main Line
WCML	West Coast Main Line
WLL	West London Line

CONTENTS

EXECUTIVE SUMMARY

RAIL FREIGHT

Rail freight delivers substantial benefits to Britain and has major advantages over road haulage in terms of its social and environmental impacts. Recent history has seen the market realigned to become dominated by sectors based around serving the needs of population centres, necessitating the use of those parts of the rail network where passenger traffic is also most prevalent and capacity is at a premium.

Source: Network Rail

FUTURE GROWTH

Industry established forecasts indicate that very strong long-term growth in demand for rail freight services should be expected between now and 2043, even when allowing for a range of possible scenarios. This includes significant forecast growth in market demand for rail freight movements in London. In addition, the government's legal commitment to a target of net-zero greenhouse emissions across the economy by 2050 is expected to further drive demand for the movement of freight by rail, by effecting significant long-term modal shift away from road transport. Realising as much as possible of that enormous potential will depend on enhancing network capacity and capability for freight, in the challenging context of a mixed-use railway where balance and accommodation with passenger needs is required.

LONDON

London's construction sector depends on rail freight for the materials it needs to support the development of housing, business facilities and major infrastructure projects. The rail network in London also supports vital movements of containerised goods as a key link in supply chains serving consumers both in the South East and nationwide. Import and export movements of cars and automotive parts also rely on lines in London, a substantial proportion of the city's waste is removed by rail and Heathrow airport is supplied with a fifth of its aviation fuel by cross-London flows of freight trains. Rail freight in London faces a range of challenges, chief among which are maintaining sufficient rail-connected terminals across the city and securing capacity on the rail network for trains to reach them.

THE LONDON RAIL FREIGHT STRATEGY

Recognising these challenges, freight stakeholders identified the development of a London Rail Freight Strategy as a strategic planning priority. The London Assembly Transport Committee also recommended the development of a unified rail strategy for London in its 2018 'Broken Rails' report, a key component of which should be a freight workstream. The London Rail Freight Strategy thus has dual roles, as both a study within NR's Long-Term Planning Process and as a constituent part of NR and TfL's London Rail Strategy.

Construction materials arriving by river at Angerstein's Wharf in south-east London, before onward movement by rail. Source: Mineral Products Association

This strategy is comprised of a range of enhancement options for funders, identified elements of existing projects or programmes whose progression is supported in the interests of freight and recommendations for further study in areas where this is required. The LRFS is intended to be not just a freight strategy, but a holistic plan to address the long-term capacity challenge on the London orbital routes, with an emphasis on the need for collective solutions to the collective constraints faced by both freight and passenger operations. Network Rail's System Operator FNPO strategic planning team will put forward these options to be developed initially as a portfolio, with a single overarching business case in support of them all. A request for a Decision to Initiate, which would allow this portfolio to enter the Rail Network Enhancements Pipeline, will be submitted to the Department for Transport.

CAPACITY ANALYSIS

The development of this strategy and the identification of options for funders has been informed by capacity analysis, focused on the London orbital routes. This took an ITSS representing future growth in an off-peak scenario for the 2040s and assessed how it could be accommodated on those routes.

THE CAPACITY CHALLENGE

A range of capacity and capability challenges have been identified, all of which need to be addressed as far as is possible, if long-term freight growth in London is to be realised. These include straightforward line of route capacity, the mixed traffic nature of the orbital routes, the provision and type of regulating points on the network, the prevalence of flat junctions and a specific constraint associated with traction changeover on the WLL. Issues relating to maximum lengths and trailing weights, Heavy Axle Weight restrictions, loading gauge and electrification also inhibit freight trains' ability to operate with optimal efficiency in many cases and therefore need to be considered alongside pure network capacity constraints.

CORE INTERVENTIONS

This strategy proposes a set of core interventions, which capacity analysis has deemed to be required in order to unlock the long-term growth represented by the ITSS. These are:

- Camden Road Platform 3

Source: Network Rail

- Reinstatement of a third track and platform on the northern side of Camden Road station, utilising part of the former 4-track formation through the station.
- Kensal Green Junction Improvement
  - Upgrade of the junction, moving it slightly to the east and realigning the layout, to facilitate faster crossing speeds sufficient for a 3-minute planning margin.
- West London Line AC/DC Changeover relocation
  - Extension of the overhead wires further along the WLL, to provide AC electrification as far south as Shepherd's Bush station.
- Clapham Junction Platform 0
  - Creation of additional bay platform capacity at the northern end of Clapham Junction station, for the use of London Overground WLL services.
- North London Line, Gospel Oak-Barking line and West London Line Headway Reductions
  - Not proposals that are being put forward for progression through the RNEP, but a critical dependency for the overall benefits of this strategy to be realised.

ADDITIONAL OPTIONS

A series of additional options are also put forward by this strategy to supplement the core interventions in the previous section, ensuring that the LRFS presents a broad range of options to address the range of rail freight needs in London over the long term, as well as tackling capacity at key locations. They are:

Source: Network Rail

- Harlesden Junction Doubling
- West London Line AC/DC Changeover relocation to Kensington Olympia
- Stratford Regulating Point Extension
- Nunhead Junction Improvement
- Longhedge Junction Speed Increases
- Gospel Oak Speed Increases
- East Coast Main Line South Bi-directional Capability
- A cross-London package of works to remove Heavy Axle Weight speed restrictions
- A package of works to remove the Heavy Axle Weight speed restriction on the Gospel Oak-Barking line

- Development of loading gauge enhancements, with W12 across north London a priority

OTHER WORKSTREAMS

There are several workstreams already underway across the rail industry that stand to benefit rail freight in London. These deserve continued support and advocacy from freight stakeholders to ensure that their freight benefits are fully realised.

YARDS AND TERMINALS

Concrete batching facility at the King's Cross terminal. Source: Rail Business Daily

Whilst there is a need to develop the rail network for future freight growth, doing so can only be effective if there are sufficient number and standard of yards and terminals for goods to be moved between. Currently, provision of these facilities around London is very much a mixed picture, with good quality nodal yards at certain locations and a wide array of construction railheads, but gaps elsewhere. Improvements in this area will require continued collaboration across the rail sector, but are also dependent on a favourable planning environment.

The LRFS proposes the development of a cross-London programme of works to realise a consistent operational standard for construction sector terminals, with a minimum of accommodating 20 wagon trains and a target of 26 wagons. This strategy also proposes a comprehensive review of railway-adjacent land across the London area, with a view to the identification and safeguarding of any remaining sites with potential to be of value for future freight use.

CONCLUSION

Accommodating London's rail freight requirements over the next thirty years demands a multi-faceted approach that will alleviate constraints, increase capacity, improve capability and facilitate growth. This strategy aims to set out a high-level approach for this to be achieved, by presenting options for enhancement schemes to the railway's funders, identifying industry workstreams that should be supported and highlighting the importance of the ongoing development of rail freight terminals and new markets.

Source: Network Rail

PART 1: CONTEXT OF STUDY

The movement of goods by rail is vital to Britain. The past thirty years have seen the rail freight market and its role in the economy substantially re-shaped, with the industry adapting to maintain its role as a critical link in supply chains even as the range of sectors these serve has continually evolved. The next thirty years will bring new challenges and opportunities and an unprecedented need for rail to expand its share of the overall freight market still further. Rail is a key part of the solution for logistics in Britain to become more efficient, safer and greener in years to come. Strategies like this one seek to set out the industry's collective vision for achieving this.

1.1 RAIL FREIGHT

1.1.1 THE BENEFITS OF RAIL FREIGHT

In recent times, rail freight has moved in the region of £30bn worth of goods annually and has been calculated to generate £1.7bn of benefits to the economy and society every year. The latter figure includes £1.2bn in productivity gains for businesses that choose to use rail freight instead of road, added to which is £0.5bn of benefits derived from reduced road congestion, carbon emissions and road accidents and better air quality. Rail freight continues to drive up its own efficiency – between 2003/04 and 2019/20, the number of freight train movements on the rail network fell by 50 %, whilst the tonnage lifted per train increased by 66 %.[1] Rail is also markedly more fuel efficient than road haulage and is responsible for 76 % less carbon dioxide per tonne of cargo.[2]

Source: Network Rail

1.1.2 MARKET TRENDS

This success has taken place in a context of substantial and at times rapid change. The major trend in the market has been a shift away from rail freight's former primary role serving traditional heavy industry and electricity generation, as demand has declined due to wider structural changes to the economy and the phasing out of coal-fired power stations. Coal for the electricity supply industry, once the backbone of British rail freight, has seen a rapid decline over the past five years and is no longer a leading commodity. That mantle has increasingly been assumed by containerised ('intermodal') freight and construction materials, as rail has shifted focus in an economy reliant on the import of manufactured goods and a vigorous urban property market. Both the intermodal and

[1] Calculated using figures from the ORR Data Portal: https://dataportal.orr.gov.uk/statistics/usage/freight-rail-usage-and-performance/

[2] *Freight Network Study*, Network Rail (2017); *Rail Freight Working for Britain*, Rail Delivery Group (2018); *Rail Freight: Delivering for Britain*, Rail Delivery Group (2019)

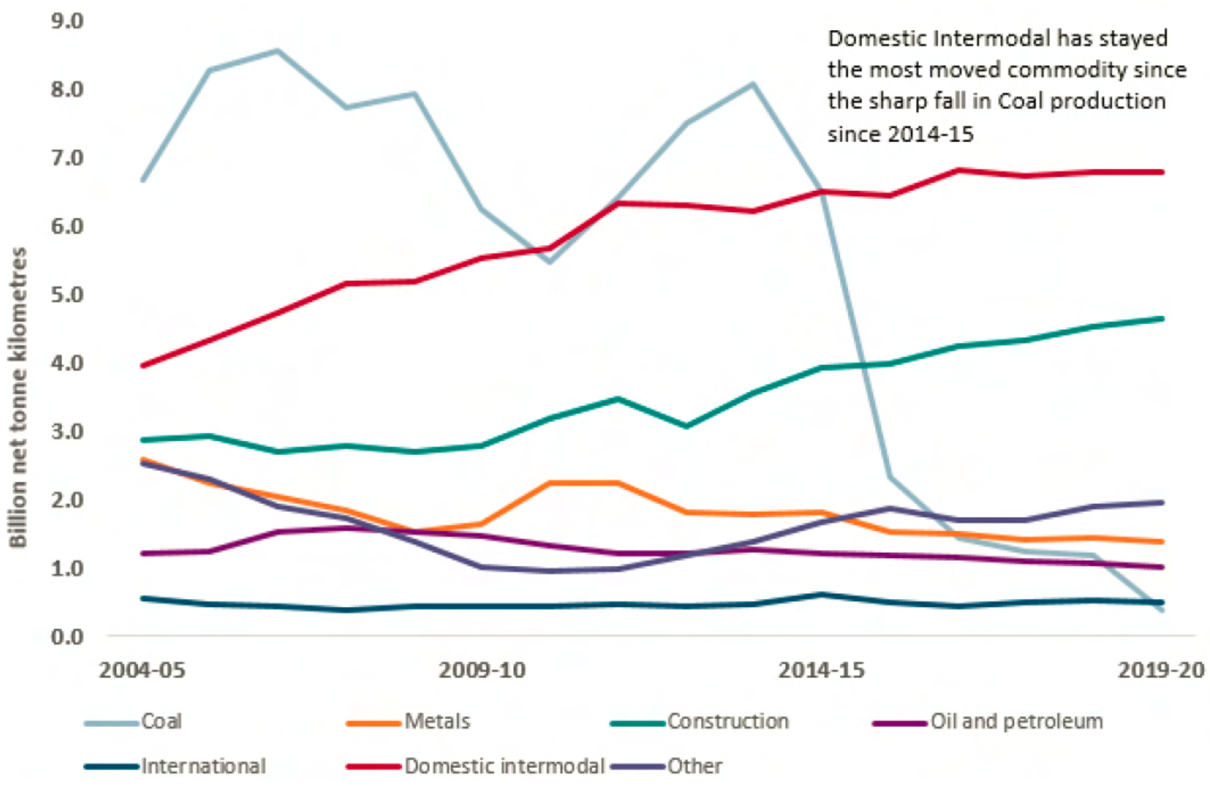

Figure 1: Rail Freight moved in Great Britain by commodity
N.B. 'Domestic Intermodal' refers to ports and domestic intermodal, distinct from Channel Tunnel International
Source: Freight Rail Usage and Performance 2019-20 Q4 Statistical Release, Office of Rail and Road (June 2020)

construction sectors are based around serving the needs of population centres, necessitating the use of those parts of the rail network where passenger traffic is also most prevalent and capacity is at a premium. These trends have led industry observers to observe a general shift in the rail freight industry's centre of gravity towards London and the South East.[3] This brings with it a particular set of challenges for rail freight to address and these have prompted freight stakeholders to identify the development of a London Rail Freight Strategy as a strategic planning priority.

1.1.3 FUTURE GROWTH

If those challenges can be successfully overcome, the potential gains for the industry and benefits to Britain as a whole are substantial. Industry established forecasts indicate that very strong long-term growth in demand for rail freight services should be expected between now and 2043, even when allowing for a range of possible scenarios (see fig. 2). In addition, the government's legal commitment to a target of net-zero greenhouse emissions across the economy by 2050 is expected to further drive demand for the movement of freight by rail, by effecting significant long-term modal shift away from road transport due to the absence of a viable non-emitting alternative to the diesel Heavy Goods Vehicle. Established rail freight forecasts, although recent, were developed prior to the 2019 legislation introducing this target and therefore do not account for its impact. This only adds to expectations of burgeoning growth, as a step change in rail's modal share of surface freight appears essential for the net-zero commitment to be upheld.

[3] 'London and South East new centre of gravity for UK rail freight', RailFreight.com, 08/07/2020

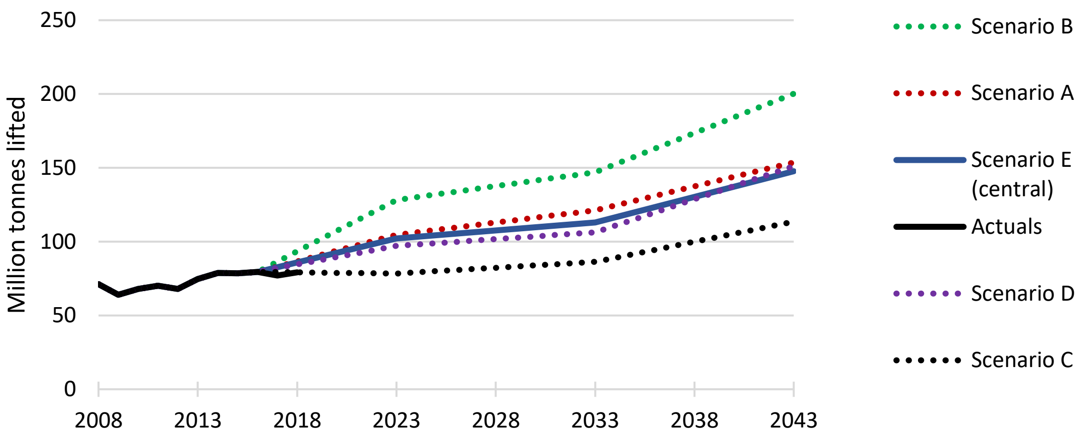

Figure 2: Rail freight forecasts: total tonnes lifted in GB excluding coal for Electricity Supply Industry

Source: 'Rail freight forecasts: Scenarios for 2033/34 & 2043/44', MDS Transmodal for Network Rail (August 2020), available at https://www.networkrail.co.uk/running-the-railway/long-term-planning/

However, forecasts of market demand and policy-driven expectations serve merely to indicate freight's potential – they do not reflect the constraints imposed by finite rail network capacity. Realising as much as possible of that enormous potential will depend on enhancing network capacity and capability for freight, in the challenging context of a mixed-use railway where balance and accommodation with passenger needs is required.

Other drivers for long-term growth will be competition with road haulage and the continuing influence of factors such as wage growth, fuel prices and technological change, as well as the rate of development and retention of rail-connected terminals in the key intermodal and construction sectors. New and emerging markets are also expected to play a role in the evolution and growth of rail freight over the coming decades (see 3.5) – the railway may need to develop novel solutions to make the most of these opportunities.

1.1.4 COVID-19

This strategy has been written at a time of extraordinary disruption and uncertainty, due to the global Covid-19 pandemic. Passenger demand on the railway has dropped to a small fraction of prior levels over the course of 2020 and it remains too soon to determine the trajectory of recovery or the long-term consequences of the pandemic. Freight volumes were also depleted for much of the spring and summer of 2020, when compared with 2019, as construction and manufacturing activities were halted and global trade severely affected. However, the impact was notably neither as severe nor as prolonged as with passenger demand. Rail freight has come to the fore in some areas to make a major contribution to Britain's response to the crisis and will be a critical driving force supporting economic recovery.[4] As of November 2020, freight traffic levels have already regained the

[4] 'West Coast main line moving 1m tonnes of critical supplies every week during Covid-19 crisis', Rail Business Daily (2nd April 2020); 'Network Rail supports London's vital supermarket supplies with new freight route from Spain', Rail Business Daily (1st May 2020); 'GB Railfreight trials express delivery trains for vital NHS supplies', Rail Business Daily (27th April 2020); 'New rail freight terminal to boost recovery of London's construction

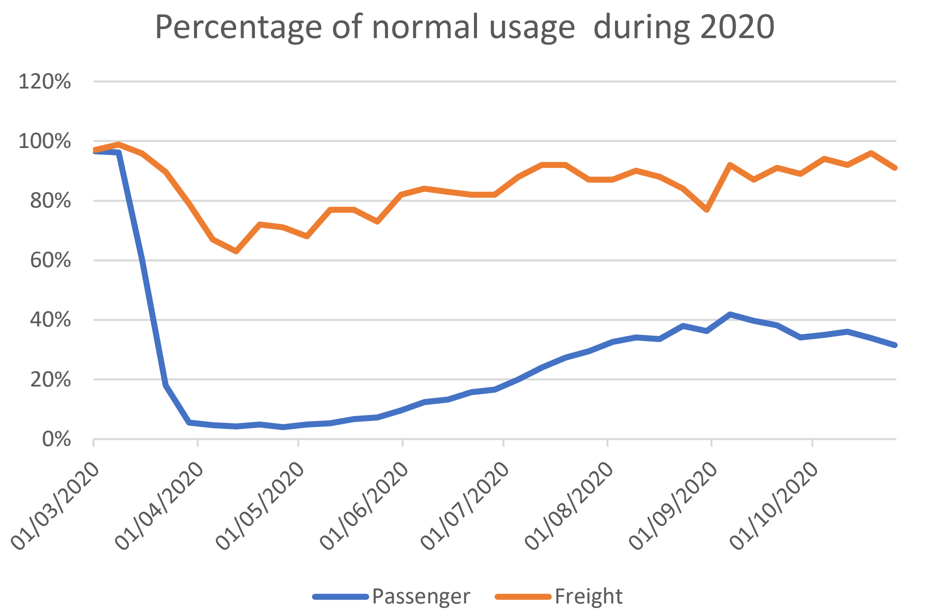

Figure 3: Impact to passenger and freight demand during the Covid-19 pandemic

Source: Network Rail Freight team weekly freight train running summaries and 'Transport use by mode: Great Britain, since 1 March 2020', Department for Transport; https://www.gov.uk/government/statistics/transport-use-during-the-coronavirus-covid-19-pandemic

N.B. Passenger figures reflect ridership as a percentage of the equivalent week in 2019. Freight figures reflect total trains run as a percentage of total run in a typical week in early 2020 (week commencing 02/02/2020)

vast majority of lost ground, with construction and maritime intermodal reporting over 90 % of normal running.[5]

Initial work by Network Rail analysts suggests that despite the magnitude of the passenger demand shock experienced, which may well set back the trajectory of growth by a number of years, there is no cause not to continue planning for growth across the railway in the long term. The overriding drivers of long-term growth remain or can for the most part be expected to return in time. Rail freight is also relatively less reliant on the wider economic recovery. Due to the nature of its competition with road and overall market share of c. 10 % the industry is not necessarily GDP growth-dependent, since latent opportunity for expansion through modal shift within the existing market is substantial. The potential for the rise of home and flexible working during the pandemic response period to have a lasting influence on passenger behaviour will also remain an area of keen interest for the rail industry moving forward. Such trends may in some cases open opportunities for the railway to reassess how we prioritise the use of the network in the future, where traditional commuting patterns may shift but the need for rail freight to play a strong role in serving the economy will undoubtedly continue.

1.2 LONDON

London has in recent years increasingly become a focal point for the overarching trends in the rail freight and wider logistics markets described in the previous section. This is evident nowhere more so than in the construction market, reflecting the buoyancy of that industry and its subsequently voracious demand for materials to feed the building sites of the capital. Freight railheads within London itself are overwhelmingly aligned to this commodity sector, which has seen the strongest growth of any over the past five years. London's relationship with the intermodal sector is different, though no less significant, and

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sector post-Covid-19 pandemic', Rail Business Daily (12th May 2020); 'RFG Director General on Building back-how rail freight can support the post COVID recovery', Rail Business Daily (22nd May 2020)

[5] Network Rail Freight team weekly freight train running summaries; 'Optimism as UK rail freight stages recovery', RailFreight.com (29/10/2020)

heavily influenced by geography, the nature of the British rail network and consumer goods supply chains.

1.2.1 THE ROLE OF RAIL FREIGHT

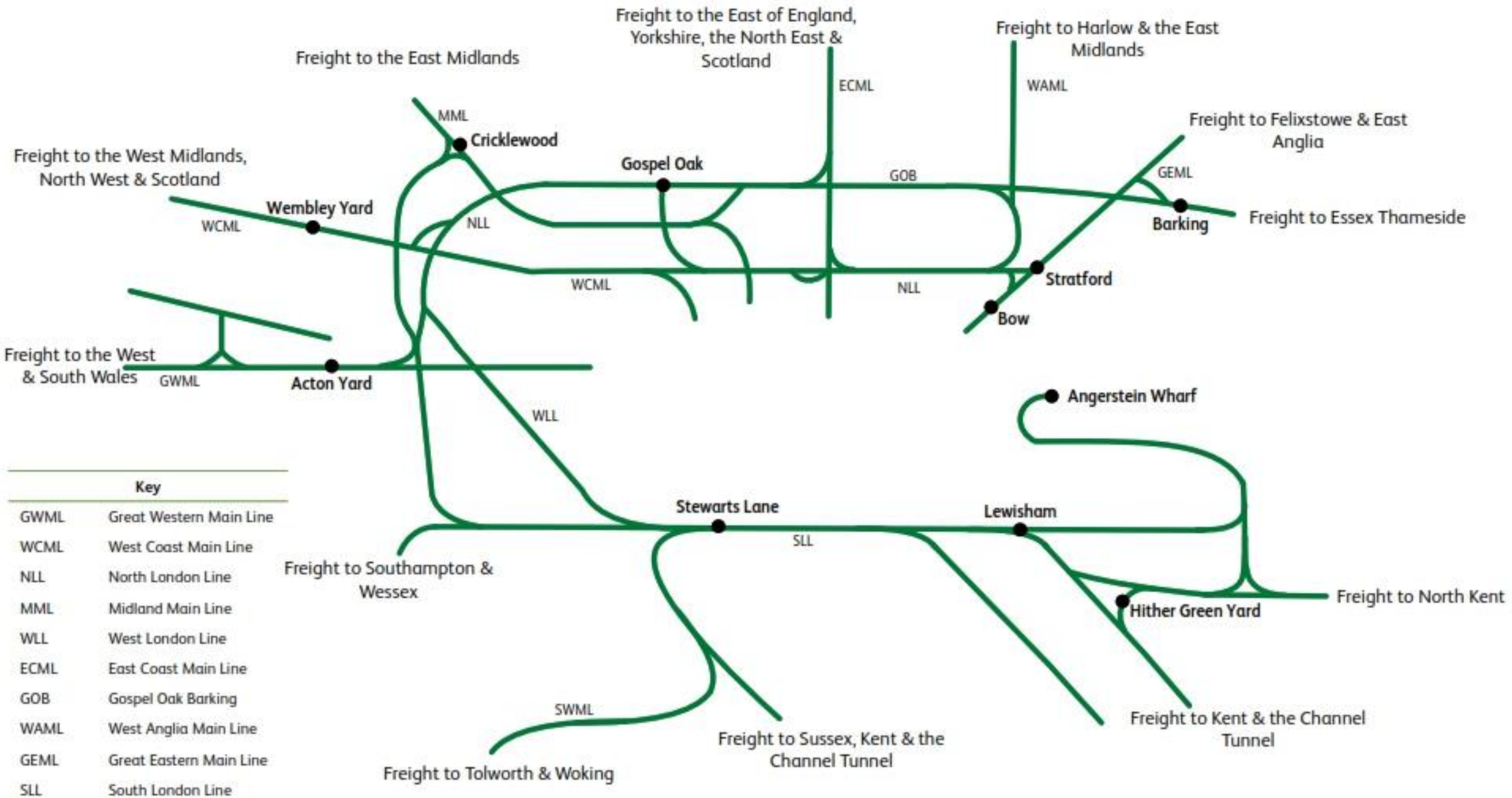
London's construction sector depends on rail freight for the materials it needs to support the development of housing, business facilities and major infrastructure projects. Using rail enables large volumes of the 'aggregates' needed to make cement and other essential building materials to be brought close to urban construction sites, minimising the use of Heavy Goods Vehicles.

The rail network in London also supports vital movements of containerised goods as a key link in supply chains serving consumers both in the South East and nationwide. Import and export movements of cars and automotive parts also rely on lines in London, a substantial proportion of the city's waste is removed by rail and Heathrow airport is supplied with a fifth of its aviation fuel by cross-London flows of freight trains.

Key facts:

- Approximately 40 % of all aggregates used in London are delivered by rail[6]
- Rail freight moves one in four containers entering the UK[7]
- In 2019, the North London Line was used by over 10,000 intermodal trains[8]
- There are 32 active freight terminals in Greater London[9]
- CO_2 emissions per tonne of material delivered by rail are 76 % lower than by road[10]
- Rail freight produces up to ten times less small particulate matter than road haulage and as much as 15 times less nitrogen oxide for the equivalent mass hauled[11]
- One freight train can remove up to 76 Heavy Goods Vehicles from the road[12]
- Rail freight is estimated to generate £130m in annual economic benefits to London and a further £87m to the wider South East[13]

[6] *Why is Rail Freight Vital for Housing and Construction?*, Mineral Products Association and Rail Freight Group (2016)
[7] *Freight Network Study*, Network Rail (2017); available at https://www.networkrail.co.uk/running-the-railway/long-term-planning/
[8] Network Rail train running data, December 2018-December 2019
[9] Network Rail. 4 further sites are due to come online by the end of 2020. Includes Colnbrook and Thorney Mill, which are fractionally outside the GLA boundary but in practice are London-serving terminals.
[10] *Value and Importance of Rail Freight*, Network Rail (2013)
[11] *Freight Britain: Continuity and certainty for rail freight*, Rail Delivery Group (2015)
[12] *Rail Freight Strategy: Moving Britain Ahead*, Department for Transport (2016)
[13] *Rail Freight Working for Britain*, Rail Delivery Group (2018)



Key	
GWML	Great Western Main Line
WCML	West Coast Main Line
NLL	North London Line
MML	Midland Main Line
WLL	West London Line
ECML	East Coast Main Line
GOB	Gospel Oak Barking
WAML	West Anglia Main Line
GEML	Great Eastern Main Line
SLL	South London Line
SWML	South West Main Line

Figure 4: Schematic map of rail freight routes in London (Not to scale). Source: Network Rail

1.2.2 CHALLENGES

The availability of suitable terminals for rail freight is a challenge in the London area. Construction railheads need to be safeguarded and protected from inappropriate adjacent housing development, which can threaten the imposition of restrictions to their operations. London and the South East also suffers from a marked lack of rail-connected facilities within the consumer goods supply chain. There are few inland intermodal rail freight terminals within the region, most Regional Distribution Centres across the South East are served by road only and recent years saw the rejection of plans for a new rail-connected distribution park on the outskirts of southeast London.[14]

Rail freight in London also shares in the capacity challenge faced by passenger services. Having rail-connected construction materials sites in relatively central locations is a major advantage to the industry, but it does mean that freight trains must share busy routes in and out of London, where the need for passenger capacity is already high. The 'wheel and spoke' layout of the national railway network means that some major intermodal freight flows cannot avoid being routed via London's orbital lines, where the expansion of the London Overground in recent decades has reduced available capacity. The major 'deep sea' ports, those receiving the largest container ships and serving as the gateways to global trade for the entire island, are all located on the South East fringes of Great Britain, close to shipping routes. As a result, a large proportion of the country's imported goods arrive through Felixstowe or London Gateway but need to be moved to distribution centres in central England or terminals nationwide to reach their intended destination. The geography of intermodal supply chains therefore means that some trains from Felixstowe and all of those from London Gateway have to use routes via London, in the former case because the 'cross-country' route via Peterborough is currently at capacity and in the latter because no alternative route exists.

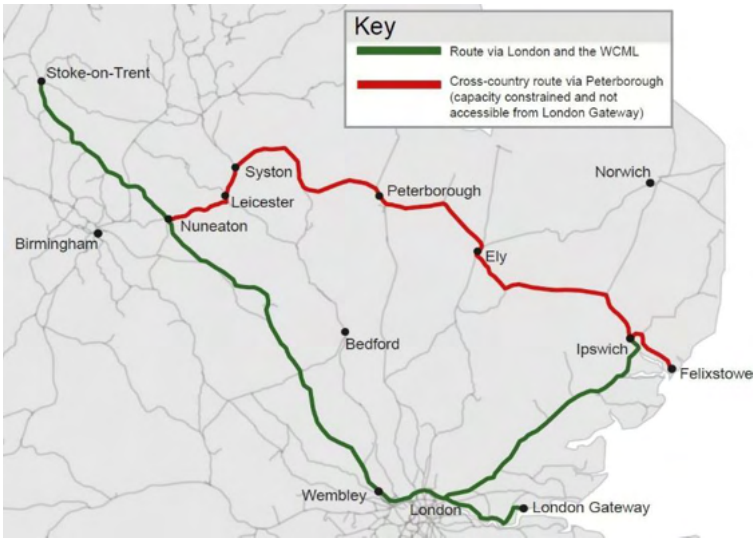


Figure 5: Routeing of intermodal flows from Felixstowe and London Gateway to the WCML. Source: Network Rail

1.2.3 THE FUTURE

Significant growth in market demand for rail freight movements in London is forecast (see Table 1). These forecasts are part of the GB-wide forecasts referred to in section 1.1.3 and were developed prior to the June 2019 net-zero legislation. The government's legal commitment to achieve a net-zero carbon emitting economy by 2050 means that the role of rail within Britain's overall freight sector may in fact have to expand beyond the levels accounted for by existing forecasts. The upper end of the range in current industry forecasts, Scenario B, is shown in the table below.

[14] 'Howbury Park' (Date of decision/Mayor's meeting: 17th July 2017); https://www.london.gov.uk/what-we-do/planning/planning-applications-and-decisions/planning-application-search/howbury-park

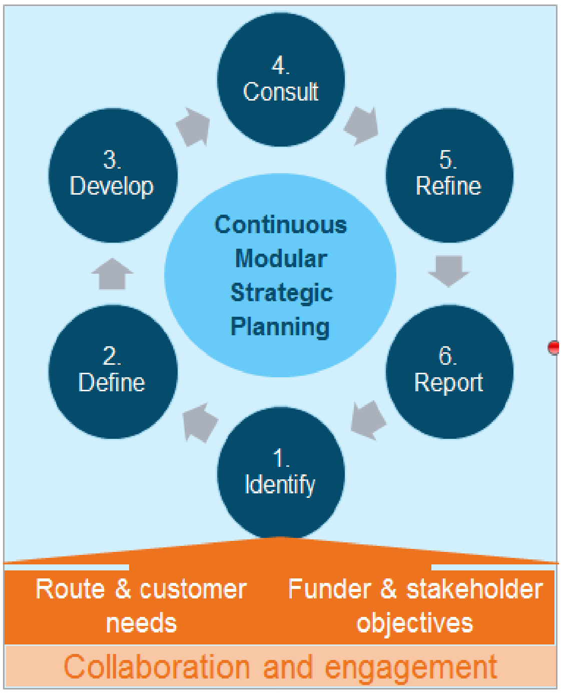
Table 1: Freight trains per weekday in each direction at selected locations, all commodities[15]

Line	Location	Base year 2016/17	Scenario E (Central Case) 2043/44	Scenario B (top of range)[16] 2043/44
North London Line	Canonbury	31	64	75+
Gospel Oak-Barking	Upper Holloway	4	8	8
West London Line	Kensington Olympia	14	34	43
South London Line	Nunhead	13	45	55
Great Western Main Line	Ealing Broadway	25	45	55
West Coast Main Line	Wembley Central	30	54	69
Midland Main Line	Hendon	6	8	19
East Coast Main Line	Alexandra Palace	10	19	28
Great Eastern Main Line	Manor Park	19	21	24
Tilbury Loop Line	Barking	15	53	68
Windsor Lines	Wandsworth Town	6	15	20
Brighton Main Line	Balham	6	10	12

Although not modelled to reflect the impact of decarbonisation, the high growth in unconstrained demand that Scenario B exhibits serves as a rough indication of the implications of the need to be net-zero by 2050. Solutions to the rail capacity challenge in London will need to address the needs of both passengers and freight in the long-term, so that rail freight's vital contribution to the economy can be maintained.

[15] Based on 'Routeing of rail freight forecasts', MDS Transmodal for Network Rail (August 2020), available at https://www.networkrail.co.uk/running-the-railway/long-term-planning/. These figures are estimates.
[16] Scenario B assumes factors which favour rail relative to road, with high market growth

1.2.4 CONTINUOUS MODULAR STRATEGIC PLANNING



Due to the widely recognised challenges outlined above, rail freight stakeholders identified a study on London rail freight as the first priority for the System Operator, Freight & National Passenger Operators (SO FNPO) strategic planning team to undertake, through Network Rail's Continuous Modular Strategic Planning (CMSP) process. CMSP was introduced at the start of Control Period 6 in 2019, as a new way for Network Rail to structure its delivery of the Long-Term Planning Process, which fulfills NR's obligation under its license to plan the long-term future of the rail network up to thirty years hence.

The CMSP process marks a move away from undertaking large Route Studies aligned to five-year Control Periods to an ongoing process of continuous planning that addresses more focused 'modules'. A key objective for CMSP studies is to help identify how rail can serve the transport and logistics needs of specific parts of the country and address strategic questions for those areas working in close engagement with stakeholders, including Train and Freight Operating Companies, funders, metropolitan transport authorities, sub-national transport bodies, industry associations and passenger/end user groups. Outputs of CMSP studies are then intended to be carried forward into collaborative development, funding and delivery of measures which help to address the identified issues and gaps.[17]

Following the instigation of the CMSP process for NR's strategic planning teams, SO FNPO have held regular CMSP workshops with a wide range of stakeholders and colleagues. These sessions have identified a long list of strategic questions as candidates to be answered through strategic studies. It was agreed through the FNPO CMSP workshops that a study on rail freight in the London area was the highest priority strategic question, as a result of which the London Rail Freight Strategy has been the first piece of CMSP undertaken by SO FNPO. The list of strategic questions remains a live document and will be continually refined and updated according to stakeholder input, to guide future CMSP prioritisation and output.

1.2.5 THE LONDON RAIL STRATEGY

Network Rail and Transport for London are working together to develop a single, co-produced rail strategy for London that all parties will commit to implementing. This major workstream was initiated following a recommendation from the London Assembly Transport Committee in its 2018 'Broken Rails' report, which noted the lack of a unified rail strategy covering the city as a whole.[18] It also forms part of the developing 'Whole Industry

[17] Further details on the Long-Term Planning Process can be found at https://www.networkrail.co.uk/running-the-railway/long-term-planning/
[18] 'Broken Rails: A rail service fit for passengers', London Assembly Transport Committee (November 2018)

Strategic Plan' for the rail network in Great Britain, which will be developed during 2020 and 2021. The London Rail Strategy will be jointly owned by NR and TfL and consulted with a broad range of stakeholders. A Pan-London Rail Strategy Group, supported by a strategic planning group, has been established to bring together key organisations with an interest in rail in the capital.

A high-level 'London Rail Strategy' has been drafted as the first output of this process, outlining the expected growth and challenges the rail network is likely to face over the next generation and the shared aspirations for improving the rail network to meet these challenges. The document identifies a series of thematic workstreams for further detailed study, with each to be led by either NR or TfL and developed in partnership with the passenger train operators, freight operators and the Department for Transport. The London Rail Freight Strategy is ideally placed to serve as the Rail Freight workstream and will therefore be the first part of the wider London Rail Strategy to be delivered.

The London Rail Freight Strategy thus has dual roles, as both a study within NR's Long-Term Planning Process and as a constituent part of NR and TfL's London Rail Strategy.

Source: Network Rail

PART 2: STUDY APPROACH

The London Rail Freight Strategy (LRFS) commenced in Autumn 2019 and has been led by the System Operator, Freight and National Passenger Operators (SO FNPO) strategic planning team. The System Operator sits within Network Rail as an impartial and expert function that leads on the long-term planning of the network on behalf of the industry. Unlike other strategic planning teams, which are aligned to a particular part of the rail network, SO FNPO have a national focus and are responsible for delivering strategic work on issues affecting the entire rail network (through Network Studies, such as the Traction Decarbonisation Network Strategy) and strategic studies that address the priorities of national operators, including freight.

2.1 GOVERNANCE

2.1.1 LRFS WORKING GROUP

The study began with the establishment of a working group to involve key industry stakeholders and strategic planning colleagues directly in the development of the strategy. The LRFS Working Group has met periodically throughout the course of the study, providing review of outputs, input into key decisions and ongoing governance throughout. The group is comprised of representatives of the following bodies:

- Network Rail (SO FNPO)
- Network Rail (strategic planning teams for all NR Routes covering part of the network in London)
- Transport for London
- Freight Operating Companies (FOCs)
    - DB Cargo
    - DC Rail
    - Freightliner
    - GB Railfreight
    - Rail Operations Group
    - Victa Rail Freight
- Rail Freight Group
- Chartered Institute of Logistics & Transport
- Department for Transport
- Rail Delivery Group

The LRFS working group has undertaken in-depth review of this report and endorsed it for publication and the progression of the options it identifies.

2.1.2 HIGH-LEVEL GOVERNANCE

The Strategic Freight Network Steering Group (SFN SG), the industry forum that provides oversight of the national portfolio of freight enhancement projects, acts as the Study Governance Group for FNPO CMSP. The SFN SG has undertaken a final review and confirmed its endorsement of the LRFS.

The LRFS has also been submitted to the London Rail Strategic Planning Group, which has provided confirmation of the study's role in acting as the freight workstream of the overall London Rail Strategy.

2.2 REMIT

The LRFS began by establishing a remit for the progression of the study. This document was developed with and endorsed by the LRFS Working Group and set out the intention to identify and propose options for funders when considering development of rail freight across London and the South East.

2.2.1 GEOGRAPHIC SCOPE

The geographic scope of the study is focused on the London orbital routes which represent the core network for freight movements within and across London (the Gospel Oak – Barking line, the North London Line, the West London Line and the South London line). Also included are connecting and diversionary sections of route that are also significant for London rail freight traffic (e.g. Stratford to South Tottenham, the Canonbury and Harringay curves, Clapham Jn to Willesden via the Kew Junctions).

This scope is framed by key nodal points around London, principally freight yards that can serve as regulating points where required and as such represent a reasonably clear point of delineation between the intra- and cross-London legs of freight flows and the key corridors on which freight runs into and out of London. Figure 6 below is a map highlighting this geographic scope.

Loaded construction materials train departing Acton yard towards the NLL. Source: Network Rail

Unloaded train arriving into Acton yard. Source: Network Rail

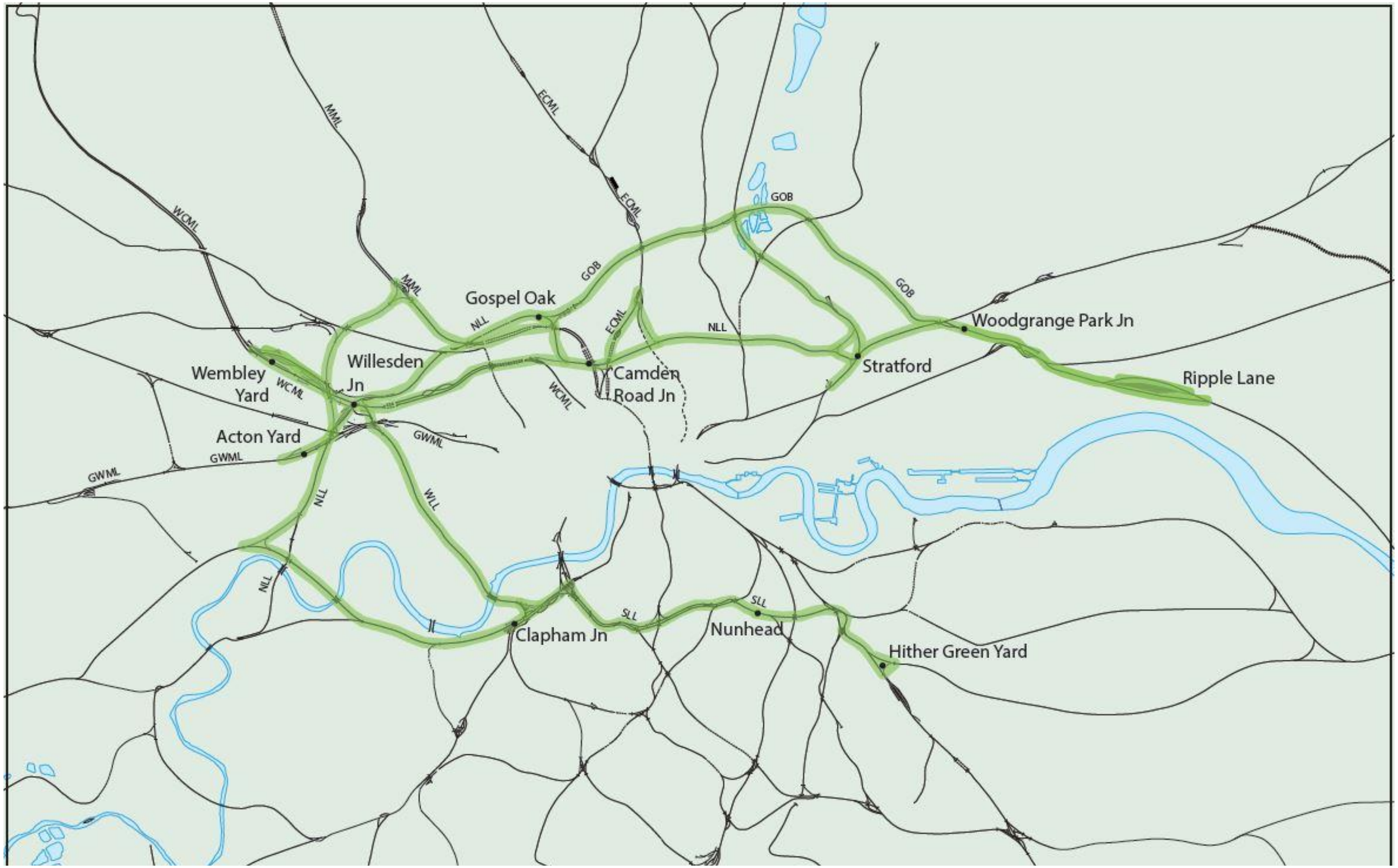


Figure 6: London Rail Freight Strategy primary geographic scope

2.2.2 STUDY PLANNING HORIZON

In line with all of NR's Long-Term Planning Process studied, the LRFS considers the development of rail freight around London over the next thirty years, to c. 2050. The reference years for the capacity analysis work undertaken to inform the study were 2033/34 and 2043/44, in reflection of those modelled in the latest rail freight market forecasts. At the timescales considered by long-term planning, the specific year stated is not of great significance, given the level of uncertainty inherent in looking so far into the future. The reference years are therefore taken to be broadly representative of the mid-2030s and mid-2040s respectively for the purposes of the LRFS.

2.2.3 STRATEGIC QUESTIONS

The LRFS remit sets out a series of strategic questions for the study to address, as per the CMSP process. These have guided the activity carried out by SO FNPO since the remit was established and they provide the framework for this report, which sets out the answers that have been determined. The LRFS has a single overarching headline strategic question, to which a series of sub-questions were identified in order to build up a comprehensive answer in the form of a strategy for rail freight in London over the next three decades.

Headline Strategic Question:

How do we accommodate future rail freight requirements in the London area in a context of increasing passenger and freight demand?

Strategic Sub-Questions:

- SSQ1: What is the baseline position of rail freight across London?
- SSQ2: What is the expected rail freight demand across London for 2033 and 2043?
- SSQ3: What are the GLA and TfL plans for the future of London rail services?
  - SSQ3a: What are the long-term service aspirations/plans of the franchised TOCs that interact with freight on the London orbital routes?
- SSQ4: Where is there insufficient capacity that restricts the expected demand / plans from being realised?
- SSQ5: Where insufficient capacity has been identified, what can be done to accommodate growth / plans?
  - SSQ5a: To what extent could changes to operating practices or to the Timetable Planning Rules (e.g. reduced headways / junction margins) increase network capacity and what would be required to enable these changes?
  - SSQ5b: Could increased capacity (or a more optimal allocation of capacity between passenger and freight services across the day) be achieved by restructuring the timetable(s) on the London orbital routes?

        - Can an hourly timetable pattern for both the peak and off-peak on the London orbital routes be identified that makes better use of capacity than at present?
    - SSQ5c: Would an increase to train length be an appropriate method of increasing capacity on any of the freight trains operating in the London area?
        - If so, for which commodities / flows would this be appropriate and feasible?
    - SSQ5d: At which locations are freight speed improvements most required?
        - Are there any areas which require work to be done to support Heavy Axle Loads?
        - Are there any areas which require work to be done to remove gauge-related restrictions?
    - SSQ5e: Would any of the routes used by freight in London benefit from infill electrification and / or power supply upgrades?
    - SSQ5f: Is the standard of gauge clearance sufficient for the current and future requirements of freight operators?
    - SSQ5g: What other infrastructure solutions would be required?
- SSQ6: Is there sufficient provision of freight yards and terminals serving London?
    - SSQ6a: Is a southern London orbital nodal yard required and if so where?
    - SSQ6b: Is there anything required to enhance the capacity/capability or improve the operations of any of the freight yards in the London area?
    - SSQ6c: Is there a need for additional freight terminals serving London in the future and if so, where might these be best located?
    - SSQ6d: What railway land suitable for potential future freight use is available in London and where? Is this adequately safeguarded for future freight needs?
- SSQ7: What diversionary routes are currently available for freight travelling across London and are they sufficient for current and future demand?
- SSQ8: Are there any known safety, performance, reliability or sustainability issues impacting rail freight operations in the London area and if so, what can be done to alleviate these?
- SSQ9: What is needed to ensure that rail freight remains able to support modal shift of freight in London from road to rail?
- SSQ10: What are the potential new markets for rail freight that may emerge over the long-term future and what is needed to support their development?

2.3 METHODOLOGY

The LRFS has progressed through a series of stages of work, each producing outputs that have informed the direction and conclusions of the study, culminating in this report.

2.3.1 BASELINE

Source: Network Rail

SO FNPO undertook an exercise to produce a comprehensive baseline of rail freight in the London area today. This served to provide the study team with a firm grounding in the subject matter of the LRFS and acted as a starting point for identifying the issues and challenges for freight that the strategy needs to address. A LRFS Baseline Report was compiled, consulted with the working group and finalised according to their feedback. It presents a baseline of current freight operations (and those of interacting passenger services) on the key routes within the scope of the LRFS study and the network capacity and capability context in which they operate. It also sets out the capacity constraints and any safety, performance or reliability issues that are currently known to affect those operations. Finally, it reviews the key relevant literature, in the form of previous Network Rail Long-Term Planning Process (LTPP) work (principally the Route Studies) and current CMSP studies, as well as documents produced by other industry stakeholders, to frame the LRFS in relation to other strategic planning and help the study to avoid duplication or contradictory conclusions. This exercise and the Baseline Report it produced provided answers to Strategic Sub Questions 1 & 8. Copies of the LRFS Baseline Report are available to interested rail industry colleagues upon request.

2.3.2 OPERATIONAL & END USER WORKSHOP

In February 2020, SO FNPO hosted a one-day workshop with colleagues in operational roles on the rail network in London and major freight end-users. The purpose of the session was to gather input from those with experience of running the railway on a day-to-day basis and the customers who rely on rail freight, to ensure the study considers their perspectives and benefits from their expertise. This aided with the identification of issues for the LRFS to seek to address and supported the development of a strategy that is consistent with the needs of the operational railway and the aspirations of freight end users. Participants included signalling, control and asset management colleagues from NR's Eastern and Southern Regions (which include the London orbital routes), representatives of several major construction materials suppliers (Aggregate Industries, Cemex, Day Group and Tarmac), Heathrow Airport, Maritime Transport (a major intermodal logistics company) and the ports of Tilbury, London Gateway and Felixstowe, along with members of the LRFS Working Group.

2.3.3 ITSS DEVELOPMENT

An Indicative Train Service Specification (ITSS) for the London orbital routes was developed, in order to facilitate capacity analysis work on the NLL, GOB, WLL and SLL. Freight assumptions were based initially on the latest established industry market forecasts, which were interpreted to derive route-specific values for 2033 and 2043 with support from System Operator's Analysis & Economics team. FOC representatives from the LRFS working group then provided detailed advice on their long-term aspirations for the orbital routes, as well as assisting with routeing and timing load assumptions. TfL also participated extensively in the ITSS development process, specifying the levels of London Overground service that should be assumed for the analysis, based on their own previous forecasting work and long-term aspirations for frequency uplifts. Assumptions for National Rail services on the WLL and SLL were developed with support from the Kent & Sussex strategic planning team and also consulted with TfL. The hourly quantum of trains in the ITSS is therefore based on a combination of forecast and aspiration for both freight and passenger trains.

Source: Network Rail

Particular focus was given to ensuring there were no contradictory assumptions between the ITSS developed for this study and that used for capacity analysis to inform the Essex Thameside Study.[19] There are clear areas of strong common interest between that study and the LRFS, due to their contiguous geographic scope, with all freight flows to and from the Essex Thameside ports and terminals running via the London orbital routes (apart from a minority that use High Speed 1). Maintaining alignment has therefore been a priority throughout the undertaking of both workstreams. The Essex Thameside study concluded that although the current infrastructure within its own geography should be able to accommodate freight demand over the next thirty years, this capacity potential cannot be fully exploited without other freight interventions across the London orbital routes. The LRFS sets out proposals for these interventions, which if delivered will help facilitate growth on Essex Thameside as well as within London.

Source: Network Rail

2.3.4 CAPACITY ANALYSIS

Capacity analysis work for the LRFS was undertaken by consultants WSP, working in close collaboration with SO FNPO throughout. Taking the ITSS provided as its key input, along with infrastructure assumptions agreed with NR and TfL, WSP undertook timetable and engineering feasibility work. This analysis focused principally on the 2043 off-peak

[19] *Essex Thameside Study*, Network Rail (July 2020); available at https://www.networkrail.co.uk/running-the-railway/long-term-planning/

specification, as the scenario with the highest quantum of train paths to try and accommodate. It identified a timetable structure to best use available capacity and a set of recommended infrastructure interventions to support that structure. The lead analyst provided updates to the LRFS working group throughout and their feedback was incorporated into WSP's final report. Infrastructure interventions were refined, in collaboration with SO FNPO, from a long list of over fifty suggested options. Twelve of these were selected for feasibility assessment by WSP's engineers, on the basis of which seven were taken forward for incorporation into the timetable analysis, to investigate their benefits to capacity. This confirmed the final set of five core interventions presented later in this report.

2.3.5 CONCEPTUAL DESIGN

In order to better understand the feasibility of the enhancement proposals identified through this study, Network Rail's Scheme Design Team (SDT) were engaged to deliver conceptual design work, the outputs of which are incorporated into this report to illustrate and explain the options for funders that it presents. This focused initially on the core interventions identified through the capacity analysis phase, before also considering additional proposals arising from the input of the LRFS working group, strategic planning colleagues and consultation with FOC train drivers.

Source: Network Rail

This phase of work was led by an experienced railway engineer with multi-disciplinary expertise. It provided an indication, at a high level, of what is expected to be required to deliver each scheme within the LRFS and advice on likely issues and challenges. This included production of the design sketches shown in this report, which enabled estimates of order of magnitude costs to be subsequently determined by NR Capital Delivery.

SDT did not undertake conceptual design for Clapham Junction Platform 0, because this scheme was developed to a far greater level of detail relatively recently before being paused. That previous work, with a review and commentary provided by SDT, is used to inform this report's proposal that the option be revived and progressed through to delivery. Cost estimates for the intervention have also been updated to 2020 prices to inform the order of magnitude indication presented here.

Likewise, no conceptual design activity was carried out in relation to the proposal for 3-minute planning headways on the NLL, GOB and WLL, as this is expected to be realised through the eventual deployment of digital signalling. This is part of another very large and complex programme in itself. Whilst this report highlights the requirement for this level of capacity to be achieved long-term as a vital element in accommodating future freight growth on the orbital routes, this is not an option for funders being put forward by the LRFS, but rather something it has identified as a critical dependency.

2.3.6 STRATEGY

Source: Network Rail

The ultimate output of each of the phases of work described above is a comprehensive strategy for the long-term development of London rail freight, as set out in this report. This strategy is comprised of a range of enhancement options for funders, identified elements of existing projects or programmes whose progression is supported in the interests of freight and recommendations for further study in areas where this is required. The enhancement options proposed are deliberately varied in terms of the size, nature and expected delivery timescales of the resultant schemes. This reflects a conscious intent to provide funders with options that address a breadth of rail freight priorities and range from targeted interventions to secure incremental freight benefits by improving network capability at key locations, which could be delivered relatively quickly, through to major capacity enhancements needed to secure long-term growth.

This strategy also recognises that providing the capacity needed for long-term freight growth around London will require accommodation with the need for increased passenger services on the routes where that capacity must be shared, particularly with the London Overground. Although at the time of writing there remains substantial uncertainty as to the rate of recovery in passenger demand following the Covid-19 crisis, the likelihood is that growth has been checked rather than reversed and will eventually return. When considering a 20-30-year planning horizon, the need for the railway around London to provide increased passenger capacity compared with today is not expected to have changed. The LRFS is therefore intended to be not just a freight strategy, but a holistic plan to address the long-term capacity challenge on the London orbital routes, with an emphasis on the need for collective solutions to the collective constraints faced by both freight and passenger operations. Many of the options identified in this report are proposed on the basis of their shared benefits to freight and passenger services around London, where their purpose is to improve the overall functioning of the orbital routes for all those who use them.

Source: Network Rail

THE RNEP

SO FNPO will put forward these options to be developed initially as a portfolio, with a single overarching business case in support of them all. A request for a Decision to Initiate, which would allow this portfolio to enter the Rail Network Enhancements Pipeline (RNEP), will be submitted to the Department for Transport. Network Rail's Regions will then lead the production of a Strategic Outline Business Case (SOBC) for the full portfolio of options, which in turn will be used to seek a Decision to Develop. Establishing a portfolio-level business case will demonstrate the interdependency of the range of options presented in this report and enable funder endorsement for the overall strategic rationale underpinning them. The purpose of this will be to prevent duplication of work in the early stages and misalignments that would be risks should the various elements of this strategy be developed from the outset independently of one another. This approach follows that recently successfully progressed for the Felixstowe to the Midlands & North (F2M&N) programme and reflects the fact that freight enhancements are by nature rarely discrete standalone schemes. Realising the benefits of freight investment typically requires a corridor approach, with a series of complimentary interventions to resolve capacity and capability constraints throughout. This applies equally to the London orbital routes.

Beyond the Decision to Develop point, options within the portfolio would be then expected to be progressed in packages or as individual projects, as appropriate to the size and required delivery timescales of each of them. They would continue to be supported through each subsequent decision point of the RNEP (or possibly through other funding mechanisms, if appropriate) by the overall business case established through the SOBC, so sight of their strategic context and collective benefits is maintained.[20]

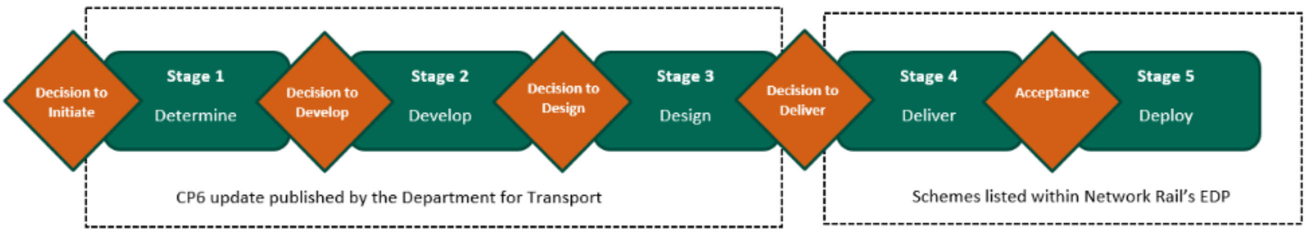


Figure 7: Rail Network Enhancements Pipeline process map

[20] For more information on the RNEP, see https://www.gov.uk/government/publications/rail-network-enhancements-pipeline

PART 3: ANSWERING THE STRATEGIC QUESTIONS

This section describes how the successive phases of work undertaken by this study have identified answers to the strategic questions in the LRFS remit. Descriptions of this process and the answers arrived at are linked directly to the questions they address, which are shown at the start of each sub-section. These answers collectively form the strategy for the long-term development of London rail freight that has been the purpose of this study.

3.1 DEFINING THE ITSS

Strategic sub-questions:

- SSQ2: What is the expected rail freight demand across London for 2033 and 2043?
- SSQ3: What are the GLA and TfL plans for the future of London rail services?
    - SSQ3a: What are the long-term service aspirations/plans of the franchised TOCs that interact with freight on the London orbital routes?

Source: Network Rail

An Indicative Train Service Specification serves as a representation of future railway service provision, enabling analysis to be carried out to understand what needs to be done to make that level of service possible. It does not need to reflect existing or future constraints to network capacity by limiting itself to what can be delivered using current infrastructure. On the contrary, an ITSS will often be based on an unconstrained growth scenario, because it is intended to represent what should be achievable if infrastructure constraints are resolved through the delivery of strategies like this one. The purpose of the ITSS constructed for the LRFS is to embody the rail industry's view of the level of service that would be required to accommodate forecast demand growth and fulfil stakeholders' aspirations on the London orbital lines, in the 2030s and 2040s.

The LRFS ITSS comprises two long-term growth scenarios, with nominal reference years of 2033 and 2043. A standard peak and off-peak hourly train service are presented for each of these reference years, detailing the quantum and type of timetable paths that would run on the NLL, GOB, WLL and SLL respectively. Assumptions as to the routeing of services and the rolling stock types, weights and lengths of trains in operation are also provided. These are critical details, as they determine the 'timing loads' used for each train's path in the hypothetical timetable being analysed. Timing loads in turn ensure that trains are planned to the correct amount of time between points on their journey.

Rolling stock assumptions are generally based on a simplified reflection of the traction types most typically operating on the orbital routes today. So, for instance, the majority of

London Overground services are assumed to be 5-car class 378 Electric Multiple Units (EMUs). Freight paths are all to be timed as though they will be hauled by class 66 locomotives, the most common type found on the British rail network at present. It is very unlikely that in 20-30 years' time these same forms of traction will still predominate around London, but given the obvious uncertainty as to what will replace them decades from now the best available approach is to apply working assumptions based on current operations. This is a 'right-side fail', in that it is reasonable to assume future traction types will be better-performing than today's. Therefore, anything deemed feasible by analysis based on the known capability of current trains ought to also be feasible with unknown improved models in the 2030s and 2040s.

3.1.1 PASSENGER ASSUMPTIONS

Passenger train lengths were also assumed to be unchanged to those of the formations operated today. There are significant challenges to achieving the extent of platform lengthening across the orbital routes that would be required to increase the number of carriages on London Overground, GTR and Southeastern services.[21] This in part drives TfL's desire for increased numbers of trains per hour in the long term, as the more realistic (albeit still challenging) means of delivering greater carrying capacity for passengers. The ITSS therefore reflects aspirations for service frequency uplifts, especially for the Overground, which is the most limited in terms of attainable train lengths on the lines it serves. Both peak and off-peak passenger trains per hour were assumed to rise markedly on the NLL and WLL compared with the current service, in recognition of the strong growth forecasted by TfL on these routes to 2050.

Transport for London's broader ambition for the 'metroisation' of passenger rail services in south London is recognised by this study and consideration was given to whether service levels on the SLL should be specified to align with the long-term implementation of this plan.[22] However, it was agreed not to fully implement uplifts to the extent that would be seen under a metroisation scenario, due to the current level of maturity of the proposals and subsequent uncertainty over the likelihood of realisation and timescales. The impact of the Covid-19 crisis, since the LRFS ITSS was agreed, has unfortunately reinforced the case for the more conservative assumptions that were applied regarding potential metroisation in south London. Nevertheless, a 6 train per hour off-peak and 8tph peak London Overground SLL/East London Line (ELL) service was incorporated into the ITSS, as this is a key aspiration for improving passenger service provision on the route. Increases to GTR and Southeastern peak frequencies on the SLL and WLL were also assumed, although to an extent short of full metroisation. More critically for the capacity analysis (which focused on the off-peak), it was also agreed to include an expansion of the Southeastern Victoria-Dartford service from 2 to 4 trains per off-peak hour within the SLL specification.

Source: Network Rail

[21] 'LOCAP GRIP 2 Level Feasibility Report: London Overground North and West London Line Capacity Upgrade Project', Jacobs/ch2m for Transport for London (March 2019)
[22] 'Strategic Case for Metroisation in south and south east London', Transport for London (March 2019)

Table 2: Train paths per hour in each direction on the London orbital routes – current and ITSS

			Off-peak			Peak		
Route	**Service**	**Rolling stock**	**2020**	**2033**	**2043**	**2020**	**2033**	**2043**
NLL	Clapham Junction – Stratford	Class 378 EMU	4	6	6	5	6	8
	Richmond – Stratford	Class 378 EMU	4	4	6	5	6	6
	Camden Road – Stratford	Class 378 EMU	0	0	0	0	2	2
	Freight (GEML – Gospel Oak)	Class 66 locomotive	2*	4	4	0*	0	0
	Freight (Gospel Oak – Acton Wells)	Class 66 locomotive	2*	4	6	0*	0	0
GOB	Gospel Oak – Barking	Class 710 EMU	4	4	4	4	5	6
	Freight	Class 66 locomotive	1*	4	6	0*	0	0
WLL	Clapham Junction – Stratford	Class 378 EMU	4	6	6	5	6	8
	East Croydon – Watford Junction/Milton Keynes Central	Class 377 EMU	1	2	2	2	4	4
	Freight	Class 66 locomotive	2*	6	7	0*	0	0
SLL	Clapham Junction – Dalston Junction	Class 378 EMU	4	4	6	4	6	8
	London Victoria – Kent (long distance via Bromley)	Class 375 EMU	1	1	1	2	2	2
	London Victoria – Dartford/Gravesend	Class 465 EMU	2	4	4	2	4	4
	Thameslink Core – Orpington	Class 700 EMU	2	2	2	2	2	2
	Thameslink Core – Bellingham	Class 700 EMU	0	0	0	0	2	2

	London Blackfriars – Sevenoaks	Class 700 EMU	2	2	2	2	2	2
	Freight	Class 66 locomotive	3*	6	7	0*	0	0

*All figures for current freight paths per hour are on average based on assessment of weekday operations during the Dec '19 timetable. Actual freight trains run typically vary hour to hour.

Most freight operates in a Y Path (see p.27)

3.1.2 FREIGHT ASSUMPTIONS

Assumptions for freight train lengths and weights were guided primarily by the long-term industry aspirations for core rail freight markets that are set out in the 2017 Freight Network Study.[23] Accordingly, class 4 paths were planned in line with the intention that all intermodal traffic operates to a standard of 1800t trailing weight and 775m length. Class 6 paths were assumed to run at 2600t and 450m, reflecting the industry's long-term goal for construction materials trains. The exceptions to this are two of the hourly class 6 paths (in each direction) to and from the Channel Tunnel and north Kent, which were assumed to haul 1800t because lighter commodities, such as automotive components or aluminium, are a feature on this corridor in addition to the heavier bulk commodities. This amendment was suggested by the LRFS working group on the basis that no major change in this traffic mix is currently envisaged.

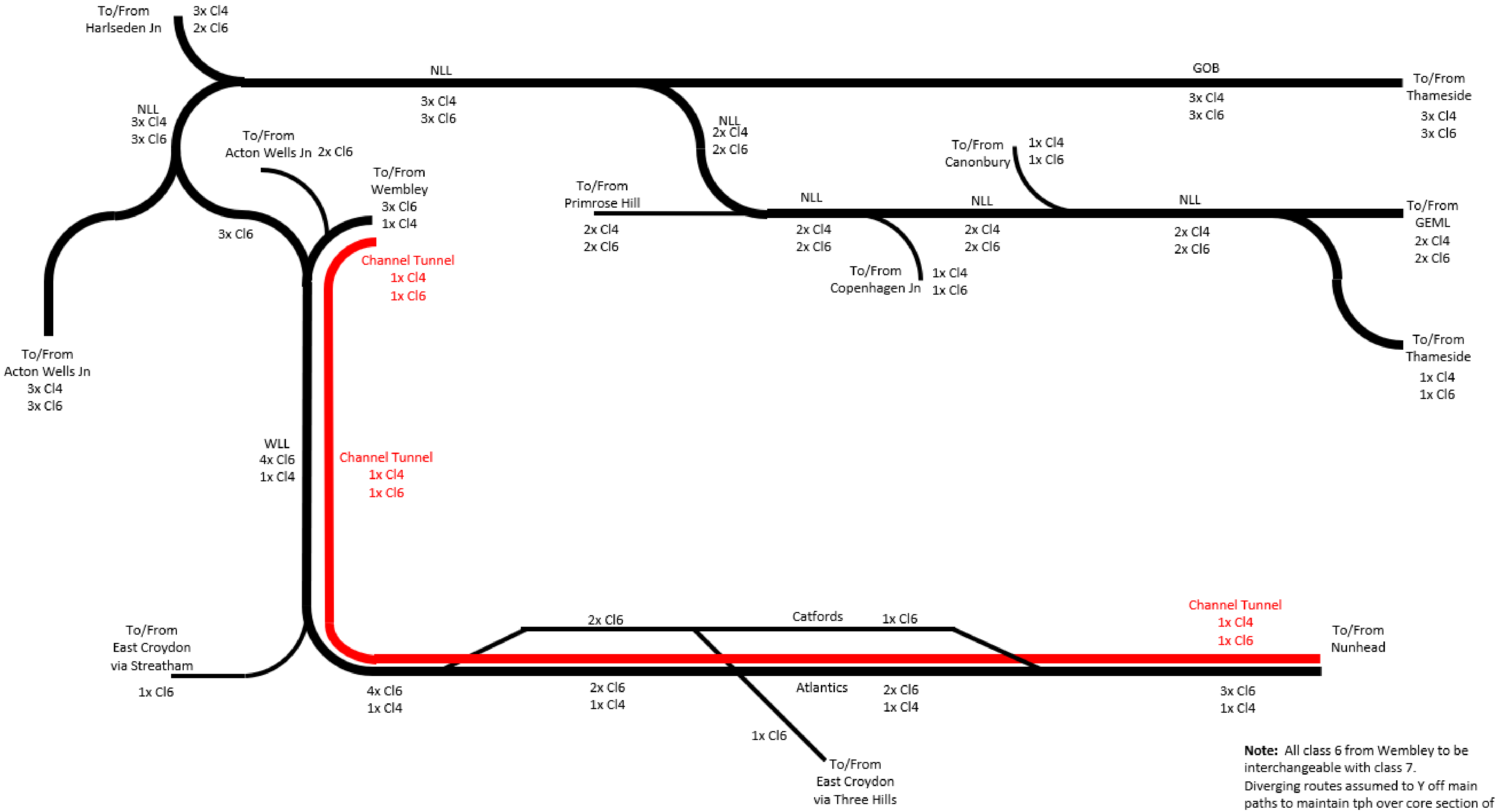
The freight traffic levels represented by the ITSS off-peak scenarios reflect the industry's firm expectation that substantial growth is attainable and necessary over the next thirty years. This translates into a marked rise in hourly paths on each of the orbital routes by 2043, compared with today's average frequencies. However, it should be noted that the standard hour format of an ITSS is by definition a simplification to aid analysis and real-world freight railway timetables are far more complex and variable hour to hour. Routeing of services is much less straightforward than for passenger service groups, meaning that the quantum of freight paths that the ITSS suggests could run on a given route section in a given hour will never do so in every hour.

Source: Network Rail

The freight ITSS is based around the Y concept, whereby groups of paths are part-combined, sharing timings for part of the routes for which capacity analysis is to be carried out, to provide flexibility in routeing options. This means that there is a common path through the network, but trains may join the study area at different times in each hour. So, a train passing West Hampstead during one hour may be from Acton, the following hour it may be from Harlesden. The diagram on the previous page shows the overall quantum of trains on a particular section, with converging paths merging with a 'trunk' path on joining a London orbital route. So, for example, at Camden Road, despite six trains appearing to feed into that area from the east, only a maximum of four would ever run in one hour in each direction. The freight specification in the ITSS, although certainly ambitious, is therefore not as substantial in scale as it might appear at first glance. Rather than an absolute number of paths that would need to each run in every hour, it is better to think in terms of a number of opportunities that need to be present within a standard hourly structure to provide freight operators with the capacity and flexibility required to deliver a service that realises the potential for long-term growth around London.

[23] *Freight Network Study*, Network Rail (2017)

Figure 8: 2043 London Freight ITSS Diagram



Note: All class 6 from Wembley to be interchangeable with class 7.
Diverging routes assumed to Y off main paths to maintain tph over core section of route.

3.2 THE CAPACITY CHALLENGE

Strategic sub-question:

- SSQ4: Where is there insufficient capacity that restricts the expected demand / plans from being realised?

In order to develop a strategy to address constraints and accommodate growth, it was essential first for the LRFS to determine a comprehensive picture of the obstacles to this. This was achieved firstly through engagement with stakeholders, through the working group and the operational and end user workshop (see 'Study approach'). Both of these forums highlighted the range of issues experienced today and anticipated in the future on the London orbital and connecting routes. The early stages of capacity analysis then quickly identified where capacity is clearly insufficient for growth, as represented by the ITSS, to be possible.

The following sub-section outlines the capacity gaps that restrict the extent of both freight and passenger services that can be operated on the orbital routes, both currently and in future. These are driven by a range of features of the railway infrastructure itself and the make-up of the traffic mix using it. In addition to issues around pure network capacity (i.e. the number and frequency of trains a route can accommodate), examples of insufficient network capability (the attributes of the infrastructure that determine the type of trains that can operate) are also presented.

The range of capacity and capability constraints to the development of rail freight around London is wide and varied in nature. It includes both challenges that are general across a route or routes and others that are location specific. This is why the LRFS seeks to offer a broad and far-reaching strategy to address constraints and unlock long-term growth.

3.2.1 NETWORK CAPACITY

LINE OF ROUTE CAPACITY

In the simplest terms, the capacity of a railway line is how many trains per hour can run, or to put it another way, how frequently they can run.

This is a function of the minimum 'headway' at which trains may operate – how closely consecutive trains can safely follow one another in the same direction on the same line. This in turn is determined principally by the capability of the signalling in place on a given route.

Source: Network Rail

Hampstead Heath Tunnel

Capacity analysis work carried out for the LRFS highlighted Hampstead Heath Tunnel as the most significant long-term capacity constraint on the North London Line. Previous studies have noted that the tunnel does not comply with modern safety standards, as a consequence of which signalling controls are in place to mitigate the possibility of a train stopping inside the tunnel. This is primarily due to the risks presented by emissions from diesel locomotives and the danger to passengers should a fire occur in the tunnel. The more constrained signalling through Hampstead Heath Tunnel means that consecutive trains on this part of the NLL must be planned to a higher minimum headway than elsewhere.

Planning headways, expressed as a number of minutes, are a key element of railway timetabling. They also set a clear finite upper limit on the number of trains per hour that may operate for the route or route section where they apply.

Capacity analysis for the LRFS was therefore able to quickly identify among its early conclusions where overall route capacity is a constraint to long-term growth on the London orbital lines. At current minimum planning headways, it would not be possible to accommodate the quantum of hourly train paths included in the 2043 off-peak ITSS, on the NLL, GOB or WLL, even before considering the more complex constraints on these routes. A key preliminary conclusion drawn from the analysis was therefore that signalling improvements would be required on the NLL, WLL and GOB to deliver the improved headways needed for this ITSS (see 3.3.2).[24]

Source: Network Rail

This finding corroborated stakeholder input, which flagged headways on the NLL and GOB in particular as a capacity challenge, both in terms of these routes featuring sections where minimum permitted values are especially restrictive and also the fact that headways are inconsistent, rising and falling between different route sections. This inhibits the smooth flow of traffic around the north London orbital routes and prevents the most efficient possible use of end-to-end capacity being made.

TRAFFIC MIX

Headways can also vary according to the types of train following each other, with different values established in the Timetable Planning Rules (TPRs) for when following a freight or passenger train, or stopping versus non-stopping trains. This reflects the mixed nature of the traffic on the orbital routes, a feature which in itself creates capacity challenges. Simpler railways with uniform usage are able to much more easily standardise their throughput of trains

[24] 'London Rail Freight Strategy: Capacity Analysis', WSP for Network Rail (April 2020)

into a consistent recurring pattern, utilising capacity to the fullest efficiency. On routes used by trains of varying lengths, calling patterns, routeings and traction capabilities, this is not possible. Because the London orbital routes are busy, mixed-traffic railways, the interaction of freight and passenger services needs to be optimised and balanced as much as possible, to accommodate the different requirements and characteristics of the trains that use them.

REGULATING POINTS

‘FREIGHT’ LOOPS

‘Loops’, additional tracks at the side of the main running lines where trains can be held out of the way of others, are a common infrastructure feature of mixed-use railways, employed to assist in regulating the flow of different traffic types. Because the principle by which they operate is to regulate slower traffic so that faster trains are not held up unduly behind it, these facilities are often referred to as ‘freight loops’. This is indeed an accurate reflection of their purpose and usage on many parts of the network, especially national main lines where long-distance passenger trains often need to overtake relatively much slower freight trains.

The addition of loops to the London orbital lines has been proposed by past strategies as a means of addressing constrained capacity and aiding the flow of traffic. However, on these routes freight is not the slowest component of the traffic mix, since passenger trains operate intensive, metro-style services, with frequent stops at comparatively short intervals. Freight trains are often required to run at a slow and steady pace to avoid catching up with a passenger train in front and being stopped at a red signal. The principal of looping the slowest trains at intermediate points along routes therefore is not appropriate for the orbital lines. Freight stakeholders have expressed a preference for solutions that enable more fast end-to-end paths across London, which will get their trains through the most congested areas as quickly as possible without being held up in a loop, only to re-join routes where they will not get a clear run amongst the frequent passenger traffic.

ROUTE INTERFACES

Whilst regulating points along the length of orbital routes are of limited value to freight, what is extremely useful is being able to hold a train at the interface between routes. Because timetable structures on different lines will not automatically align to one another, especially if there is no through passenger service between them, the existence of a freight-only connecting section of track where a train can make a planned stop to await a path on the route it needs to join is a significant advantage. This is evidenced clearly by the orbital routes and the various locations where they connect to the radial routes in and out of London. Key examples of the principle in action are found in the Wembley/Willesden area, where the freight-only City lines and Goods lines offer a

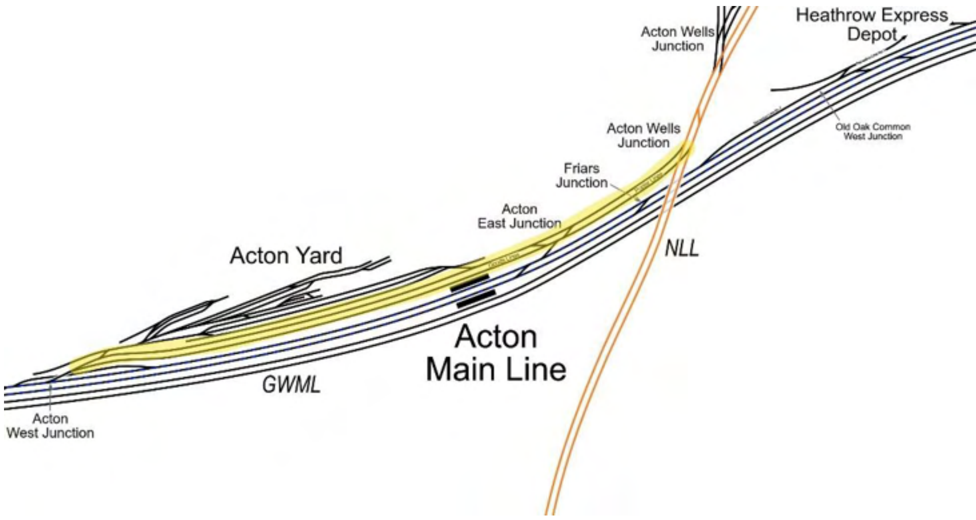


Figure 9: Map showing interface between the NLL and GWML in the Acton area, with freight-only lines highlighted. Source: Franklin Jarrier – cartometro.com

useful holding point for freight trains travelling between the NLL at Harlesden Jn and the West Coast Main Line (WCML), as well as access to the adjacent ‘nodal yard’ at Wembley. A similar role is played by Acton Yard and the surrounding freight-only lines (see fig. 9), which again provide a firebreak between the timetable structures of the Great Western Main Line (GWML) and the NLL at Acton Wells Jn.

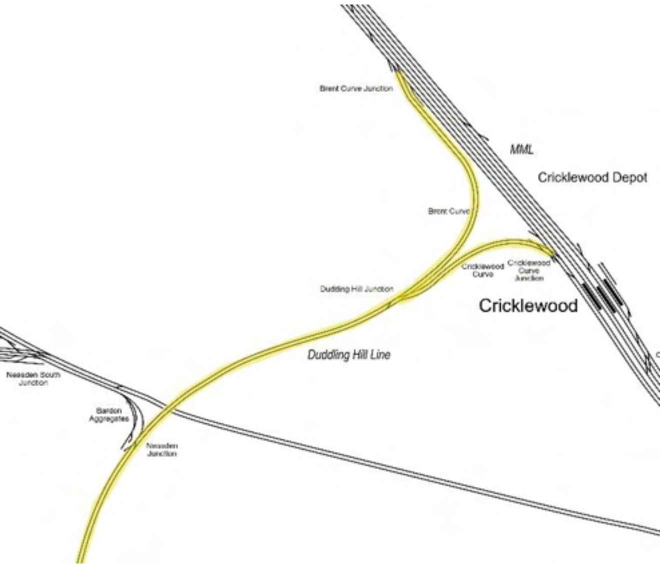


Figure 10: Map showing the interface of the freight-only Dudding Hill lines (highlighted) and the MML. Source: Franklin Jarrier – cartometro.com

Other key examples are found where the freight-only Dudding Hill lines meet the Midland Main Line (MML) (see fig.10) and on connecting lines between the NLL and East Coast Main Line (ECML).

Conversely, a number of interfacing points between London’s orbital and radial routes have a notable lack of holding points for freight. The reduced ability to align paths and ‘mesh’ timetable structures for trains passing through these locations is a key capacity constraint for freight operators. The LRFS capacity analysis highlighted the Stratford area, where the NLL feeds into the Great Eastern Main Line (GEML), as a particular challenge in this regard.[25] Although there are points for freight trains to be regulated, these are less segregated from the adjacent heavily used passenger lines than in the Acton or Wembley area and are not capable of accommodating the longest freight trains in both directions, which diminishes their utility (see fig. 11).

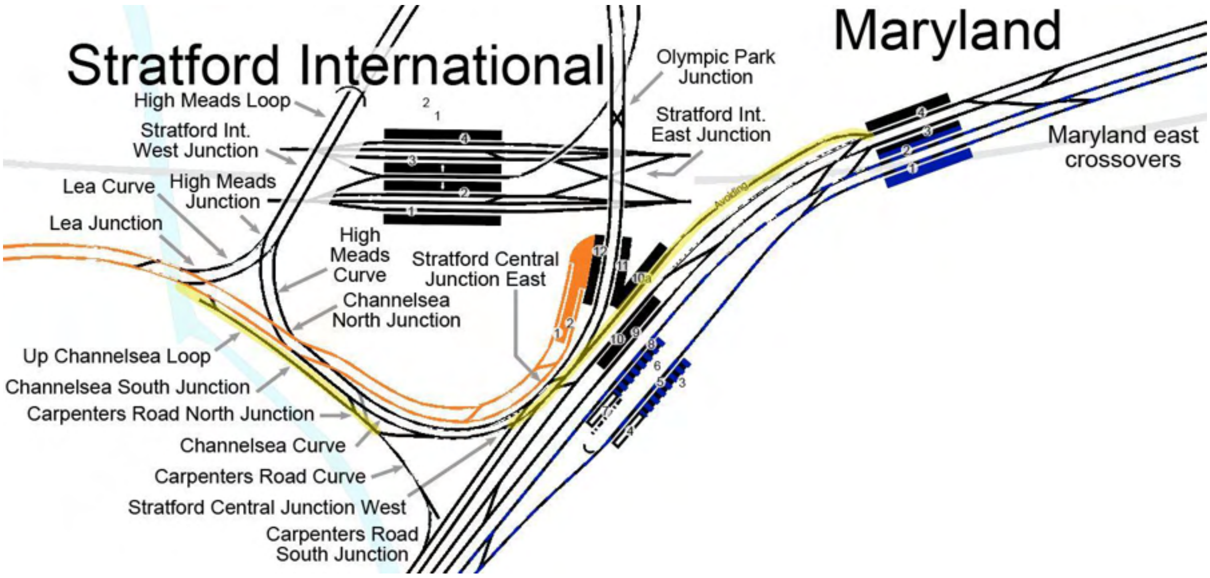


Figure 11: Map showing the interface between the NLL and the GEML at Stratford, with regulating points highlighted. The Avoiding line/platform 10a (see photo next page) is typically used by eastbound freight trains (as well as some passenger trains) and the Up Channelsea Loop by westbound freight trains Source: Franklin Jarrier – cartometro.com

The SLL also lacks for dependable freight regulating points, in part due to the different layout of the network south of the Thames. Instead of national main lines running perpendicular to the orbital route and connected by lines that can serve as a refuge for

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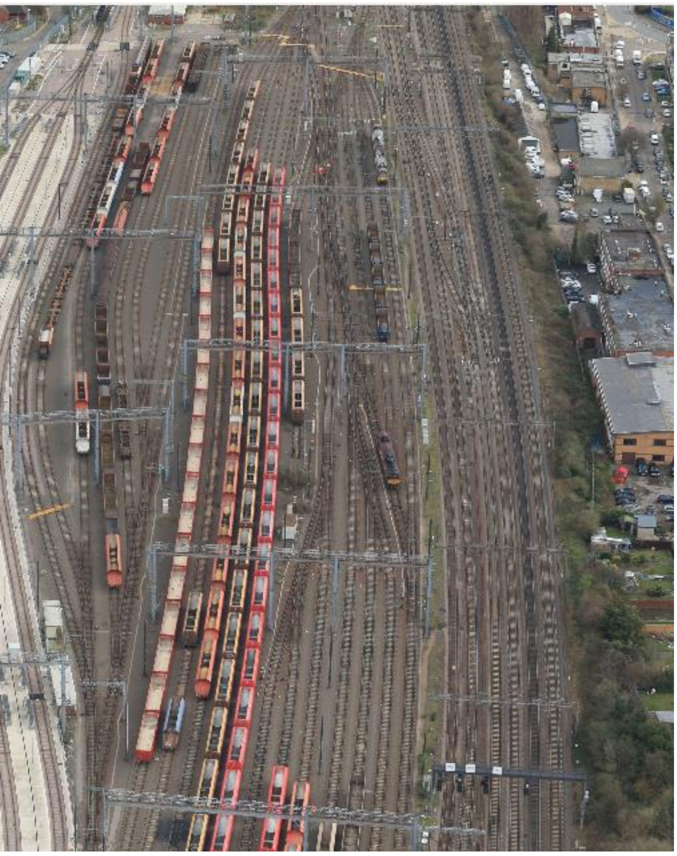
25 ‘London Rail Freight Strategy: Capacity Analysis’, WSP for Network Rail (April 2020)

freight, as characterises the locations on the NLL where this works best currently, the SLL continues beyond Nunhead directly into routes in and out of London. This means compliant freight paths have to be found right through, without being able to hold and await an opportunity to slot into the timetable structure of the next route. In the Lewisham direction in particular, achieving this is difficult, as freight trains have to thread through the flat crossing at the station between multiple converging passenger service groups. This applies to a degree for Stratford also, being at the end of the NLL, although there are at least limited holding points there. At the western end of the SLL, there are lines in the Battersea area used by freight only or shared with a relatively light passenger service, meaning freight trains transiting between the WLL and SLL, or to and from the Brighton Main Line (BML) via Clapham Junction platforms 16 and 17, can be held to await a path. In the latter case, however, the planned introduction of additional London Overground WLL shuttle services between Clapham Junction and Shepherd's Bush, which will turn around in platform 17, will reduce the ability to do so.

Platform 10a at Stratford station. Source: Network Rail

NODAL YARDS

As alluded to above, Wembley and Acton Yards are both located at particularly strategically useful locations on the network. They are close to the conjunction of a national main line (the WCML and GWML respectively) and the orbital NLL and can be accessed from freight-dedicated lines. These facilities serve as vital freight staging and regulation points in themselves, allowing multiple trains to await onward paths when transferring from one busy route to another. They can also provide an opportunity for trains to combine and split in order to serve locations which do not demand a full train, whilst taking advantage of the efficiencies of a long train on the core leg of the journey, a practice commonly employed at Acton. These capacity-benefitting attributes are what give freight yards like Wembley or Acton their 'nodal' distinction. The lack of equivalent facilities around the rest of the London network, especially in south London, is itself a form of capacity gap.



Aerial view of Wembley yard. Source: NR Routeview

FLAT JUNCTIONS

Source: McKenna (Thryduulf)

A key reason why the orbital routes are so important for freight is the extensive connectivity to the radial routes that they offer. The NLL alone features connections to the Kew triangle (for routes toward the South-West or to Clapham Junction), the GWML, the MML (via the Dudding Hill lines), the WCML (via multiple connections), the WLL, the GOB, the ECML (from separate east and west-facing connections), High Speed 1 (although this connection is not currently utilised) and finally, at Stratford, the West Anglia Main Line (WAML) and GEML. Every one of these links is made via means of a flat junction, though, which makes the pathing of many of the crossing moves necessary for trains to converge or diverge from the route a significant capacity challenge. This issue affects each of the orbital lines, where passenger services predominantly run the length of the route but freight trains often need to join and depart at intermediate points, introducing conflicting moves that must be separated in the timetable and thus consuming capacity.

On some parts of the rail network, grade separated junctions, where lines cross one another by means of flyovers and/or dive-unders, have been constructed to address this problem and enhance capacity. However, these are major pieces of engineering that are challenging to implement even in less constrained parts of the country and require the footprint of the railway to expand to accommodate the necessary structures. Implementing new grade separated junctions is therefore a very difficult proposition when considering railway lines that run through densely built-up urban environments, such as those within London.

An aerial view of North Pole Junction. The northern limit of third rail electrification is at the top of this image, where the main lines pass over Scrubs Lane. Source: NR RouteView

The southern limit of OLE electrification, just before the Westway passes over the WLL. Source: NR RouteView

WEST LONDON LINE AC/DC CHANGEOVER

A further, specific case of a capacity constraint on the orbital routes is found on the WLL, at the point where the electric traction power supply changes over from the Southern Region third rail 750-volt Direct Current (DC) system to 25-thousand-volt Alternating Current (AC) Overhead Line Equipment (OLE). London Overground trains and any electric freight operating on the WLL perform the switch between the two systems whilst moving, but must slow down when passing through the changeover, incurring a time penalty. GTR trains stop entirely in order to raise or retract their pantograph. This practice, by slowing or stopping traffic mid-route, restricts capacity on the WLL and is a widely recognised constraint.

SUMMARY

As noted in the 'Context of study' section at the start of this report, market trends in recent years have meant that freight and passenger trains have increasingly come to depend on use of the same routes, at the same time as increasing demand has driven pressure on operators of both to seek to achieve greater capacity for their services. In the long-term, this can be expected to remain a challenge on routes around London especially, despite the check to growth in the short to medium-term caused by the Covid-19 pandemic. This will continue to demand a coordinated response from the rail industry, in order to achieve an optimised and equitable use of London rail capacity for both freight and passenger needs.

3.2.2 NETWORK CAPABILITY

Whilst the network's finite capacity to accommodate train paths in the timetable is the most obvious limit to growth, there are also varying limits to the weights, lengths, sizes and traction types of train that it is capable of allowing to operate over it. These issues are often a challenge for freight especially. It is important that any strategy for growth seeks to address these along with enhancing overall route capacity. Freight stakeholders recognise the significantly constrained nature of the railway in London – the urban environment restricts opportunities to unlock additional route capacity through constructing new infrastructure. There is a consequent need to achieve as much as possible with the city's existing network, before considering major capacity enhancements. Incremental improvements to the capability of the network are key to this, because they can contribute to the ability to move more goods by running bigger, longer, better-performing trains. This enables some growth in volumes to be achieved in advance of the requirement for larger schemes, which typically take years to develop, design and deliver.

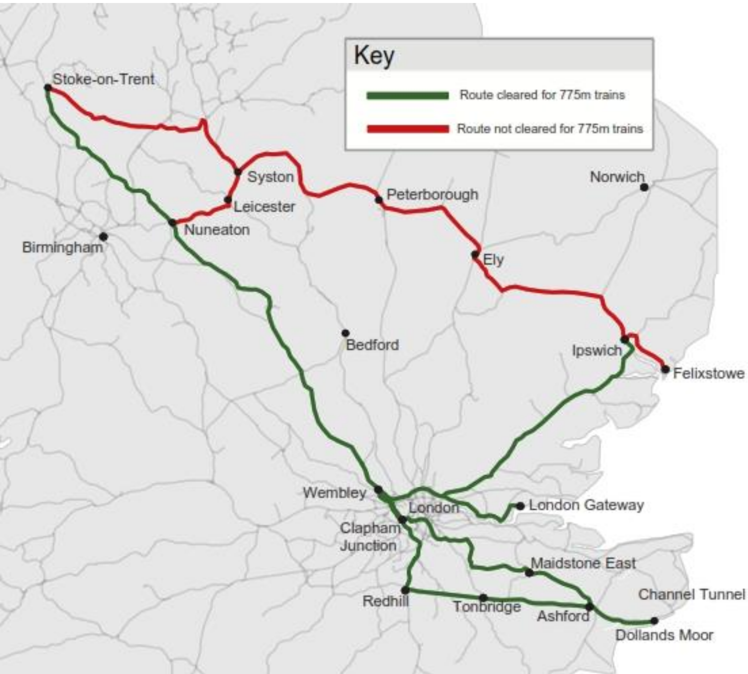


Figure 12: Baseline train length position for Felixstowe/London Gateway to the West Midlands and the North, and via the Channel Tunnel. Source: Network Rail

MAXIMUM LENGTHS AND TRAILING WEIGHTS

LENGTH

The maximum length at which trains can operate on a given route, before taking into account the effect this has on their overall weight, is dictated by distances between junctions and the standage available in loops and at other regulating points. There needs to be sufficient room for a train to be safely stopped when needed, without blocking junctions or other running lines. For lighter commodities, these are the main factors that influence maximum permissible lengths on each route.

The industry target length of 775m as standard for intermodal traffic can be accommodated across the NLL, GOB, WLL and SLL (Chatham/Catford lines only). This is extremely valuable in the case of the orbital routes across north London, which are a critical link in national flows of containerised goods, as the railway can offer 775m capability right through from the ports of Felixstowe, London Gateway and Tilbury to the WCML. The long-term ambition to revive the Channel Tunnel intermodal market is also aided by the capability to run the longest trains on the WLL and SLL.

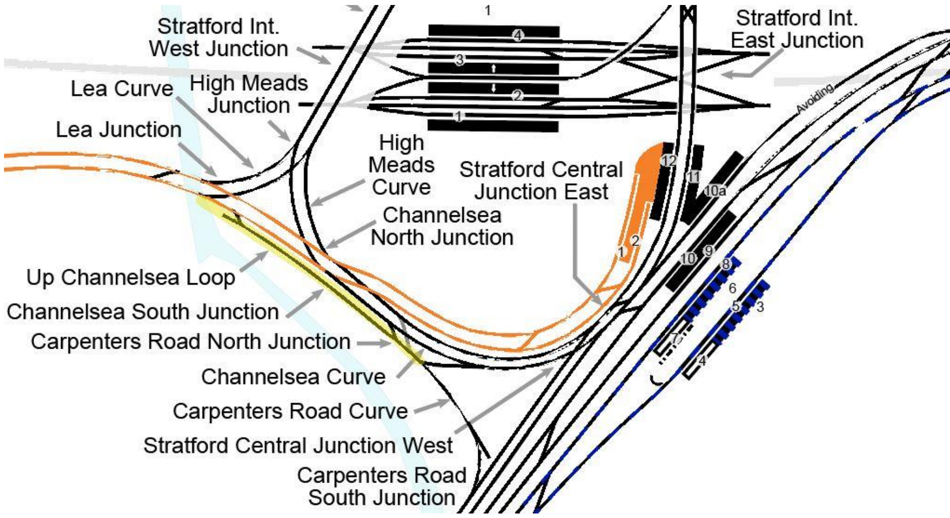


Figure 13: The Up Channelsea Loop at Stratford. Source: Franklin Jarrier – cartometro.com

However, a route being cleared for 775m traffic overall does not necessarily mean every regulating point on it has standage for trains of that length. A prime example of this is found at Stratford, where westbound trains can be held in the Up Channelsea Loop to await a path onto the NLL (see fig. 13), but will foul Stratford Central Junction if they are any longer than 707m. A 775m freight train held in the loop would therefore block the passage of trains on the Down Main, which is not viable given the frequency of passenger traffic through the area. This does not prevent longer trains from running on the route, but it means that they must have a path straight through Stratford to do so. The inability to regulate the longest freight trains at this key interface location reduces the pathing opportunities that are available for them.

TRAILING WEIGHT

For trains hauling the heavier bulk commodities, maximum lengths are intrinsically bound up with trailing weights, which are limited by route topography, locomotive traction power and the strength of wagon and locomotive couplers. The longer a train, is, the heavier it is and therefore the harder it will be for it to travel up inclines. There are a number of locations around London where the industry goal of 2600t for construction materials trains is not permitted when hauled by a class 66, the most common freight locomotive in service currently. In some cases, other traction units can achieve greater trailing weights, but generally the value for a 66 is a good indicator of where the gradient of the route presents a constraint. The most notable example on the London orbital routes is in the northbound direction on the WLL, where trains face a substantial incline towards Wembley. This limits the number of wagons that can be operated on the many construction flows that use the route, as well as on the Heathrow fuel trains. Increasing maximum lengths and weights wherever possible is a general freight industry aspiration, as this enables payload per train to be maximised, ensuring the greatest efficiency is delivered from each path operated.

Table 3: Restrictive loads for a Class 66 on the London orbital routes

From	To	Maximum trailing weight (tonnes)	Notes
Harringay Park Jn	South Tottenham Jn	**1,920**	Eastbound on the GOB Class 66 – note Class 66/6 is 2,470 tons
Harringay Park Jn	Harringay (ECML)	**2,055**	Connector from the GOB to the ECML Heavier trains have to be routed Gospel Oak – Camden Road – North London Incline
Willesden Junction	Kensal Green Jn	**2,305**	Eastbound on the NLL Class 66/6 = 2560
Carlton Rd Jn	Junction Road Jn	**1,955**	Connector from the Midland Main Line to the GOB Class 66/6 = 2510
Lea Junction	Canonbury	**2,215**	Westbound on the NLL Class 66/6 = 2835
Latchmere Jn	Falcon Jn	**2,315**	WLL to BML Class 66/6 = 2445
Latchmere Jn	Clapham Jn	**2,200**	WLL to Windsor Lines Class 66/6 = 2320
North Pole Jn	Mitre Bridge Jn	**1,130**	Northbound WLL incline Class 66/6 = 1470
Courthill Loop North Jn	Courthill Loop South Jn	**2,060**	From Lewisham towards Angerstein / North Kent Class 66/6 = 2175
Lewisham	Nunhead	**2,145**	Lewisham to the SLL Class 66/6 = 2265

HEAVY AXLE WEIGHT RESTRICTIONS

In common with the majority of the rail network, the London orbital routes have a Route Availability rating of 8 throughout. This defines the maximum axle weight that can be carried, which for RA8 is just under 23 tonnes per axle. RA ratings are primarily determined by the strength of underline structures. Some commodities, such as construction materials, are often conveyed in wagons with a RA rating of up to RA10. Although these exceed the route RA over much of the network, they can be allowed over selected routes through a mechanism known as the Heavy Axle Weight process, which permits derogations. These allowances are in many cases made subject to speed restrictions at specific locations, due to the condition of bridges or viaducts the train will pass over. These restrictions, by forcing heavier freight trains to slow down significantly below the normal line speed, are a constraint to capacity, especially on busy routes like those around London. Works to improve the condition of structures can permit the lifting of HAW restrictions. Addressing cross-London Heavy Axle Weights in this way was identified as number one in the 'Highest priority' category, under 'Short term capability (excluding gauge) options for funders', by the Freight Network Study.[26]

LOADING GAUGE

Freight trains, especially in the intermodal sector, are also constrained physically by the structures they must pass through, such as tunnels, platforms and lineside equipment. Loading gauge standards define what profile of train can be accommodated on a given route and on routes where clearances are insufficient, containerised traffic in particular can be prevented from running or forced to use more specialised wagons.

The major orbital routes north of the river Thames conform to the W10 gauge standard as far west as Kensal Green Junction, where the NLL connects to the WCML. This permits most 'deep sea' intermodal (containers through globally served ports like London Gateway and Felixstowe) traffic to operate. On the NLL and the GOB, 9'6" high boxes, increasingly the norm in international shipping, can be conveyed on standard flat-bed wagons, which reinforces these routes' vital role in connecting major ports in Anglia to the WCML, Britain's primary intermodal route. However, the inability to run trains at the slightly wider W12 gauge restricts rail's offer to other parts of the intermodal market where different box types are prevalent, for example refrigerated units. This includes, for instance, 'short sea' flows from continental Europe and some domestic intermodal freight. West of Kensal Green Junction and through to South Acton, the NLL is only published to W9, which represents a notable gauge gap between the W10 orbital routes and the GWML, which is W12 from Acton to Reading.

Beyond the NLL and GOB, loading gauge standards around London are much more restrictive, though to varying degrees. The WLL and SLL offer W9 gauge, reflecting their historic role in carrying Channel Tunnel intermodal traffic. The limitations this imposes is one of the key reasons that market declined in the early 2000s. A programme of clearance to W12 on the core routes from the tunnel to Wembley, including the WLL and SLL, which would enable modern wagon and box combinations to take advantage of the more generous clearances that would provide, is a long-held aspiration for freight stakeholders. The route between Clapham Junction and Willesden/Wembley via Kew, which can serve as a diversionary alternative to the WLL, does not even have consistent W9 clearance over all sections. It has also therefore been highlighted by stakeholders as a noteworthy gauge gap.

Other routes in the London area typically feature W8 or lower, with their freight traffic being characterised by bulk commodities that can be hauled in low-gauge conforming wagons. In the main this is not an immediate problem, since the capability of these routes in terms of gauge is adequate for existing flows. However, it represents a constraint to any long-term ambition to expand the intermodal network to use new routes and serve new parts of the country. In the wider context of the need to decarbonise all freight by 2050, which may call for moves to address the dearth of rail-served Regional Distribution Centres and intermodal terminals across London and the South East as part of an expansion of the domestic intermodal sector, this capability gap is a concern.

[26] *Freight Network Study*, Network Rail (2017)

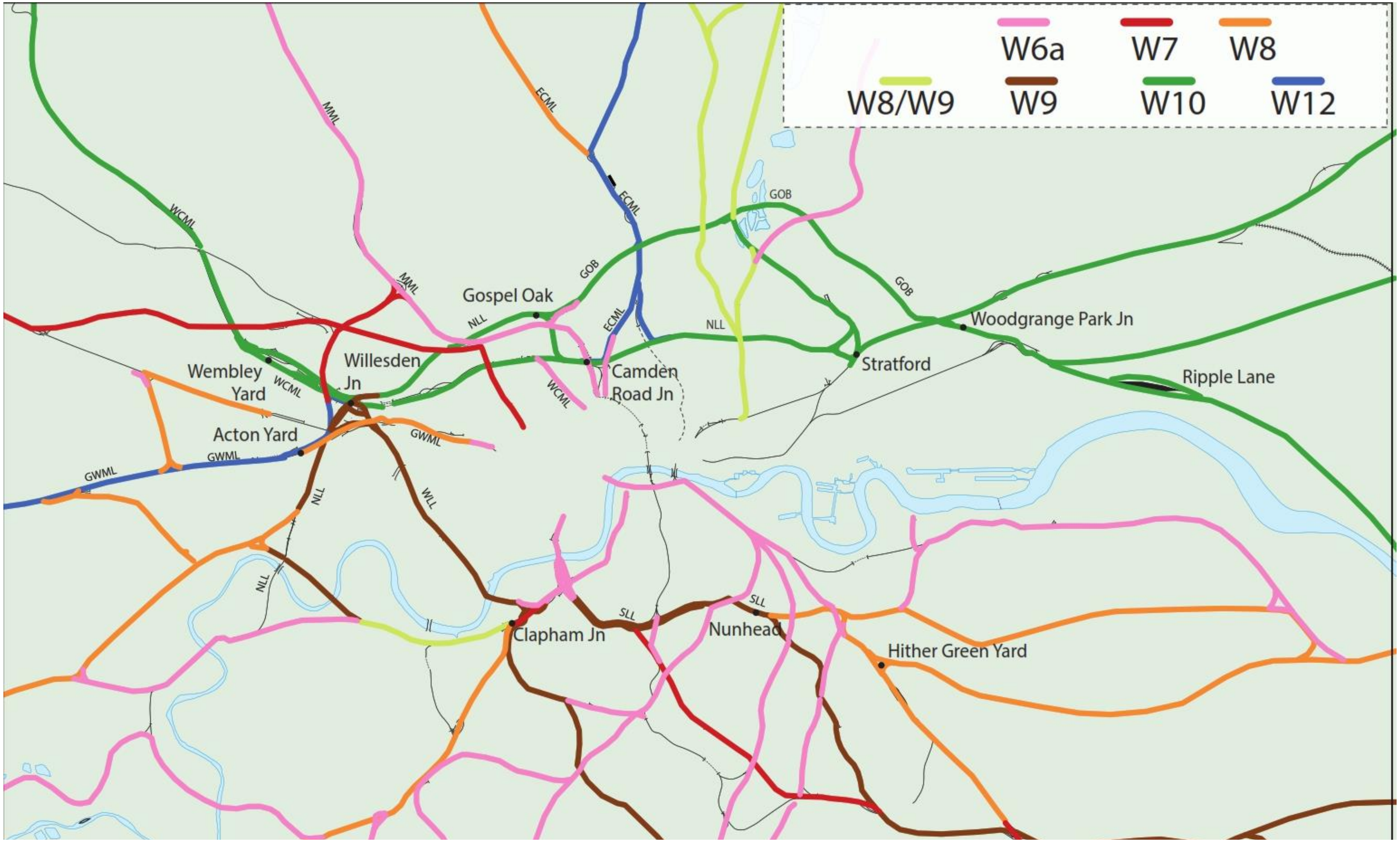


Figure 14: Map showing the published gauge clearance of routes in London.

ELECTRIFICATION

In addition to the obvious environmental benefits, conversion of rail freight to electric traction can in many cases enable trains to be faster and better performing than their diesel counterparts. Electrification of previously diesel only route sections also benefits other aspects of network capability – standard OLE clearances provide W12 gauge by default and the use of electric traction can be a means to increase trailing loads above what is possible with most diesel locomotives.

Although a significant minority of freight in London is currently electrically hauled (primarily NLL/WCML intermodal flows) there is huge scope for this proportion to be increased and in the long run achieving this will become an ever more urgent prerogative as 2050 draws nearer. There are several route sections and branches to terminals used by freight that do not provide electric traction capability, including the Angerstein's Wharf branch, the incline from Acton Yard to the NLL, the line between the Kew Junctions and South Acton, the Dudding Hill line from Acton to Cricklewood via Neasden (connecting the NLL and MML), the Greenford Branch and Acton-Northolt Line (by which the aggregates terminal at Park Royal is accessed) and the tunnel between Carlton Road Junction and Junction Road Junction that connects the MML with the GOB. The lines within important freight yards at key nodal locations around London (Acton, Wembley, Ripple Lane) are also non-electrified infrastructure in the most part, even when surrounded by or adjacent to fully electric main running lines.[27]

All of the above is reflective of a network set up on the premise that the majority of freight traffic cannot be hauled by electric traction, even if it may travel beneath wires or beside a live rail for most of the time it is in and around London. Historically this has indeed been the case, given that much of the freight seen in the area has travelled from distant locations right across the national network and will have had to run on non-electrified routes somewhere. However, capability gaps in London also contribute to the inability to run more electrically hauled freight.

The DC-electrified network south of the river also presents a long-term challenge to the aspiration to reduce freight's dependence on diesel traction. Power supply issues have historically been experienced with the substantial draw on the third rail demanded by the dual-voltage class 92 locomotives (originally introduced for the operation of Channel Tunnel traffic via the 'classic' routes through Kent and London). However, AC electrification of such a large, complex and intensively used part of the rail network as the Southern Region is not a viable prospect even within the next thirty years, especially given the need to prioritise the parts of the national network yet to be electrified in any form. It is therefore reasonable to expect that freight will need to take traction power from the third rail where this is the established form of electrification, if it is to reduce and ultimately end its use of diesel locomotives, which in turn suggests that upgrades to the DC power supply will be necessary in the long-term. Given the cross-regional nature of much of its operations, decarbonisation of rail freight in the South East (including south London) is also likely to be dependent on technical advancements in locomotive traction, with bi- or even tri-modal units expected to be required to replace the current preponderance of diesel-only in this part of the country.

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[27] Freight terminals, however, are in many cases not suitable for OLE electrification due to their operational requirements i.e. top-loading/unloading of wagons. The eventual removal of diesel traction from the network will require the implementation of some form of 'last mile' traction solution for freight to address this issue.

Figure 15: Railway electrification. The pink lines highlight 25 kV AC, the green lines highlight 750 V DC and the grey boxes highlight lines without electric traction capability.

SUMMARY

A comprehensive rail freight strategy for London will need to take account of how the categories of network capability described above can be addressed in both the short and the long-term. Opportunities for improvements in these areas are an essential complement to the major schemes that will unlock capacity in pure train path terms. Incremental enhancements to capability at locations right across the network of routes used by freight in London will ensure that the additional future capacity needed for growth is used in the most efficient and effective ways possible. Minor improvements to operations and performance for freight also need to be pursued where opportunities exist.

3.3 ACCOMODATING LONG-TERM GROWTH

Strategic sub-questions:

- SSQ5: Where insufficient capacity has been identified, what can be done to accommodate growth / plans?
    - SSQ5a: To what extent could changes to operating practices or to the Train Planning Rules (e.g. reduced headways / junction margins) increase network capacity and what would be required to enable these changes?
    - SSQ5b: Could increased capacity (or a more optimal allocation of capacity between passenger and freight services across the day) be achieved by restructuring the timetable(s) on the London orbital routes?
        - Can an hourly timetable pattern for both the peak and off-peak on the London orbital routes be identified that makes better use of capacity than at present?
    - SSQ5c: Would an increase to train length be an appropriate method of increasing capacity on any of the freight trains operating in the London area?
        - If so, for which commodities / flows would this be appropriate and feasible?
    - SSQ5d: At which locations are freight speed improvements most required?
        - Are there any areas which require work to be done to support Heavy Axle Loads?
        - Are there any areas which require work to be done to remove gauge-related restrictions?
    - SSQ5e: Would any of the routes used by freight in London benefit from infill electrification and / or power supply upgrades?
    - SSQ5f: Is the standard of gauge clearance sufficient for the current and future requirements of freight operators?
    - SSQ5g: What other infrastructure solutions would be required?
- SSQ7: What diversionary routes are currently available for freight travelling across London and are they sufficient for current and future demand?

Through capacity analysis, this study has identified a theoretical timetable structure to accommodate as much as possible of the LRFS Indicative Train Service Specification for the 2040s. This provides an answer to strategic sub-question 5b. This is not intended to prescribe the actual timetable that will be in place in 2043, but to serve as an indicator of the maximum achievable capacity on the London orbital routes should the full scope of this strategy be implemented, whilst also reflecting the limits to capacity that cannot reasonably be expected to be lifted within the next thirty years. The core interventions proposed by this study each directly support this timetable solution, thereby forming an interdependent package of interventions required to achieve long-term capacity growth.

This is in turn supported by a range of additional options that are also key to this overall strategy. These have been identified through stakeholder engagement, capturing the input of a wide range of industry expertise. These further proposals complement the core interventions to enhance capacity, in some cases directly and in others by improving the wider capability of freight routes around London. This report also recognises several other workstreams, projects and programmes that stand to benefit rail freight in the London area. Although they do not directly form part of the strategy being proposed, they are highlighted as important and worthy of continued industry support. Finally, a commentary is given on the diversionary routeing options available to freight flows, both within London and avoiding it, noting that flexibility is critical to rail freight operations.

3.3.1 TIMETABLE

The orbital routes timetable identified by the capacity analysis phase of this study relies on some key changes to existing Timetable Planning Rules and operational practice in order for it to work. These provide the first part of the answer to strategic sub-question 5a – each is the intended outcome of a proposed infrastructure enhancement, which completes the answer by indicating what is required to enable the desired change. The following operational/TPR changes were deemed to be required:

- A 3-minute minimum junction margin at Kensal Green Junction (in place of the current 4-minute margin)
- No timetabled stops for traction changeover at North Pole Junction on the WLL (all relevant Sectional Running Times for passing North Pole assumed to be ½ a minute less than stopping)
- Freight trains from the West towards the ECML to be routed via Harringay Park Junction, to reduce flat crossing moves at Camden Road Central Junction[28]
- Headways improved to 3 minutes on the NLL, GOB and WLL, with the exception of a 4-minute minimum between Gospel Oak and West Hampstead

The decision to apply a 4-minute headway to part of the NLL was due to the constrained signalling in place through the Hampstead Heath Tunnel (see box p.30). Extensive investigations were carried out through this study to fully understand the nature of the tunnel's safety non-compliances and the subsequent need for 'tunnel controls', as well as the inability to reduce the relatively long signal block sections on that part of the NLL, with a resultant evidence paper being shared with the LRFS working group. It was concluded that, even under digital signalling, controls would still be required to mitigate the risks of engine fumes and possible fire.

It is likely that, as the railway transitions away from the use of diesel traction towards 2050, all-electric operation on the NLL will render those risks significantly diminished – this appears to be the strongest prospect for alleviating the capacity constraint posed by the tunnel. Given the long planning horizon and lack of certainty as to when or how an all-electric NLL will come about, it was decided that for the purposes of this study, the capacity impact of Hampstead Heath Tunnel should not be disregarded, hence the assumed 4-minute headway. This makes for a right-side fail, as this strategy's proposals are predicated on this constraint limiting the attainable train paths per hour on that part of the NLL to below the 18tph specified in the 2043 off-peak ITSS. Should full electrification facilitate a significant relaxation, this would potentially enable the full ITSS to be accommodated.

[28] With the exception of heavier trains (+2,055t with a class 66 hauling). A timetable solution was found to enable occasional eastbound trains to be routed via Camden Road Central Junction and the North London Incline to access the ECML.

Allowing for a reduction to the specified paths per hour on the NLL west of Camden Road, due to the higher headway through Hampstead Heath Tunnel, the off-peak timetable structure identified by the capacity analysis work featured the following:

- 4 tph Clapham-Stratford
- 4tph Richmond-Stratford
- 4tph Camden Road-Stratford
- Everything else, including freight, as per the ITSS
- Clockface 15-minute frequency on Gospel Oak–Barking line, in line with the Essex Thameside study (see 2.3.3)

Focus was limited to the off-peak, as this is harder to path than the peaks. The peak specification, although challenging, consisted entirely of passenger trains, with no freight paths at all. This would mean that there would be only a handful of flat junction conflicts to deal with between passenger trains, mostly in the Willesden area. The junctions at Gospel Oak, Camden Road Jn, Canonbury West Jn, and Channelsea Jn should see no conflicting moves whatsoever. Crucially, since the peak specification has the same (or less) overall quantum of trains per hour as the off-peak, the analyst's judgement was that, if the off-peak specification can be accommodated, then so can the peak specification.[29]

3.3.2 CORE INTERVENTIONS

There were five enhancements to the London orbital routes identified as necessary to facilitate the level of capacity reflected in the timetable solution described above. Four of these are put forward as options for funders by this strategy and the fifth is a requirement that will need to be realised separately.

CAMDEN ROAD PLATFORM 3

This proposal would reinstate a third track and platform on the northern side of Camden Road station, utilising part of the former 4-track formation through the station.

BENEFITS

The additional capacity provided would facilitate much greater flexibility in pathing options for trains on this busy central section of the NLL, opening up new options for future service provision and bolstering performance resilience. Reinstatement of a third platform would enable platform 2 to be used as a central turnback, with platform 3 becoming the eastbound line for through London Overground services and the majority of freight. TfL modelling suggests that the eastern end of the NLL, from Canonbury to Stratford, will see

Source: Wikimedia Commons

[29] 'London Rail Freight Strategy: Capacity Analysis', WSP for Network Rail (April 2020)

some of the strongest long-term demand growth on the Overground network. A turnback platform will allow this to be addressed with peak capacity boosting Stratford-Camden Road services, as specified in the ITSS. There would also be the option to operate these through the off-peak, which could offer a means of providing additional passenger capacity where it is most needed, should the capacity constraint at Hampstead Heath Tunnel (see p.30) limit the ability to run more through services on the NLL west of Camden Road.

The availability of an additional platform would also aid performance recovery during perturbation on the orbital routes. Boosting resilience on this part of the network would be of great benefit to all operators and their customers. At present, the Overground NLL service can be susceptible to disruption, with stop-skipping a required means of service recovery at times. The option to turn trains around instead, which could be done in either direction using platform 2, would be a valuable asset in the management of the NLL during disruption.

The added flexibility in routeing trains through the Camden Road area would also bring general benefits to capacity. Platform 2 would retain through running as an option, so any freight needing to access the North London Incline at Camden Road Central Junction could still do so (see 3.3.1). It would also be possible for eastbound London Overground trains from Gospel Oak to use platform 2, as they do today, which would enable freight following them (either from Gospel Oak or Primrose Hill) to pass through platform 3, without having to wait until the passenger train has cleared Camden Road East Junction. This would ease the flow of freight through this critical part of the NLL, by de-conflicting services sooner than is currently possible.

FEASIBILITY

This option would see a third track installed on currently disused formation between Camden Road West Junction and Camden Road East Junction together with the reconstruction and reinstatement of the former Platform 3 at Camden Road Station. Significant through girder bridges crossing Camden Road, Randolf Street, Baynes Street and St Pancras Way would also require substantial refurbishment and the masonry viaducts between them the renewal of their waterproofing system.

The conversion of the existing Platform 2 at Camden Road Station to provide a new turnback facility is likely to require the relocation of signals and changes to signalling controls to provide adequate 'bang road' protection when trains enter and/or depart the platform. The curvature of the new Platform 3 is likely to be close to 500m and therefore require a formal risk assessment to support a deviation from the recommendations of Clause 2.1 of Railway Industry Standard RIS-7016-INS.

No major engineering issues are likely to be encountered during the construction of the proposed works beyond those that may be anticipated working in a dense, inner city urban environment.

Aerial view of Camden Road Station looking to the East, with out of use track bed on the left. Source: NR RouteView

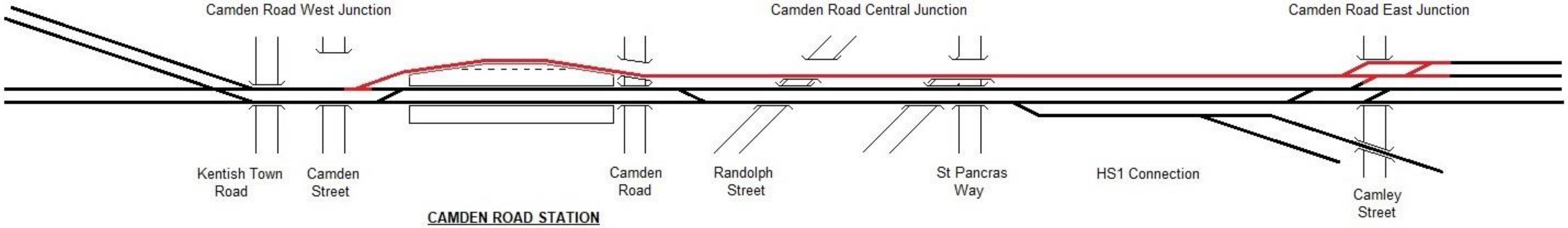

Figure 16: Schematic drawing of proposed Camden Road Platform 3 scheme

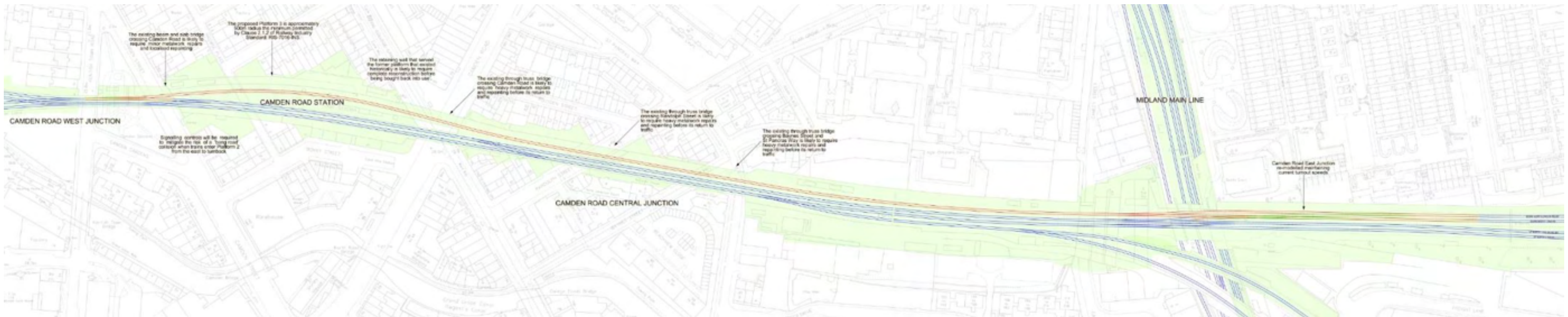

Figure 17: Detail from conceptual design sketch of proposed Camden Road Platform 3 scheme (see Appendix A for full sketch)

KENSAL GREEN JUNCTION IMPROVEMENT

Kensal Green Junction, just to the northeast of Willesden Junction High Level station on the NLL, is a key location for the functioning of the orbital routes. It connects the NLL to the WCML and Wembley Yard, a vital link for cross-London intermodal flows. Westbound freight trains must cross over the flat junction to access the City lines towards the WCML, a conflicting move with any eastbound London Overground or freight services from Willesden High Level. Ensuring these moves can take place as quickly and as smoothly as possible is essential to the efficient use of capacity on the NLL.

Intermodal train passing from the WCML towards Kensal Green Junction and the NLL. Source: Network Rail

BENEFITS

The proposed enhancement would upgrade the junction, moving it slightly to the east and realigning the layout, to facilitate faster crossing speeds. Currently trains from the City lines (in the Up direction) are limited to 10 mph over Kensal Green Junction, while trains towards the City lines (in the Down direction) are limited to 15 mph.

Although this is a relatively minor scheme, it could have a significant positive impact on both capacity and performance in the area. In the current TPRs, trains towards the City lines require a 4-minute margin following their conflicting move at Kensal Green Junction, which poses a significant constraint on capacity. This constraint would be significantly reduced if this margin could be reduced to 3 minutes or less.[30]

FEASIBILITY

This option would see the track realigned and the junction itself moved a little to the east in order to improve line speeds on the route towards Harlesden. This change is likely to facilitate an increase in line speed from 10/15mph to 35 or 40mph, effectively making Harlesden the 'main' route through the junction. However, in order to fully utilise this line speed increase improvements are also likely to be needed to both track and OLE between Kensal Green and Harlesden Junctions to improve the existing 30, 15 and 10mph line speeds together with the remodeling of Harlesden Junction itself (see 3.3.3). It is anticipated that the track and OLE improvements required might be delivered as part of an accelerated programme of maintenance.

The relocation of 2 or 3 signals is also likely to be needed on the Up North London line between Willesden Junction High Level station and Kensal Green Junction in order to achieve the desired junction margin. The existing embankment on the north side of the line west of the A404 highway overbridge will need to be steepened (potentially using a reinforced earth technique) to provide the formation width required to accommodate the position of the new junction.

No major engineering issues are likely to be encountered during the construction of the proposed works beyond those that may be anticipated working in a dense, inner city urban environment.

[30] 'London Rail Freight Strategy: Capacity Analysis', WSP for Network Rail (April 2020)

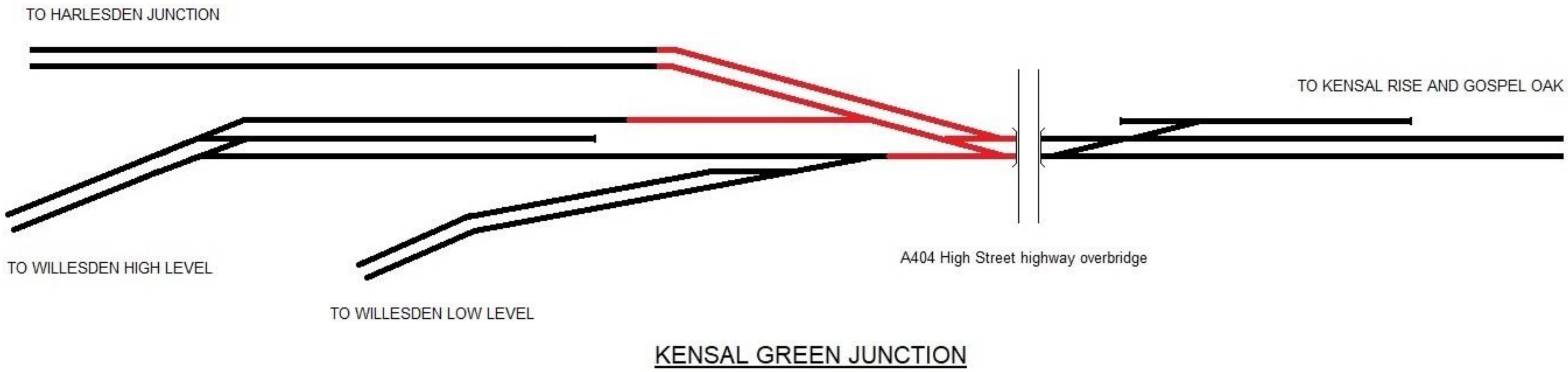

Figure 18: Schematic drawing of the proposed Kensal Green Junction Improvement scheme

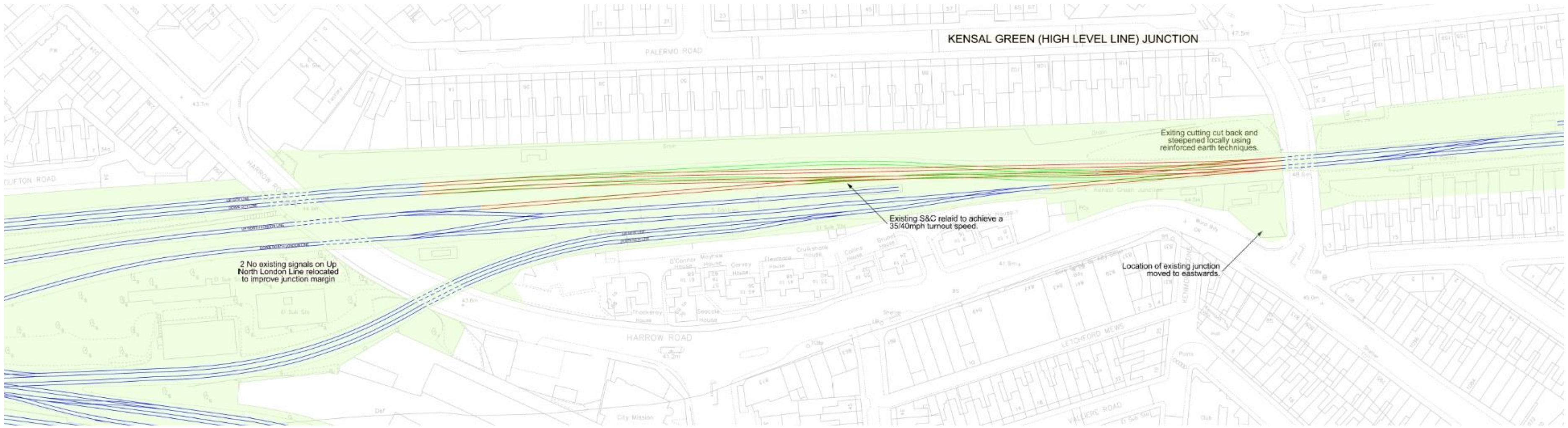

Figure 19: Detail from conceptual design sketch of the proposed Kensal Green Junction Improvement scheme (see Appendix A for full sketch)

WEST LONDON LINE AC/DC CHANGEOVER – SHEPHERD'S BUSH

This option would involve extending the overhead wires further along the WLL, to provide AC electrification as far south as Shepherd's Bush station. Recent work for TfL has recommended this proposal be taken forward, to alleviate the existing capacity constraint represented by the mid-route traction changeover at North Pole Junction (see 3.2.1).[31]

BENEFITS

Extending the OLE to Shepherd's Bush would enable passenger trains to change traction source whilst making their scheduled station stop. A slight extension to dwell times at Shepherd's Bush may be required, but the elimination of the need to slow down or, especially, to stop, as is the case for GTR trains, at North Pole Junction would release a significant amount of capacity.

A Class 92 dual voltage locomotive approaching Shepherds Bush southbound on the West London line. Source: Railway Centre

The 2019 'LOCAP' report calculated that the relocation of the changeover to the Shepherd's Bush could provide an indicative net saving of 7 minutes per hour, which is equivalent to an additional path and some additional time for timetable flexibility. The LRFS capacity analysis suggested that in the off-peak scenario, with two GTR services per hour timetabled (as against the one per hour today), up to two additional paths could be created in each direction if these trains no longer stop at North Pole. Moreover, the analysis advised that eliminating the need for GTR services to stop to change traction would be of significant performance benefit even today.

FEASIBILITY

This option would involve extending the existing 25kV AC OLE electrification from its existing limit at 4m 73 ch on the West London Line to 4m 00ch south of Shepherd's Bush station where the AC/DC changeover would in future take place. The Holland Park roundabout is situated just to the south of Shepherd's Bush Station under which the railways passes in a covered way. It is proposed that a 'dead' section of OLE is installed through the covered way in order to mitigate the risk of pantographs being torn from the roofs of rolling stock, and limit the consequential impact on train services, should a driver forget to lower the pantograph on starting away from the station or an equipment failure occur that leaves the pantograph in its raised position. It has been assumed that the existing scissors crossing located at Mitre Way will be retained in order to turnback those services that fail to successfully change over the traction power supply at Shepherd's Bush Station and retention of the existing isolating transforms will be sufficient to prevent stray

[31] 'LOCAP GRIP 2 Level Feasibility Report: London Overground North and West London Line Capacity Upgrade Project', Jacobs/ch2m for Transport for London (March 2019)

DC traction return currents passing into the AC network north of Scrubs Lane. Both assumptions will need to be validated as part of the scheme's further development.

Directly fixed track, bird guards and surge arrestors attached to the OLE and earth screens and bridge arms attached to overline structures are likely to be required in association with the minimum clearance beneath existing structures of 4.20m assumed for the purpose of the study. This figure being based on work reported to have been undertaken by the Western Region as part of the South Wales electrification programme and is based on a minimum wire height of 4057mm, a maximum allowance for pantograph uplift of 58mm, 40mm electrical clearance and a notional addition of 45mm for unforeseen local factors. Although the proposed structural clearance to overline structures is believed to be realistically achievable based on the work completed by the Western Region a specific risk assessment, compliant with the CSM Regulation, will be required to ensure it is acceptable on the West London Line.

No major engineering issues are likely to be encountered during the construction of the proposed works beyond those that may be anticipated working in a dense, inner city urban environment.

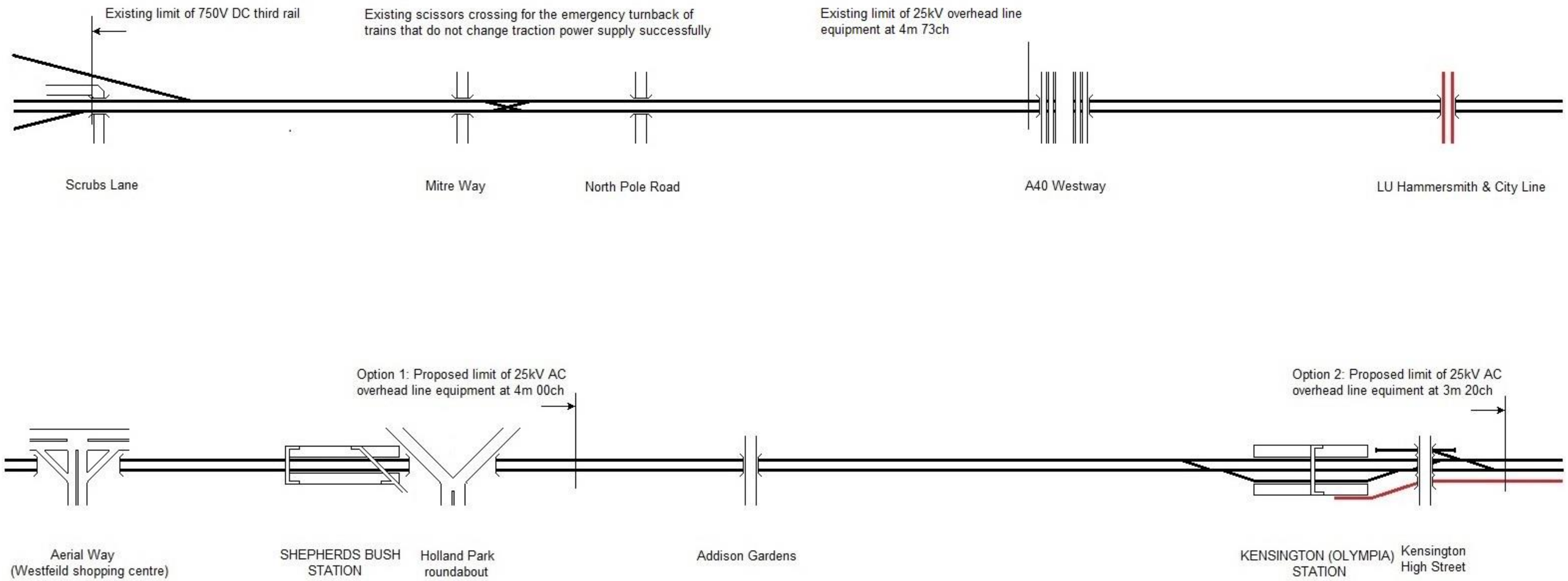

Figure 20: Schematic drawing of the proposed relocation of the West London Line AC/DC changeover (Option 1 to Shepherd's Bush)

Figure 21: Detail from conceptual design sketch of the proposed relocation of the West London Line AC/DC changeover – Option 1 to Shepherd's Bush (see Appendix A for full sketch)

CLAPHAM JUNCTION PLATFORM 0

Proposed location of Platform 0. Source: Network Rail

The longstanding proposal for the creation of additional bay platform capacity at the northern end of Clapham Junction station, for the use of London Overground WLL services, is supported by this strategy. The scheme would reinstate the disused former platform 1 to create a newly designated 'Platform 0', adjacent to the present platforms 1 and 2. This intervention has been recognised as key to long-term growth on the WLL by several previous pieces of work for both NR and TfL and was developed as far as GRIP (Governance for Railway Investment Projects) stage 2 in 2016, with a range of potential bay platform configurations considered.[32] The ultimate preferred option from among these will need to be determined during the course of more detailed development work, as and when this can recommence through the RNEP, but the LRFS proposes a minimum of a single 5-carriage bay platform.

BENEFITS

Previous studies have consistently concluded that additional platform capacity at Clapham Junction is needed, if TfL's aspiration to increase the WLL Overground service to 6 trains per hour is to be met.[33] Capacity analysis for the LRFS has reaffirmed that the desire to operate this level of service throughout the day cannot be achieved with a single bay platform.[34] It also noted that delivery of Platform 0 could release capacity in the current platform 1 for SLL Overground services. This may assist in operational transfers for any units needing to travel to and from New Cross Gate to the WLL service group.

Although this scheme would clearly be of direct benefit to the London Overground passenger service, the positive impact it would have on the capacity and performance of the WLL overall means that it is also very much in the interest of freight that Platform 0 be delivered. Arriva Rail London (ARL, operator of the Overground concession) are at present preparing to introduce capacity-boosting shuttle services between Clapham Junction and Shepherd's Bush, which will bring the Overground to 6 trains per hour on the WLL in many hours of the day. Because additional services cannot reliably be operated using the existing platform 1 alone, these trains will turn around in platform 17 at the far end of the station, where freight and GTR trains pass through towards the BML. The shuttle services'

[32] *Sussex Area Route Study*, Network Rail (September 2015); 'London Orbital Capacity Enhancement Project, Clapham Junction Station: Platform 0, Options Development Report', ARUP for Network Rail (June 2016); 'LOCAP GRIP 2 Level Feasibility Report: London Overground North and West London Line Capacity Upgrade Project', Jacobs/ch2m for Transport for London (March 2019)
[33] *Sussex Area Route Study*, Network Rail (September 2015); 'Clapham Junction Platform 0', NR Capacity Analysis (February 2018); 'LOCAP GRIP 2 Level Feasibility Report: London Overground North and West London Line Capacity Upgrade Project', Jacobs/ch2m for Transport for London (March 2019)
[34] 'London Rail Freight Strategy: Capacity Analysis', WSP for Network Rail (April 2020)

occupancy of platform 17 during turnarounds will restrict pathing of southbound freight trains through the area and is likely to limit freight growth for as long as Overground operations persist on this basis. The use of the lines between the Latchmere Junctions and Clapham Junction platforms 16 and 17 by a significantly increased number of passenger trains is a serious capacity concern for freight, as it will erode the ability to hold trains between the BML and the WLL to await an onward path (see 3.2.1).

Freight therefore has a major stake in seeing Platform 0 realised, as a vital mitigation against these capacity pressures. Use of platform 17 is also not the preferred long-term solution for providing a sufficient level of passenger service on the WLL, as demand recovers following the Covid-19 downturn. The curvature of the platform makes boarding more difficult for passengers when compared with the straight bay platforms at the station's northern end, resulting in poorer accessibility. Terminating services at the far end of the station makes interchange between the SLL and WLL far less convenient. Running to and from platform 17 introduces more conflicting moves between Overground trains at Latchmere Junction No. 2 than there would be if the entire WLL service used the far side of Clapham Junction, which would be preferable for performance. Use of platform 17 also fails to deliver a consistent 6 trains per hour throughout the day, due to clashes with existing freight paths, so is an incomplete solution to TfL's service requirements that also impinges on freight capacity. Recognition of the shared passenger and freight benefits of this scheme is therefore crucial to any future business case supporting it.

FEASIBILITY

Previous studies have deemed this scheme feasible to deliver, but there are a number of known challenges that will need to be overcome. The platform layout option chosen will also have a significant impact on the extent and complexity of the construction required.

There is a large quantity of lineside equipment located on the disused track bed (see pictures bottom of this page), much of it critical signalling infrastructure for the currently operational lines in the area. This includes a Relocatable Equipment Building (REB), several location cabinets, cabling and points heating equipment, as well as track inspection team and security cabins, lighting columns and CCTV posts. Previous work on the feasibility of Platform 0 has concluded that all the lineside equipment currently located in the disused formation would need to be permanently relocated.

The condition of underline structures and the extent of work that would be required to ensure they can safely bear traffic in and out of Platform 0 is also a known issue that any future scheme will need to address. The track serving what was historically Platform 1 at Clapham Junction Station is carried on a metal structure known as the Grant Road Viaduct. The structure comprises: metal troughing (to support the former track); longitudinal girders bearing on riveted box section columns; and, spread masonry foundations. The viaduct was assessed as part of the London Orbital Capacity Enhancement Project by Ove Arup & Partners (OAP) the results of which are contained their assessment report (ref: 148508-ARP-REP-EST-000001). This assessment concluded that the viaduct was not capable of carrying

Existing lineside equipment. Source: '148508-ARP-SKT-EOI-000002 Existing Lineside Equipment Plan View', Arup for Network Rail (17/04/16)

RA8 loading, with both longitudinal girders and cross beams failing, and also not capable of carrying real vehicle loadings (Class 377 vehicles), with the end panels of the longitudinal girders and some web panels of one cross beam failing. As part of their GRIP Stage 2 study OAP prepared preliminary proposals for both the refurbishment of the existing viaduct and its complete replacement to accommodate both five and eight car trains. Therefore, it is highly likely that as a minimum a significant refurbishment of the structure will be needed as part of any scheme to deliver Platform 0.

The formation of the track that formerly served Platform 1 is also now partially obstructed by a new stair, opened in 2009, that improved access to the main station footbridge. The OAP report concluded that although a platform to accommodate five car trains might be provided without the need to remodel this stair its substantial rebuilding would be needed to accommodate eight car trains.

London Overground trains in platforms 1 and 2 at Clapham Junction. Source: Network Rail

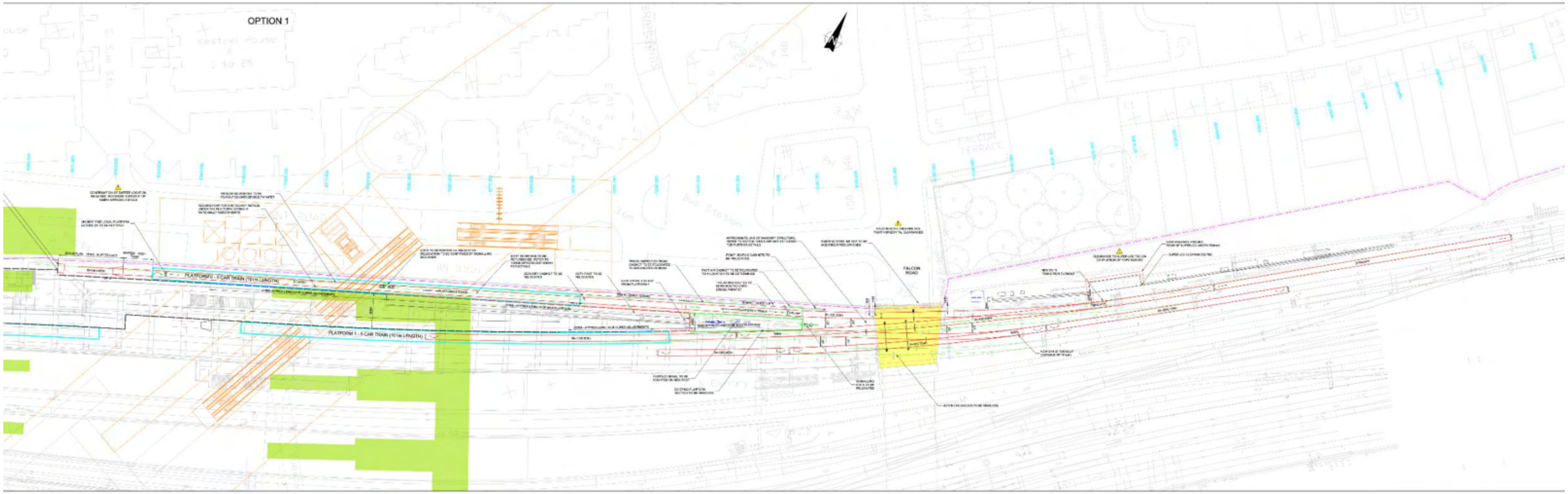

Figure 22: Detail from 148508-ARP-DRG-EMF-100007 Clapham Junction Platform 0 – Option 1. Produced by Arup for Network Rail during 2016 GRIP 2 feasibility study. This work considered 5 possible platform options – Option 1 shown here for illustrative purposes only

NLL, GOB AND WLL HEADWAY REDUCTIONS

Signalling enhancements to facilitate consistent 3-minute headways on the three orbital lines where these are not currently feasible will be necessary, if growth akin to the timetable solution identified by the capacity analysis for this study is to be realised. It is not the role of the LRFS to specify the nature of these upgrades, however it is expected that the required headway reductions are most likely to be achieved in a more manageable and cost-effective way through the deployment of European Train Control System (ETCS) digital signalling.

Network Rail's Digital Railway programme has developed a Long-Term Deployment Plan, which maps out expected timescales for the deployment of ETCS to routes across the national rail network. This is based on a steady programme of asset renewal to manage the transition to digital technology and also maintain continuity of service for passengers and freight end users. The current version of the plan would see the GOB and parts of the NLL and WLL in the Willesden area converted to ETCS during Control Period 8 (CP8, 2029-2034), the WLL during CP9 (2034-2039) and the remainder of the NLL during CP10 (2039-2044).[35] Expected ETCS deployment for the orbital routes requiring headway reductions thus aligns well with the planning horizon of the LRFS.

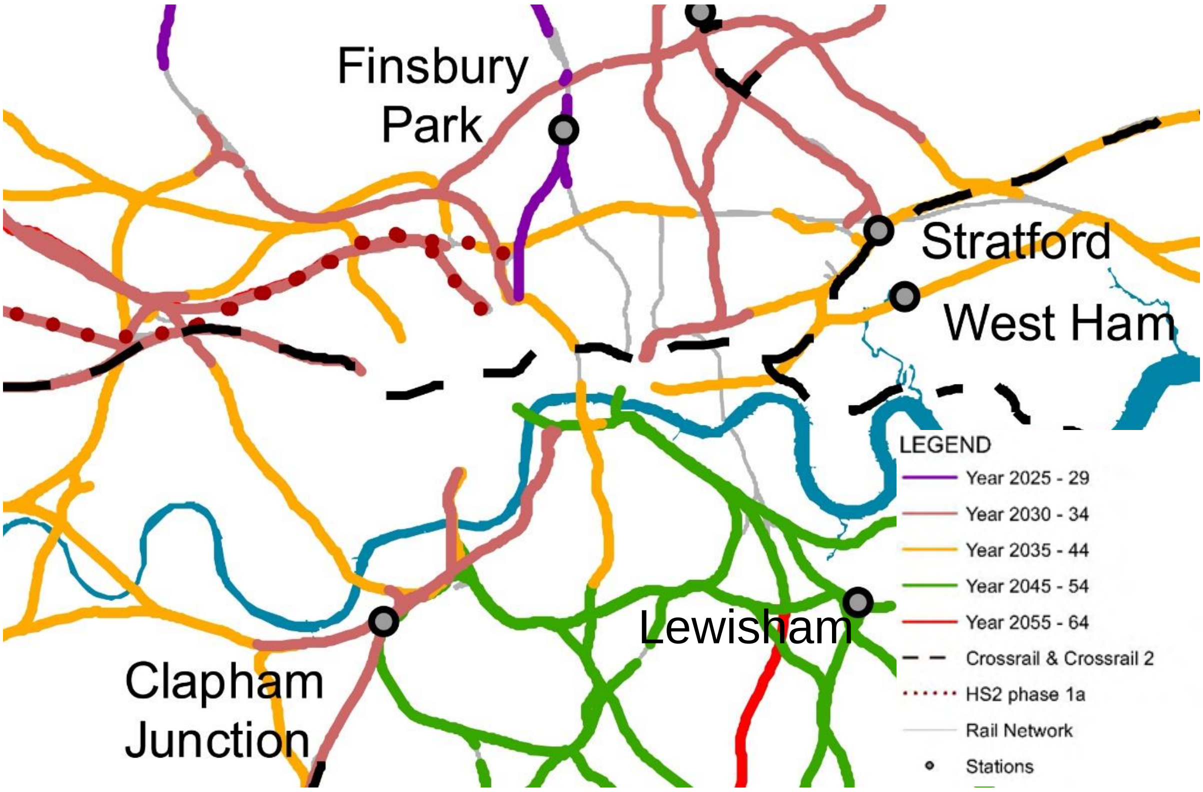

Figure 23: Detail from Digital Railway Long-Term Deployment Plan, London map (see Appendix B for full map). Source: Network Rail
N.B. Gaps in colouring on some routes are due to signalling database and do not indicate ETCS will not be deployed.

[35] For more information on the Digital Railway Long-term deployment plan, see https://www.networkrail.co.uk/running-the-railway/railway-upgrade-plan/digital-railway/digital-railway-strategy/digital-railway-long-term-deployment-plan/

An extensive programme to fit freight locomotives with the in-cab equipment necessary to run on digitally signalled routes is already underway, to prepare the fleet for the need to operate between ETCS and conventional signalling as lines are progressively upgraded over time. Digital Railway colleagues have advised that, although actual deployment will be a lengthy and complex process, from a pure signalling capability perspective there should not be any reason to expect 3-minute headways would not be achievable on the NLL, GOB and WLL with ETCS. Other elements, such as line speed for example, could be a constraint to the desired headway, but without design and modelling well beyond the depth of a strategic study it is difficult to establish the impact. A 3-minute headway was therefore incorporated into the capacity analysis for the LRFS (with the exception of a 4-minute assumption for Hampstead Heath Tunnel, see p. 30) and is noted here as a core intervention required to enable long-term growth. Headway reductions are not, unlike the other four core interventions described above, proposals within the strategy itself that are being put forward for progression through the RNEP, but they are an absolutely critical dependency for the overall benefits of them all to be realised.

3.3.3 ADDITIONAL OPTIONS

The following proposals supplement the core interventions in the previous section, ensuring that the LRFS presents a broad range of options to address the range of rail freight needs in London over the long term, as well as tackling capacity at key locations. These additional options include ways to supplement some of the core schemes put forward by this report, or align with other ongoing workstreams, to maximise freight benefits. They also include options for further standalone schemes and for the development of packages of interventions to address capability gaps right across London. Adding these schemes to the core interventions enables the LRFS to present a holistic strategy for the long-term development of rail freight in the London area, through a wide-ranging portfolio of enhancements that will collectively facilitate the accommodation of future growth.

HARLESDEN JUNCTION DOUBLING

This option would involve the reinstatement of a fourth track at the point where the WCML Slow lines and City/Goods lines pass beneath the Dudding Hill line overbridge, with the new layout allowing for increased line speeds for trains to and from the City lines. At present, several Goods lines from the direction of Wembley Yard converge into a single lead through Harlesden Junction, the connection to the City lines, from which the NLL is accessed. Conceptual design work for the LRFS has identified that the bridge span immediately above the junction, which the two WCML Slow lines also pass under, formerly accommodated four tracks in total.

BENEFITS

Because the City lines extend for a relatively short distance between Harlesden Junction and Kensal Green Junction, a speed increase at Harlesden Junction is necessary in order to align with the uplifted speeds proposed for Kensal Green Junction (see 3.3.2), so that the full length of a freight train can pass through Kensal Green Junction quickly enough for a 3-minute junction margin to be applied. Upgrading Harlesden Junction is therefore required in order to realise the benefits of the core intervention at Kensal Green Junction. Doubling the junction would further ease the flow of freight trains through this critical connection between the WCML and the orbital routes. This strategy proposes that Harlesden Junction

Doubling be developed as a part of the Kensal Green Junction Improvement scheme, so that these interdependent enhancements can be delivered together.

FEASIBILITY

This option would involve remodeling the existing junction to provide continuous double track between the Up & Down City Lines and the Up & Down Goods Loops (Nos 1 & 2) part of the Wembley Yard complex. Works to improve the existing 15mph line speed through this junction would, in any event, be necessary if the suggested remodeling of Kensal Green Junction to improve its capacity were to be implemented and the two proposals are therefore best treated as being complementary.

The viaduct carrying the Dudding Hill Line over the West Coast Main Line comprises five spans. The north span of this viaduct now crosses three tracks although historical Ordnance Survey mapping of the area available online shows that it once crossed four. The current proposal makes use of the space once occupied by the fourth track to accommodate the doubling of the route between the Up & Down City Lines and Wembley Yard. However, an early topographic survey to confirm the span of the structure and the space available to accommodate the additional track remains advisable.

No major engineering issues are likely to be encountered during the construction of the proposed works beyond those that may be anticipated working in a dense, inner city urban environment.

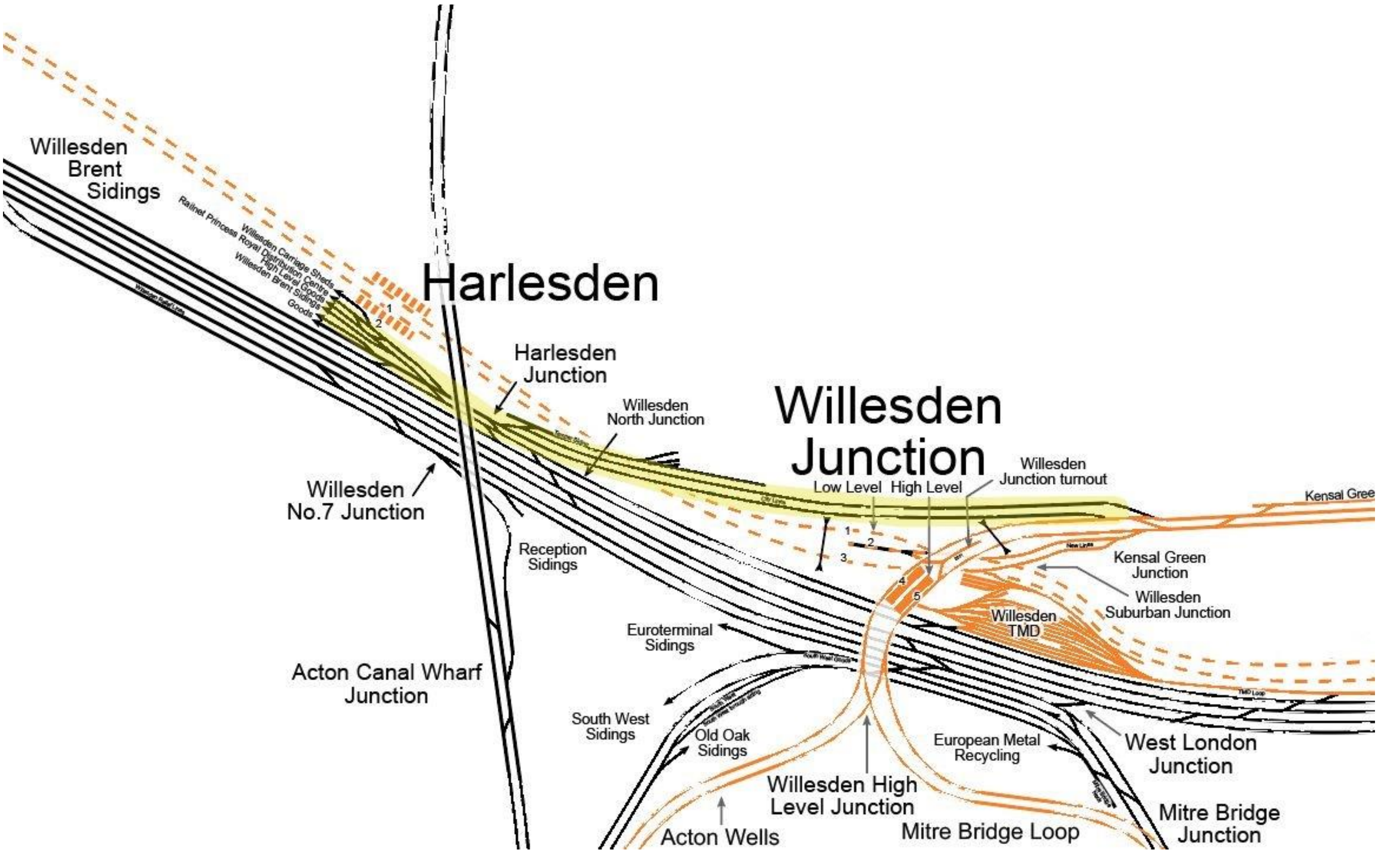

Figure 24: Map showing interface of the NLL and WCML at Harlesden Junction. Freight-only lines from Kensal Green Junction on the NLL towards Wembley yard, via Harlesden Junction, highlighted. Source: Franklin Jarrier – cartometro.com

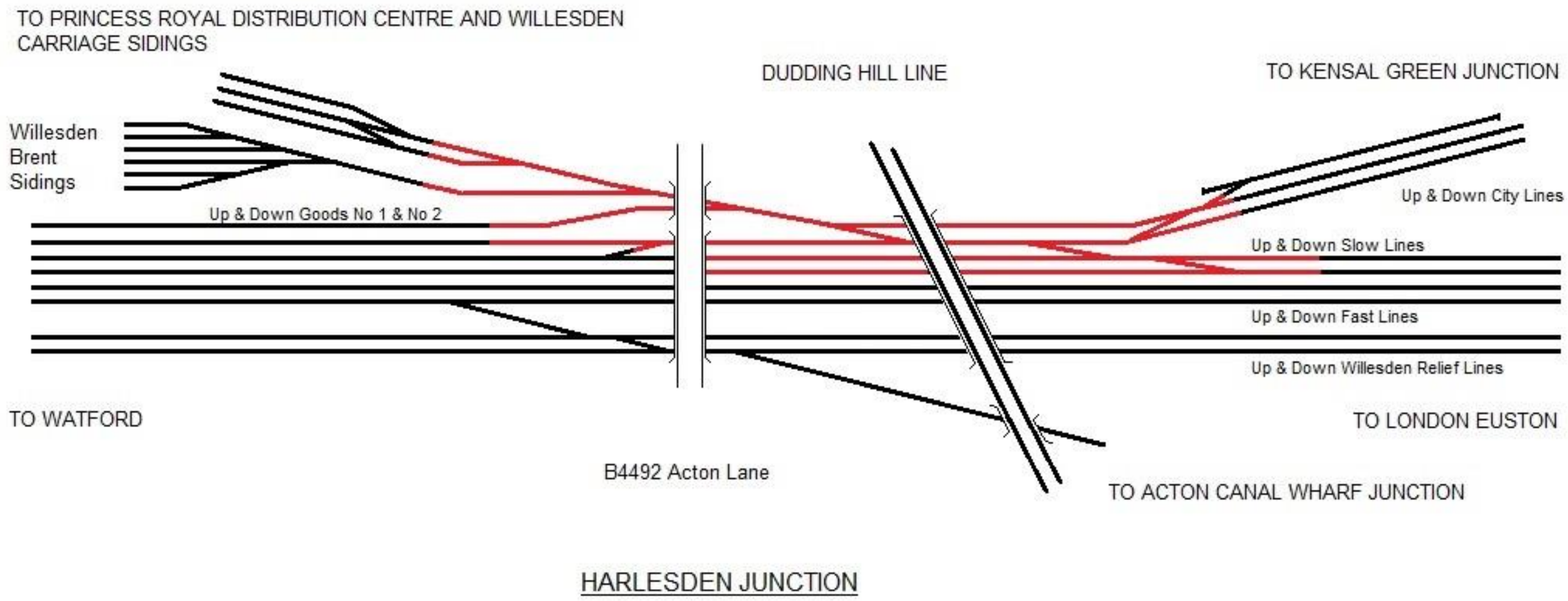

Figure 25: Schematic drawing of the proposed Harlesden Junction Doubling scheme

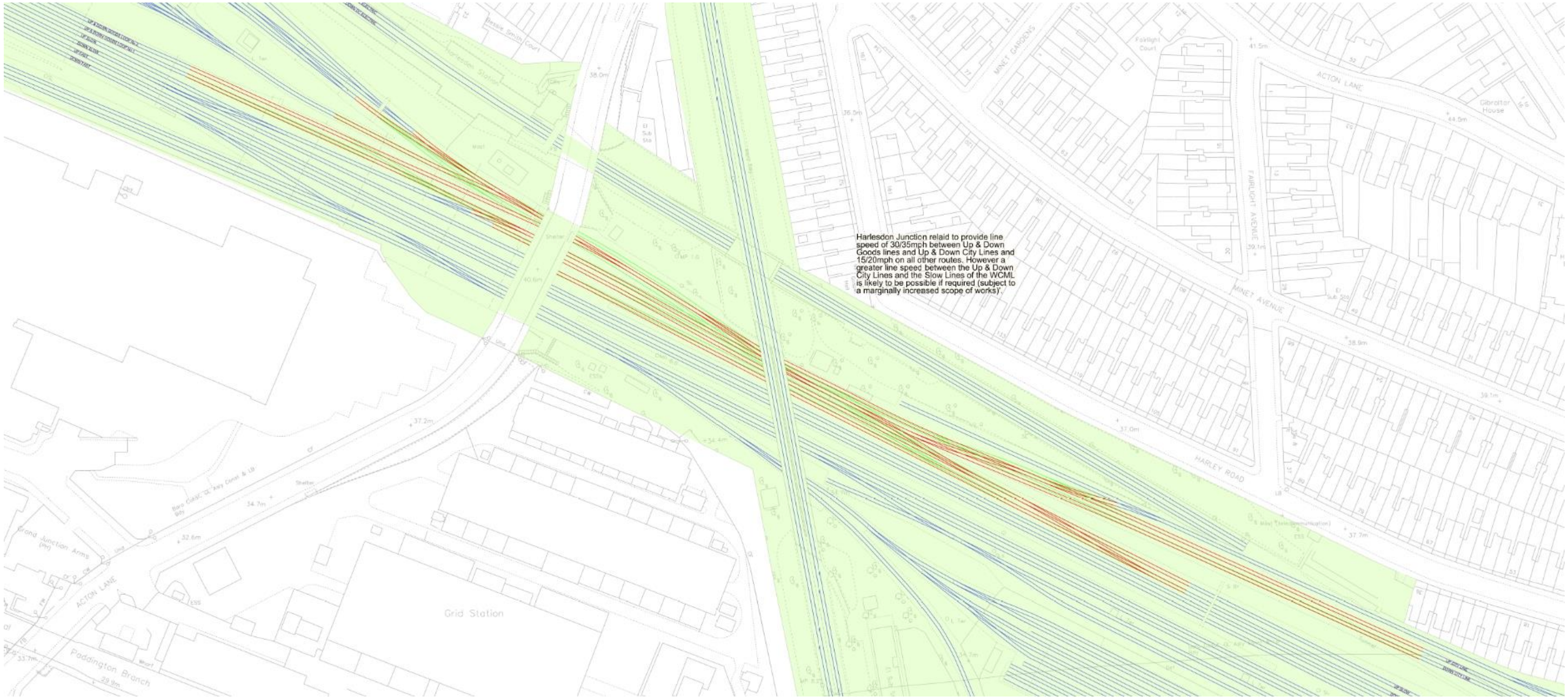

Figure 26: Detail from conceptual design sketch of the proposed Harlesden Junction Doubling scheme (see Appendix A for full sketch)

WEST LONDON LINE AC/DC CHANGEOVER – KENSINGTON OLYMPIA

As an extension to the proposal described in 3.3.2, there is an option to relocate the WLL traction changeover point even further to the south, to Kensington Olympia station rather than Shepherd's Bush.

BENEFITS

Although moving the changeover to Shepherd's Bush would eliminate the need for passenger trains to slow down or stop at North Pole Junction, electrically hauled freight trains will still need to switch power supply modes whilst moving, wherever the AC/DC interface is located. Due to the substantial incline facing trains running northward on the WLL, which increases in severity towards the Willesden end of the route, it would be preferable for the changeover to be made as far south as possible. This would enable freight trains to slow down to switch traction before reaching the worst of the gradient, giving them a much better chance of regaining line speed once drawing power from the OLE.

Although Kensington Olympia is less than a mile to the south of Shepherd's Bush, the intervening route section is almost entirely level, with the incline commencing just before Shepherd's Bush station and continuing to rise sharply along the rest of the WLL. The capacity and performance benefits of relocating the changeover are therefore likely to be greater if the overhead wires are extended to Kensington Olympia, removing the risk to traffic flow that would remain if freight trains were forced to switch whilst running uphill. This would prepare the WLL for the transition to electric freight that will be necessary as part of the decarbonisation of the railway over the next thirty years. Resolving the current traction changeover issues for freight as well as passenger trains would support this transition by encouraging freight operators to invest in electric locomotives to run on the orbital routes, in the confidence that this constraint has been addressed.

FEASIBILITY

This option would involve extending the existing 25kV AC OLE electrification from its existing limit at 4m 73 ch on the West London Line to 3m 20ch south of Kensington (Olympia)station where the AC/DC changeover would in future take place. Kensington High Street highway overbridge is situated just to the south of Kensington (Olympia) station. It is proposed that a 'dead' section of OLE is installed beneath the overbridge in order to mitigate the risk of pantographs being torn from the roofs of rolling stock, and limit the consequential impact on train services, should a driver forget to lower the pantograph on starting away from the station or an equipment failure occur that leaves the pantograph in its raised position. It has been assumed that the existing crossovers located at

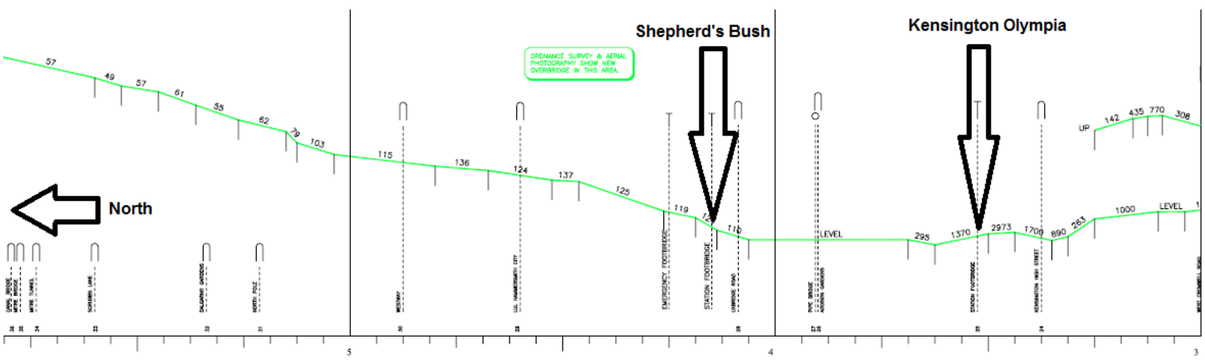

Figure 27: Gradient on the West London Line (extract from Network Rail 5-mile line diagrams)

Kensington (Olympia) will be retained in order to turnback those services that fail to successfully change over the traction power supply at the station and retention of the existing isolating transforms will be sufficient to prevent stray DC traction return currents passing into the AC network north of Scrubs Lane. Both assumptions will need to be validated as part of the scheme's further development.

Source: Network Rail

Directly fixed track, bird guards and surge arrestors attached to the OLE and earth screens and bridge arms attached to overline structures are likely to be required in association with the minimum clearance beneath existing structures of 4.20m assumed for the purpose of the study. This figure being based on work reported to have been undertaken by the Western Region as part of the South Wales electrification programme and is based on a minimum wire height of 4057mm, a maximum allowance for pantograph uplift of 58mm, 40mm electrical clearance and a notional addition of 45mm for unforeseen local factors. Although the proposed structural clearance to overline structures is believed to be realistically achievable based on the work completed by the Western Region a specific risk assessment, compliant with the CSM Regulation, will be required to ensure it is acceptable on the West London Line.

No major engineering issues are likely to be encountered during the construction of the proposed works beyond those that may be anticipated working in a dense, inner city urban environment.

Source: rail-record.co.uk

Figure 28: Detail from conceptual design sketch of the proposed relocation of the West London Line AC/DC changeover – Option 2 to Kensington Olympia (see Appendix A for full sketch)

STRATFORD REGULATING POINT EXTENSION

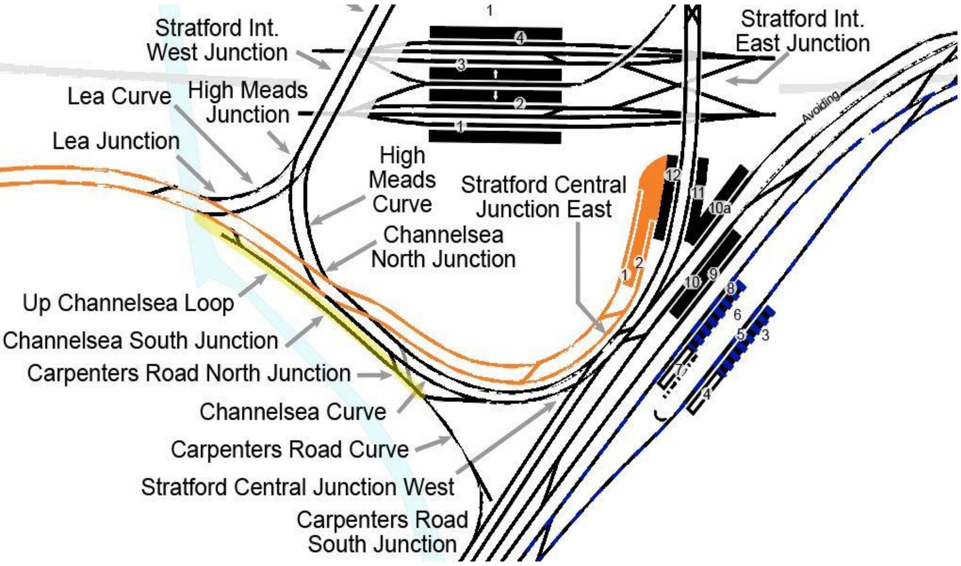

Figure 29: A map showing the Up Channelsea Loop at Stratford. Source: Franklin Jarrier – cartometro.com

Capacity analysis for this study emphasised in its conclusions that the key to making the timetable work is the ability to hold trains in strategic locations in order to match capacity between the orbital lines and the radial routes in and out of London (see 3.2.1). It therefore noted that holding capacity at Stratford for the longest freight trains (up to 775m) is essential, recommending that consideration is given to lengthening the Up Channelsea Loop at Lea Junction in particular.

In the Stratford area, there are loops to hold trains, but they are of limited length. Westbound freight trains held up in the Up Channelsea Loop (signal NL1286, see fig. 29) are subject to a maximum length of 707m if they are to be clear of Stratford Central Jn. To remain clear of passenger services on the Down Main, a westbound freight longer than 707m may need to be routed through platform 10A in the up direction, preventing any eastbound freight trains from passing through Stratford in parallel and blocking access to platforms 1 and 2 for Overground trains arriving from the NLL. This is not an adequate means of regulating traffic in such a busy part of the network and does not offer much opportunity to secure paths for 775m trains that need to be held before proceeding westbound onto the NLL.

The purpose of this scheme would be to provide a regulating point offering 775m standage for freight trains passing through Stratford towards the NLL, fully segregated from other traffic. This would be achieved by extending the existing Up Channelsea Loop to the North-West, so that it can accommodate a 775m train clear of Stratford Central Jn.

BENEFITS

This option offers combined capacity and train lengthening benefits, as the ability to regulate the longest trains at key interface points on the network increases the chances of finding them a compliant path through successive timetable structures as they pass from route to route (see 3.2.1 & 3.2.2). Without this capability, some trains may have to run at limited lengths or be unable to achieve a path at all. Enhancing the standage offered within the Up Channelsea Loop will also enable 775m trains to operate through Stratford with reduced performance risk, because they can be held in the loop if necessary during perturbation without overhanging any junctions and restricting the flow of other traffic.

FEASIBILITY

An initial engineering assessment undertaken by the Scheme Design Team for this study identified a conceptual design indicating how a loop long enough to accommodate a 775m freight train might be achieved (see fig. 31).

A new half through span will be needed to carry the extension to the loop across the River Lea. The existing bridge carrying Clarnico Lane over the railway is unlikely to require reconstruction as it has a span that is probably adequate to accommodate the additional track. The modern covered way supporting the hard-landscaped area on the west side of the River Lea has a span that is probably adequate to accommodate the additional track. However, the abutments of the covered way will probably be within the 4.5m wide hazard zone either side of the railway and a formal risk assessment will be needed to support the proposal, though this is not expected to highlight any major difficulties. A small amount of land acquisition will almost certainly be required on the north side of the line between the Clarnico highway overbridge and the Lee Navigation.

About half a dozen signals will need to be relocated, although this has not been looked at in any detail for this study. It is assumed that a pair of catch points would be installed at the exit from the extended loop to minimise overlap requirements although, this issue might better be dealt with using appropriate signalling controls if the scheme is developed further. The rear of a freight train of a full 775m in length will obstruct movements using the chord between Carpenters Road South Junction and Carpenters Road North Junction but this is no different to the situation that exists at present.

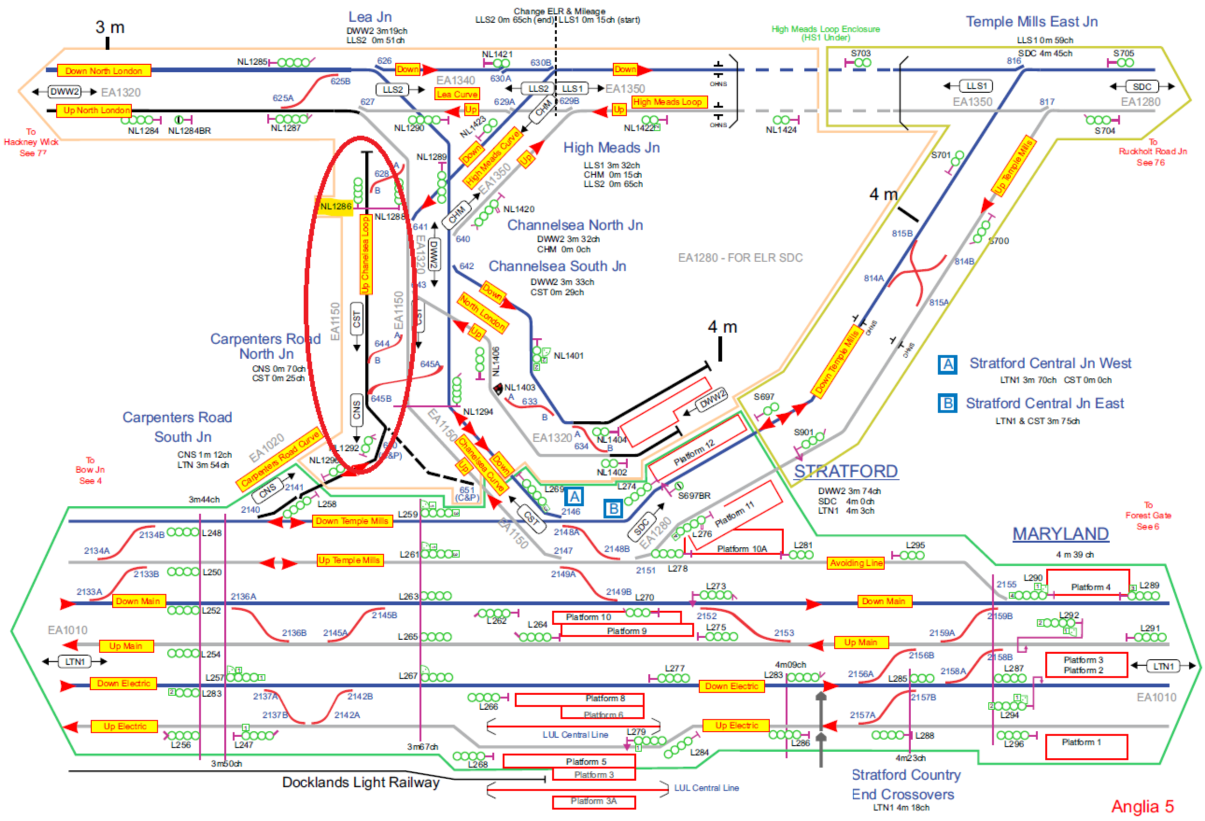

Figure 30: Stratford area track diagram, with the Up Channelsea Loop circled in red. Source: Network Rail

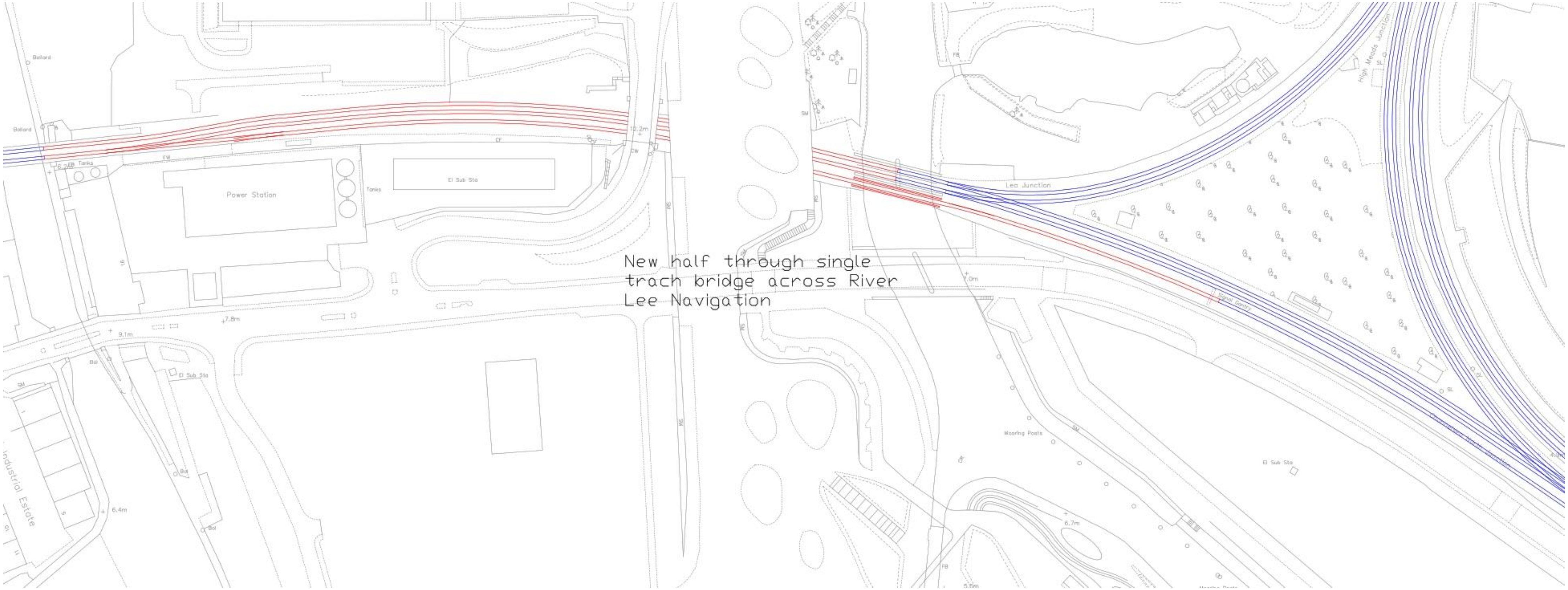

Figure 31: Detail from initial conceptual design sketch of the proposed Stratford Regulating Point Extension scheme (see Appendix A for full sketch)

NUNHEAD JUNCTION IMPROVEMENT

Rail freight stakeholders within the LRFS working group have consistently highlighted Nunhead as a priority location for improving the flow of freight around the London orbital routes. The junction to the immediate east of the station is a flat crossing where two lines of route and multiple passenger and freight services groups converge into the SLL, creating a pinch point for capacity. Freight train drivers, when consulted for input into this strategy, flagged the route eastbound from Peckham Rye through Nunhead and towards Lewisham as a challenging section on which to keep heavier trains moving. This is primarily a consequence of the relatively slow permissible speed of 25mph over Nunhead Junction when routed towards Lewisham, which follows a steadily rising gradient from Peckham Rye (see fig. 32).

A range of potential interventions for the Nunhead area have been considered, both by this study and other ongoing workstreams (see 3.3.5). A number of locations in the vicinity were examined as candidates for the installation of a loop to enable the regulation of freight traffic, as previously suggested by the Kent Area Route Study.[36] However, engineering feasibility assessment of these options was not favourable. An alternative suggestion of re-handing the junction so that Lewisham would become the faster route was also considered. This would have realigned Nunhead Junction to provide 60mph (40mph for class 6 and 7 freight) on the straighter route towards Lewisham, matching the existing speeds on either side of the junction on this route. This would result, though, in the Catford Loop becoming the branch route and a likely reduction in speeds permitted for trains to and from that direction. Given that non-stop passenger services operate via the Catford Loop and currently benefit from a 55mph speed through Nunhead Junction, it is likely that there would be a negative capacity impact resulting from a re-handing of the junction.

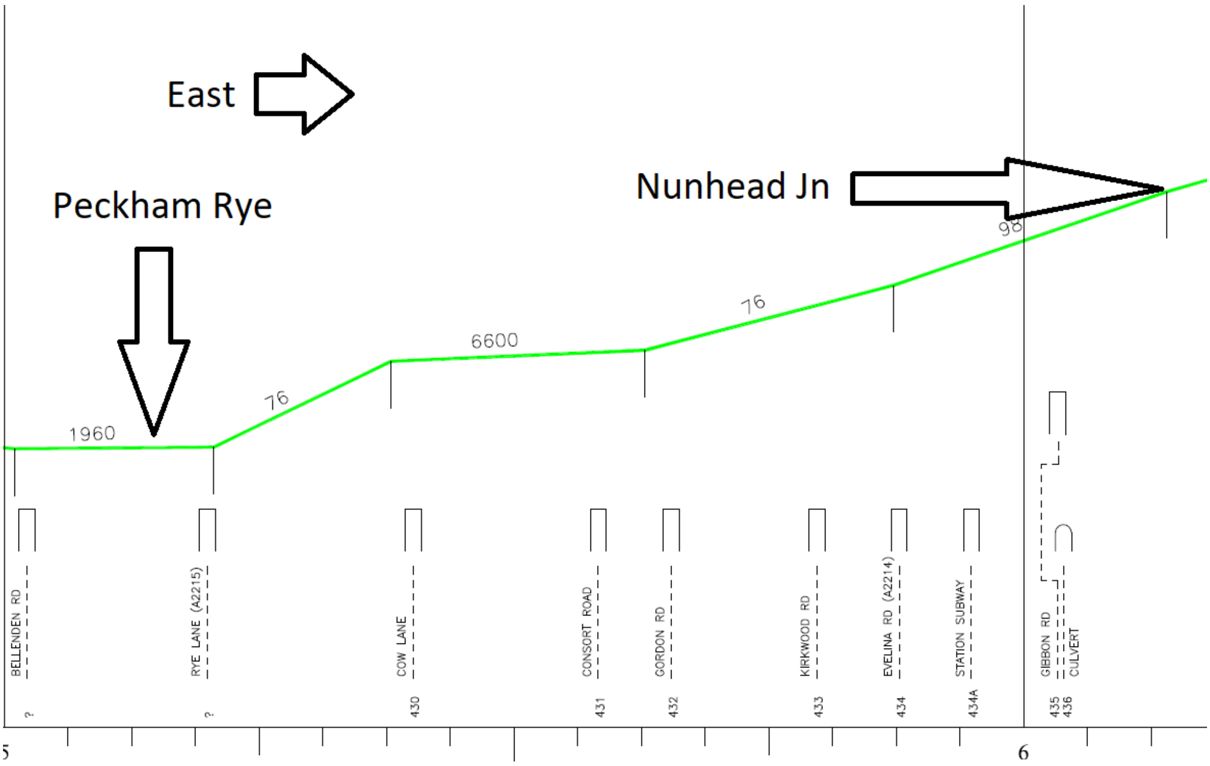

Figure 32: Gradient towards Nunhead (extract from Network Rail 5-mile line diagrams)

[36] *Kent Area Route Study*, Network Rail (2018)

Aerial view of Nunhead Junction, looking west towards Nunhead station. The route towards Lewisham is to the bottom right. Source: NR Routeview

The option proposed by this study is therefore for changes to the track alignment in order to increase the speed of the turnout towards Lewisham, as far as can be achieved without affecting the speed of the main route towards Catford.

BENEFITS

This option would primarily benefit the performance of eastbound freight flowing from the SLL towards the North Kent lines, one of the key rail freight corridors in the South East. Especially if combined with complementary signalling improvements, as suggested by the FOC drivers' contributions to this study and subsequently advised to the Victoria Resignalling programme (see 3.3.5), delivery of this option would enable freight trains to run at faster and more consistent speeds towards Lewisham. This would most likely increase right time presentation at the critical flat junction at Lewisham, as well as assisting the flow of passenger and freight trains to the Catford Loop by ensuring preceding Lewisham-bound traffic can clear Nunhead Junction as quickly as possible. Addressing the existing constraints to freight traffic through Nunhead, which by their nature most affect the heavier bulk traffic that characterises the North Kent corridor, would also support industry aspirations to maximise that payloads trains can haul.

FEASIBILITY

This is a relatively challenging scheme and it is only after a site survey has been undertaken and some initial detailed track alignment design completed that a clearer understanding of feasibility will be possible. The main route towards Catford and Shortlands Junction is quite sharply curved, and therefore heavily canted, while the route towards Lewisham curves away in the opposite direction. Current track design standards impose a limit on the amount of negative cant that is allowed in this situation. It is probably this limit on the negative cant that drives the 25mph line speed through the junction in the Lewisham direction. The constrained railway land boundary at this location leaves very little scope to realign the junction.

However, initial assessment has determined that it might be possible to achieve a marginal improvement in line speed in the Lewisham direction, without a consequential reduction in the Catford direction, by increasing the curvature of the plain line on the approaches to the junction while at the same time straightening the Lewisham route, as illustrated by fig. 34.

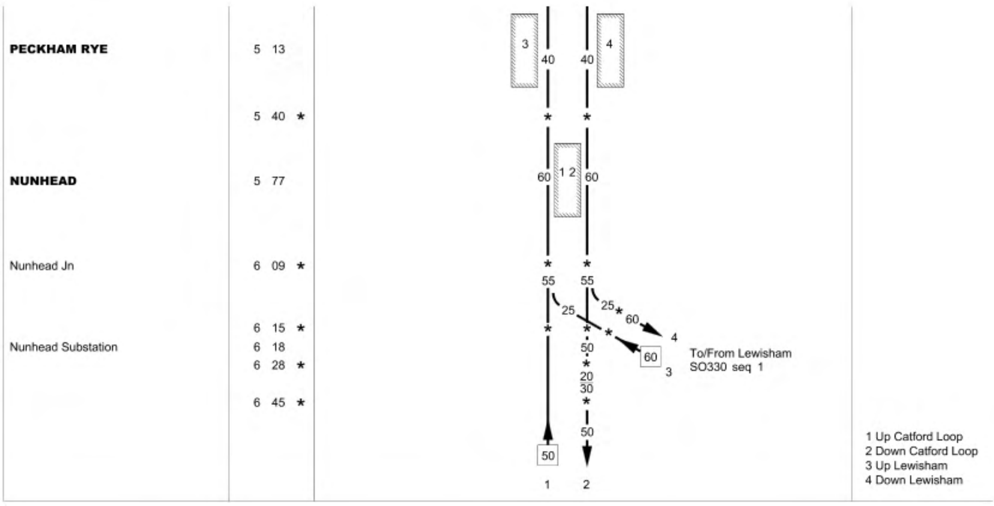

Figure 33: Source: Diagram of the Nunhead area, showing current line speeds at Nunhead Junction. Source: National Electronic Sectional Appendix

Figure 34: Detail from initial conceptual design sketch of the proposed Nunhead Junction Improvement scheme (see Appendix A for full sketch)

LONGHEDGE JUNCTION SPEED INCREASES

There is an opportunity to enhance Longhedge Junction, a key location for freight passing through the Battersea area, to enable higher speeds. This would complement potential line speed increases on the Ludgate and Kensington lines, which are currently undergoing early development by NR's Southern Region (see 3.3.5), providing faster transit between the SLL and WLL or Clapham Junction (for the BML or Windsor lines). This would benefit the numerous freight flows through this important part of the network, where two orbital routes connect to each other and to radial routes in and out of London to the south and south-west. London Overground SLL services running to and from Clapham Junction would also benefit from an increase to the existing 25mph line speed through Longhedge Junction.

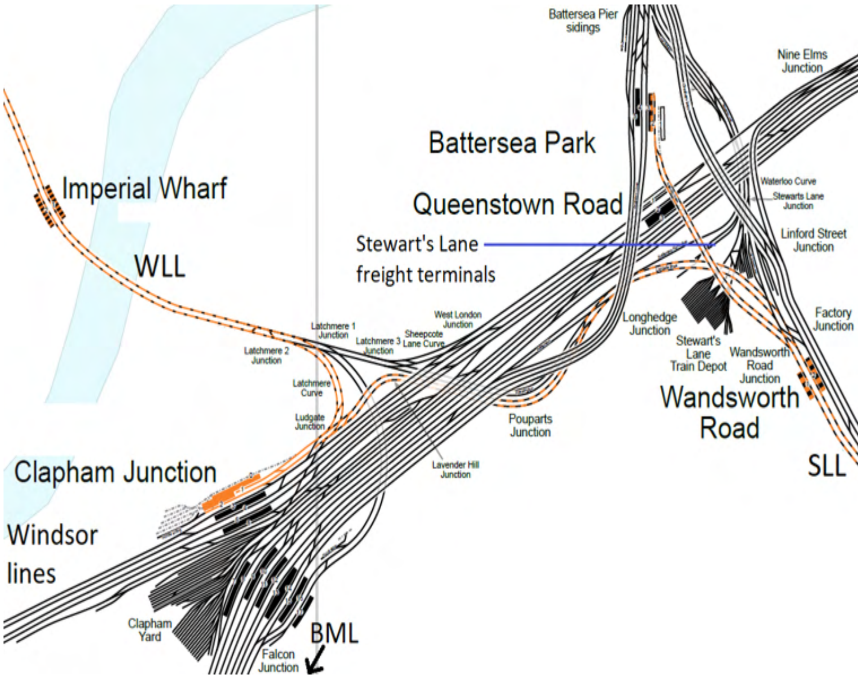

Figure 35: Map of the Battersea area. Source: Franklin Jarrier – cartometro.com

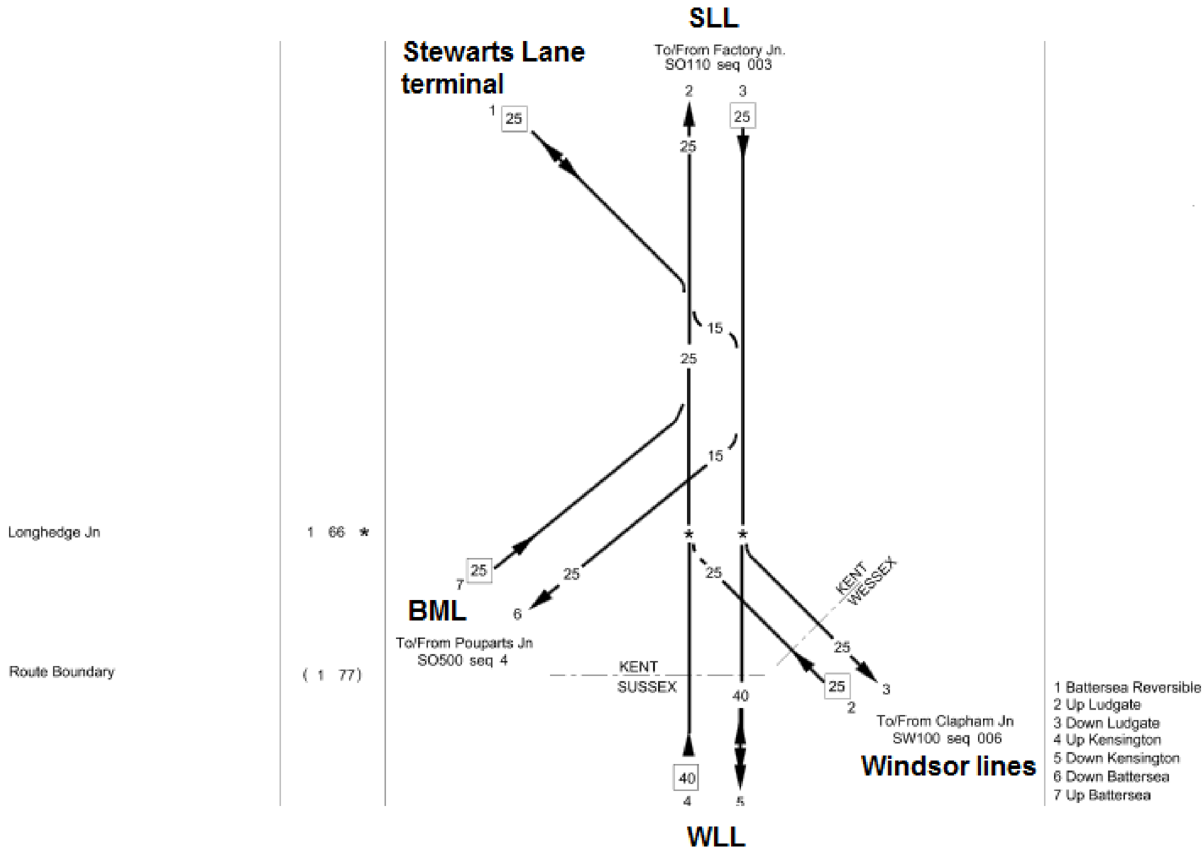

Figure 36: Current line speeds through Longhedge Junction with routeings for freight. Source: National Electronic Sectional Appendix

GOSPEL OAK SPEED INCREASES

This proposal would see the current 20mph line speeds through Gospel Oak increased, through an upgrade to the junction immediately to the west of the station. Improving the flow of traffic through this critical flat junction, where the NLL and GOB meet, would be of benefit for the wider operations and performance of these orbital routes. Freight trains in particular, which run non-stop through Gospel Oak, using all available routes, would see a notable uplift to how quickly they are able to pass through the area. This would not only contribute to achieving the fast end-to-end cross-London paths that are a priority for freight but would also reduce the time trains would occupy the junction, increasing performance resilience at Gospel Oak, the impact of which would drive improvement right across the NLL and GOB.

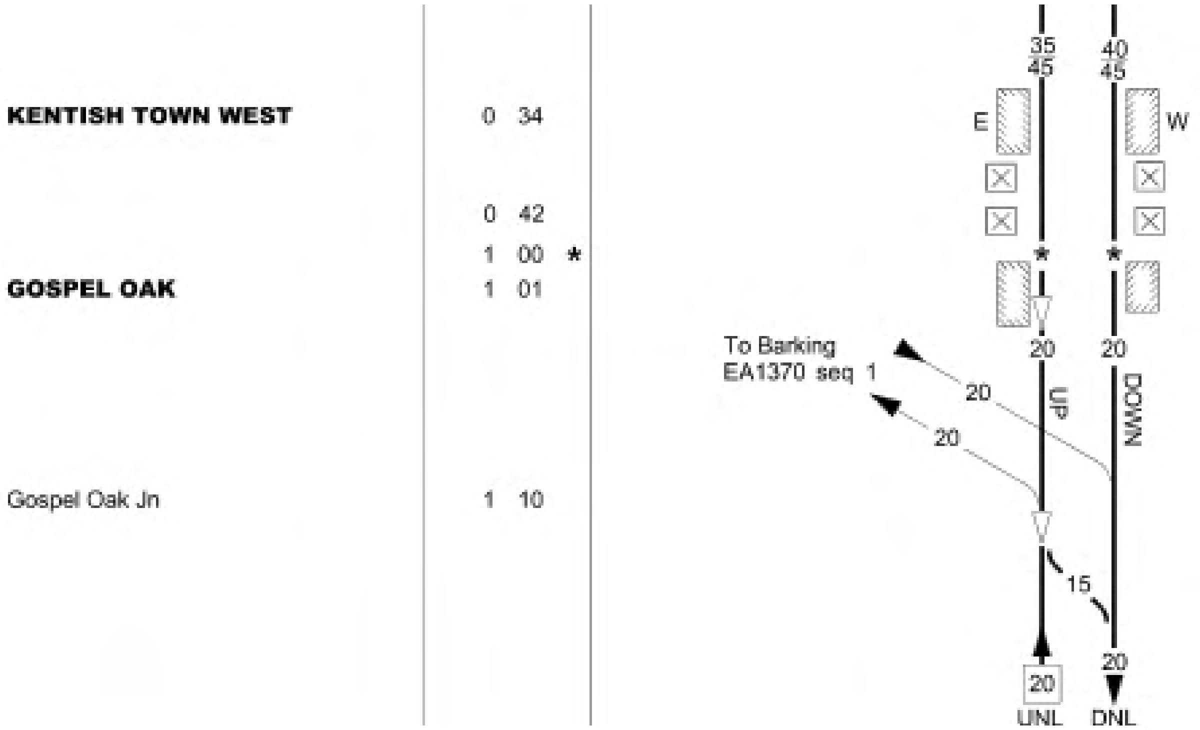

Figure 37: Current line speeds through Gospel Oak Source: National Electronic Sectional Appendix

EAST COAST MAIN LINE SOUTH BI-DIRECTIONAL CAPABILITY

The southern end of the East Coast Main Line, from Kings Cross to Stoke Tunnel (about five miles south of Grantham), is due to be the first part of a national main line to be fully converted to ETCS digital signalling. This will deliver a range of benefits to capacity, performance, asset sustainability, safety and wider economic benefits, all of which freight to and from London on this major corridor will share in. The East Coast Digital Programme is currently in the process of developing a Full Business Case, in order to secure a Decision to Deliver under the RNEP (see 2.3.6). This will support deployment of digital technology on the ECML South through a series of tranches, including progressive roll-out and transition to ETCS, over the course of CP6 and CP7.[37]

[37] For more information on the East Coast Digital Programme, see https://www.networkrail.co.uk/running-the-railway/our-routes/east-coast/east-coast-digital-programme/

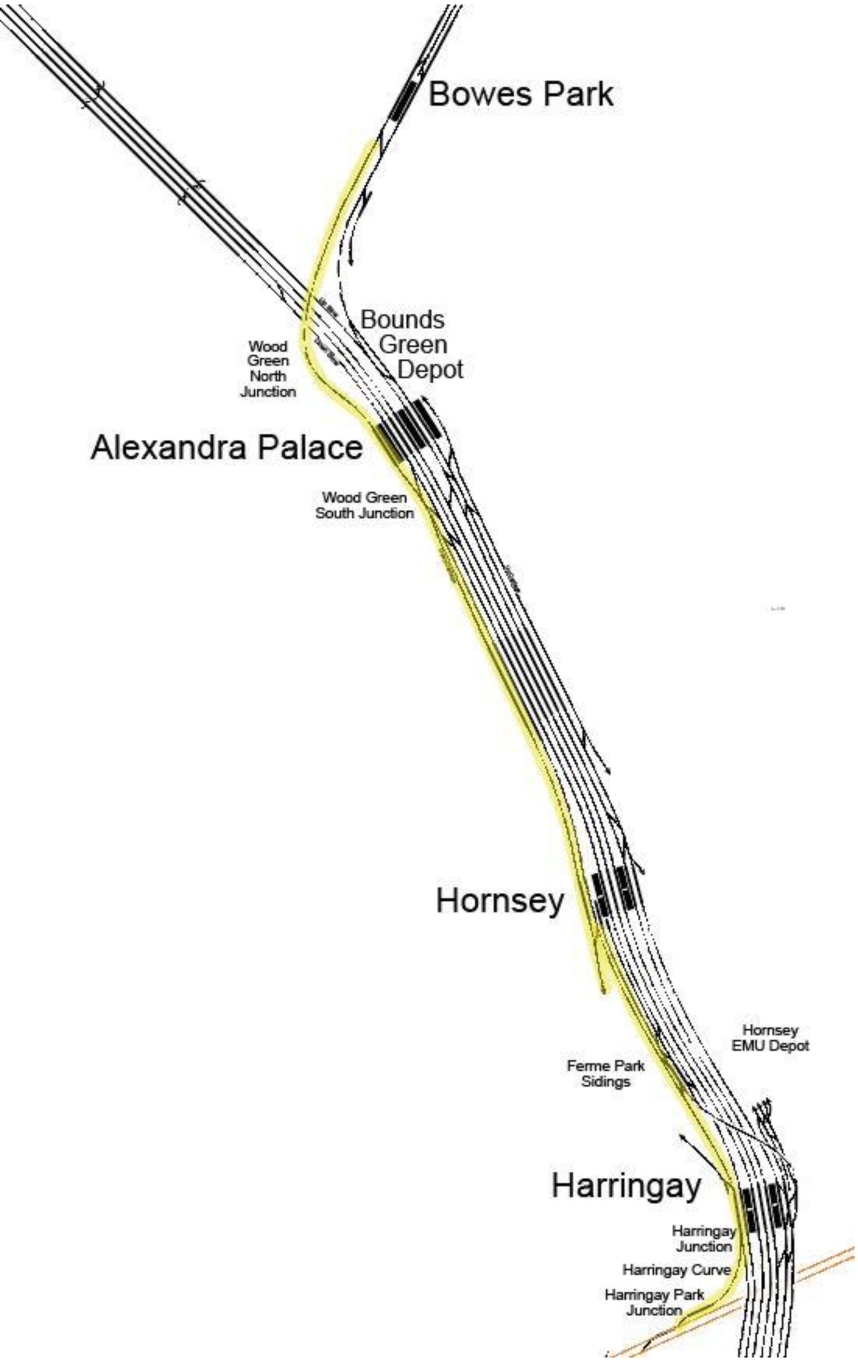

Figure 38: Map of the ECML between the Hertford Loop and the Harringay Curve, with proposed new southbound freight route highlighted. Source: Franklin Jarrier – cartometro.com

ETCS signalling, because it does not rely on fixed lineside equipment facing one way or another, is bi-directional by nature. Where the infrastructure layout allows, the digital signalling system is able to communicate with drivers to continually regulate train movement, whichever direction they are running along the track. This presents an opportunity for freight to make use of a new routeing at the southern end of the ECML, which current signalling and track layout do not permit.

Southbound freight trains from the Hertford loop (by which most freight is routed between Alexandra Palace and Stevenage) cannot currently access the GOB at Harringay. The London end of the ECML is laid out according to direction, with all down (northbound) lines on the western side of the formation and all up (southbound) lines on the east. The single-track Harringay Curve connects the GOB to the down side of the ECML only, with bi-directional signalling provided to enable freight trains to get into and back out of the aggregates terminal at Ferme Park. If this capability extended further northwards, through Hornsey and Alexandra Palace to Bowes Park on the Hertford Loop, freight trains would be able to run directly on to the GOB, or access Ferme Park, from the north. This would avoid running on the busiest section of the route towards Kings Cross, in order to reach the NLL via North London Incline from Copenhagen Junction. Running via the Incline restricts maximum trailing weights for freight trains (1605t with a class 66), so the availability of an alternative routeing via Harringay would also facilitate train lengthening benefits.

This strategy therefore proposes that a scheme is developed to install new track layout features that would facilitate such a routeing for freight trains, enabling them to take advantage of the bi-directional capability brought about through ETCS deployment. The main expected change would be the creation of a facing crossover at Bowes Park, to enable southbound freight trains to run onto the Down Enfield Viaduct in the up direction. Adjustments to the OLE, to align with the amended track layout, would also need to be delivered within the scope of this scheme.

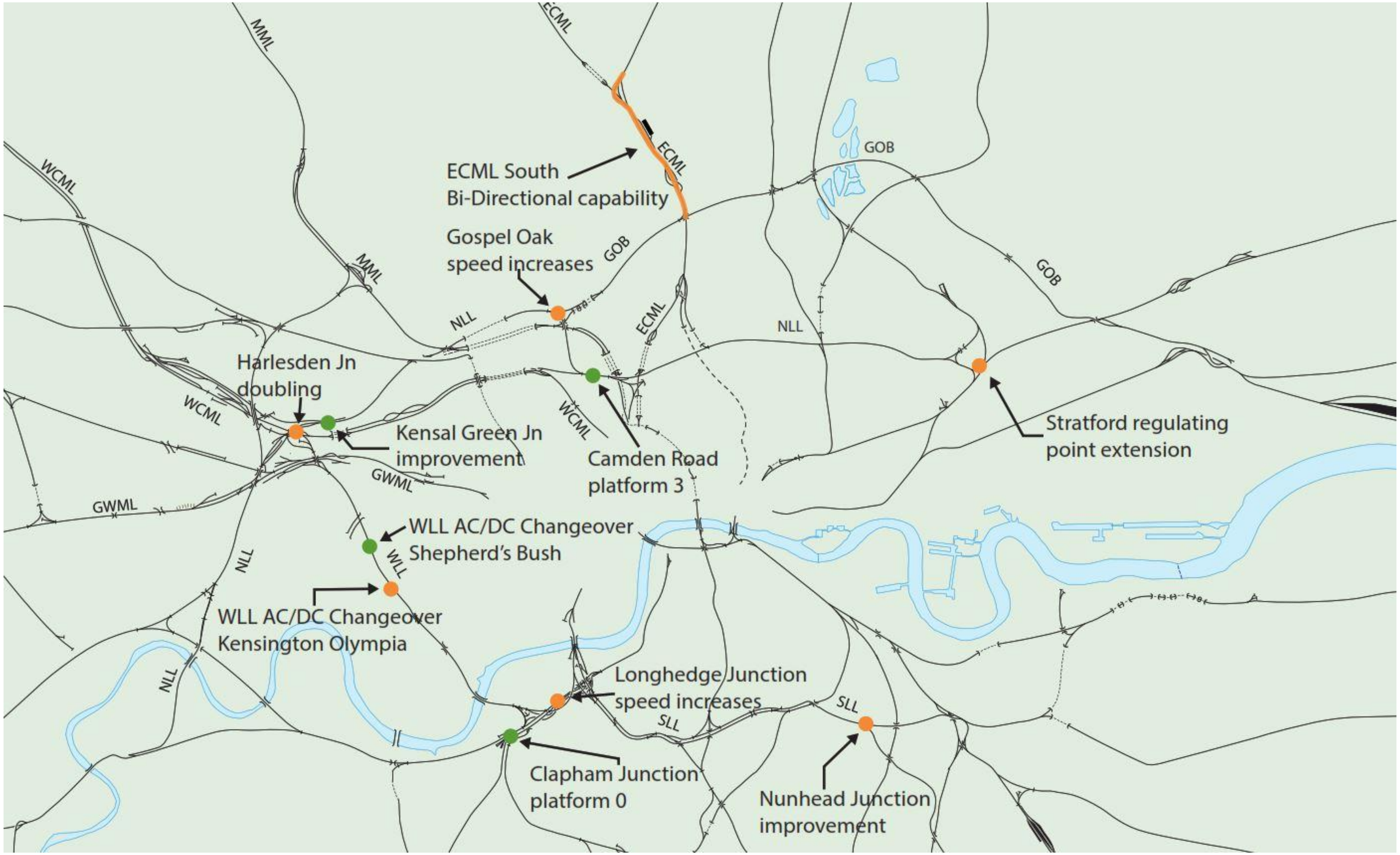

Figure 39: Map showing the core interventions (green) and the additional options (orange)

HEAVY AXLE WEIGHT RESTRICTIONS

In consultation with train drivers for the FOCs and NR structural engineers, this study has identified a list of Heavy Axle Weight restrictions on routes used by freight in London, which are known to negatively impact the movement of heavier trains around the network (see 3.2.2). The resulting proposal, as part of the LRFS, is for packages of works to enable the removal of these restrictions to be progressed.

SOUTHERN REGION IMPROVEMENTS

Review of two HAW restrictions on the Southern Region, after they were highlighted by freight drivers, has resulted in the immediate easing or lifting of speed restrictions, at Balham and near Crayford. The speed restriction of 20mph for HAW freight at Balham now applies to the BML Fast Lines only, meaning the majority of freight will not be affected. Works to address structural issues with Balham High Road bridge are also planned for during CP6, which should allow the restriction to be removed completely. The restriction at Saw Mill viaduct, near Crayford, has been entirely lifted, allowing HAW freight trains to pass at 40mph instead of 15mph.

LRFS PROPOSALS

CROSS-LONDON

There remain several HAW speed restrictions in place at sites within London, on the Wessex and Anglia Routes, which are detailed in the table below. These are locations that have been highlighted by train drivers as constraining to freight operations and where the structures responsible are not currently funded for any remedial works. It is therefore proposed by this report that enhancement works to the relevant structures are undertaken, in order to permit the removal of these restrictions. For the first two examples, on the NLL, removing the speed restrictions would deliver a quantifiable capacity benefit, as Sectional Running Times (SRTs) that apply for these sections are longer for Heavy Axle Weight trains than for other freight trains. In all cases there would be a clear benefit to performance achieved by removing the requirement for some trains to slow down substantially when passing over these structures.

Table 4: Heavy Axle Weight speed restrictions within London

Location	Restricted line speed for HAW trains	Normal freight line speed	Region	Route
Kentish Town viaduct – NLL between Camden Road and Kentish Town West	10mph	35mph Up North London 40mph Down North London 20mph both lines approaching Camden Road	Eastern	Anglia

Clarnico's viaduct and River Lee bridge – NLL between Hackney Wick and Lea Junction	20mph	40mph	Eastern	Anglia
Bridge over the Chiltern Main Line and London Underground Metropolitan and Jubilee lines – Dudding Hill line between Neasden Junction and Dudding Hill Junction	10mph	30mph	Eastern	Anglia
Old York Road bridge – Windsor lines, Wandsworth Town station	10mph	40mph class 6/7 trains	Southern	Wessex
Latchmere Road bridge – Ludgate lines between Clapham Junction and Longhedge Jn	10mph	25mph	Southern	Wessex

GOSPEL OAK-BARKING LINE

NR structures engineers have raised the condition of underline structures on the GOB as a particular concern. Trains on this route, which runs above street level on a series of arched viaducts for a substantial stretch of its eastern half, pass over a very large number of different structures. The GOB features alternating sections of harder and softer materials beneath the permanent way, due to the presence of a high number of wheel timber bridges, which are challenging to maintain even at current levels of freight traffic. The sheer variety and complexity of structures on this route means that it is likely that a wholesale upgrade will be required at some point in the future, if the level of growth represented by the ITSS developed for this study is to be realised.

The GOB, looking west from Wanstead Park station, on viaduct and succession of underline bridges. Source: NR Routeview

HAW traffic on the GOB is now subject to a blanket speed restriction of 20mph throughout the almost 3-mile long section between Walthamstow Queens Road and Woodgrange Park Junction, due to the succession of structures in sub-optimal condition. The LRFS therefore includes a proposal that a package of structures enhancement works focused on the GOB be developed, to facilitate the removal of the current speed restriction for HAW traffic and to strengthen the route so that it is capable of accommodating future rail freight growth.

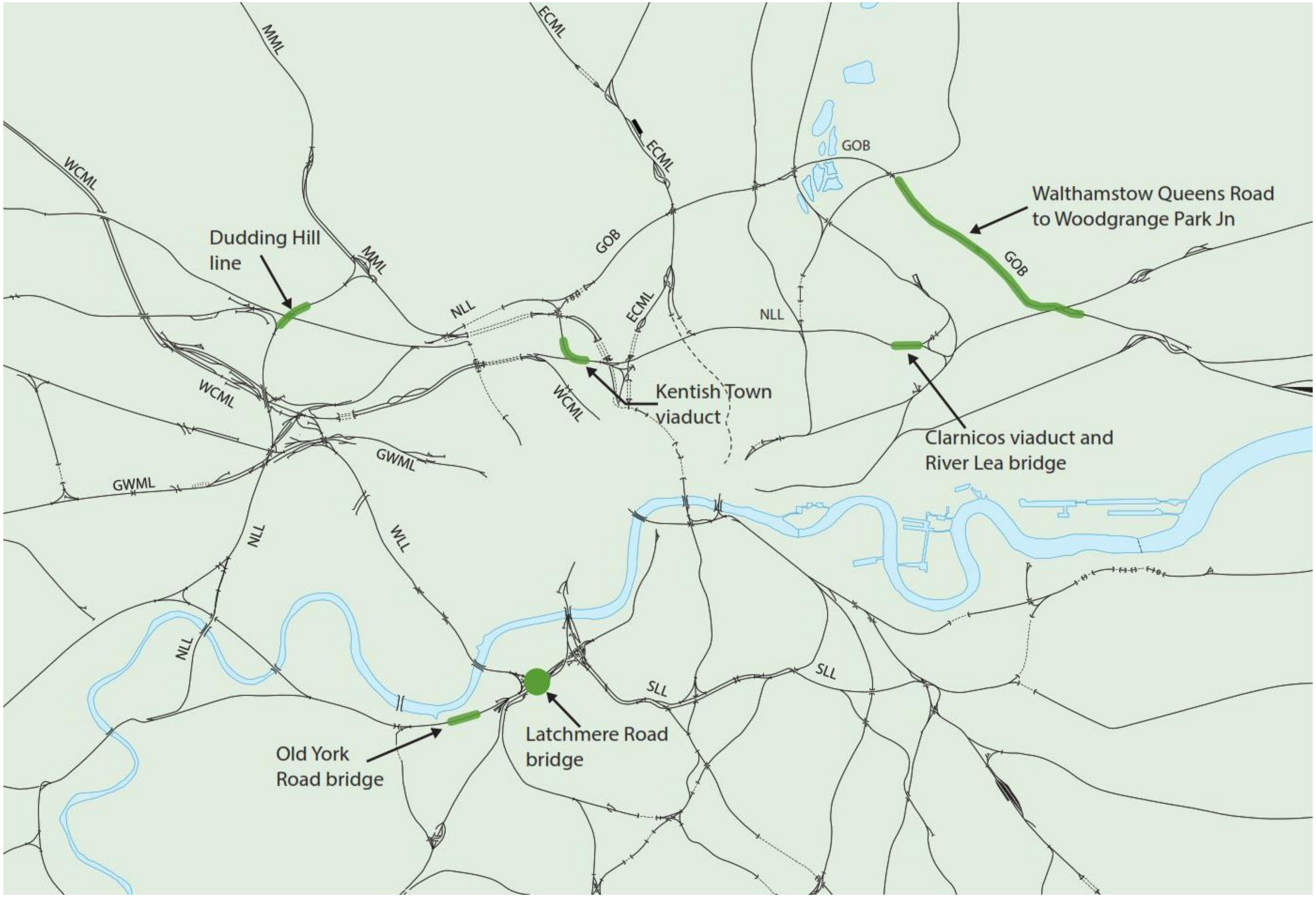

Figure 40: Map showing speed restricted locations for HAW trains.

GENERAL STRUCTURES ISSUES

Although these proposed packages of works should address the structures currently known to cause speed restrictions that negatively impact freight operations in London, maintaining the infrastructure to a level that can safely accommodate Heavy Axle Weight loads is an ongoing challenge for Network Rail. There are no permanent fixes when dealing with structures that have been bearing railway traffic since the nineteenth century. Ongoing maintenance funding to prevent the need for HAW speed restrictions to be imposed in the first place is just as critical as interventions to remove existing ones.

Ideally, key routes for bulk flows would be maintained to RA10, rather than RA8 with HAW trains permitted under dispensation (see 3.2.2). This would prevent the imposition of HAW speed restrictions or the possibility of dispensations being removed should structures deteriorate too far for HAW traffic to safely operate. Many rail freight operations rely on the ability to run above RA8 in order to be economically viable, so addressing these risks would be of significant benefit to the sector. However, formalisation of RA10 would of course incur maintenance and renewal costs over and above current funding. The standard to which underline structures are maintained and the impact this has on the ability of freight trains to deliver the most efficient loadings (or to operate at all) is therefore an area of major importance for the railway's funders to consider.

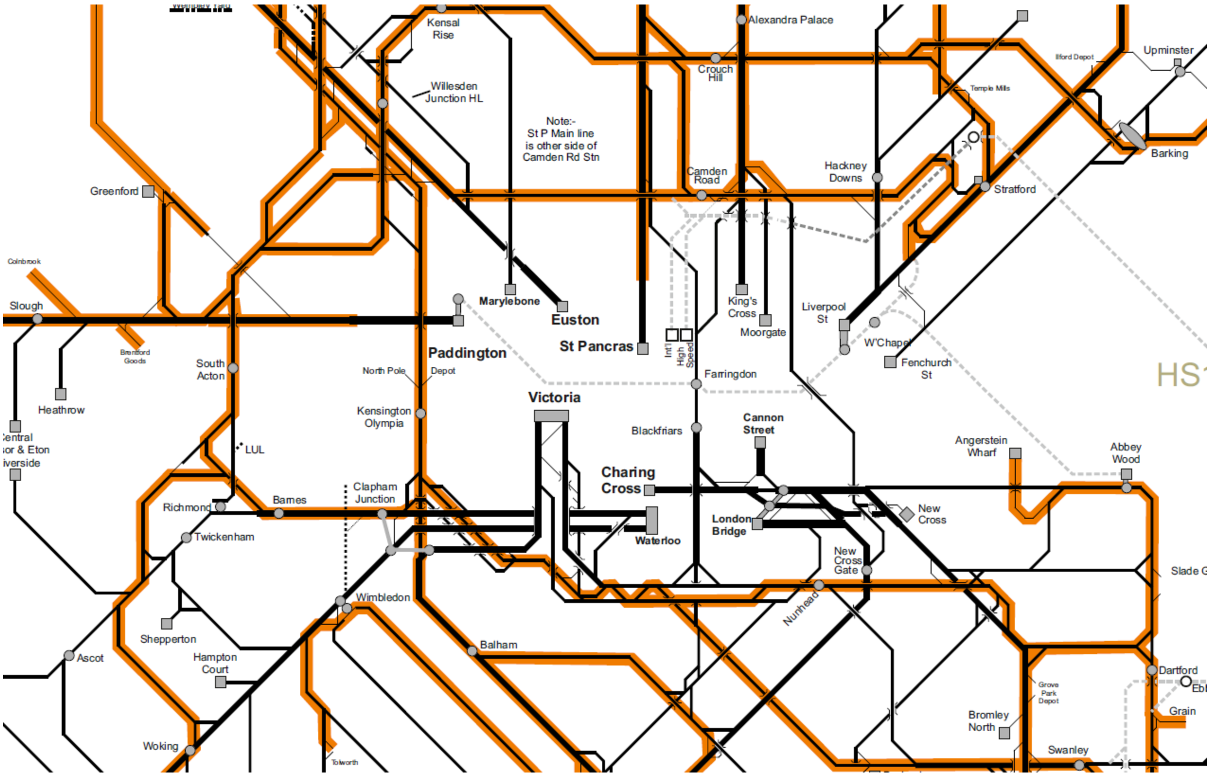

Figure 41: London detail from Heavy Axle Weight Freight Flows map, showing all routes typically used by HAW traffic. Data from P6, 2020/21. Source: Network Rail Freight team

GAUGE ENHANCEMENTS

The portfolio of options developed from this strategy needs to include a cross-London programme of gauge clearance, to address existing gaps and open up new market opportunities for rail freight in the long-term future (see 3.2.2).

An immediate priority is the NLL from Kensal Green Junction to Acton Wells Junction, which is currently only published as W9. This route has been used in the past for diversions of W10

Source: Network Rail

traffic when the main Southampton to the West Midlands corridor has been blocked, with trains to intermodal terminals in Yorkshire routed eastwards from Reading into London, joining the NLL at Acton Wells, then via the orbital routes to reach the ECML. However, clearance of the outstanding gauge gap in the Willesden area has yet to be formally published. Given the previous use of the route by higher-gauge traffic under dispensation, there should not be any need for any significant clearance works to make W10 status permanent, therefore this should be progressed as soon as possible.

Further work to understand what would be required to achieve W12 clearance on the NLL and GOB is also recommended. This stands to enable rail freight to take advantage of emerging opportunities in the short-sea market from the Essex Thameside ports and is a priority for stakeholders. A proposal for enhancement to W12 across north London should be incorporated into subsequent business case development as the LRFS portfolio enters the RNEP.

Gauge enhancement of the Channel Tunnel classic routes, which run through south and west London to Wembley, is currently under early development by the Southern Region and sits in the 'Determine' stage of the RNEP (see 2.3.6). The ultimate aim is to progress a programme of clearance works to achieve full W12, but opportunities to deliver incremental improvements by clearing for wagon and box combinations above what is possible today, but short of W12, are also being actively considered. The LRFS supports the continuation of this work and the aspiration to eventually enhance the Channel Tunnel routes to W12, both with a view to the revival of regular flows of international intermodal traffic and as an enabler for the expansion of the domestic intermodal network into the South East, so that rail can play a much greater role in serving the consumer goods market of London and the wider region.

3.3.4 PHASING OF ENHANCEMENTS

The LRFS proposes a broad portfolio of enhancements, for delivery over a thirty-year horizon, so it is naturally to be assumed that the need to begin work towards each intervention will arise at different times for different options. It is not possible at the strategic level to establish a clear programme for such an extensive and far-reaching set of proposals, but an indication of which schemes are likely to be required sooner, or where logical delivery opportunities may arise, can be given.

IMMEDIATE PRIORITIES

A number of the schemes listed under 'Additional Options' are intended to address known capability gaps that exist today, or to drive incremental capacity and performance improvements that would benefit operations on the orbital routes immediately. Since these are not directly dependent on alignment with other projects or programmes and are not primarily required for long-term capacity growth in the way the core interventions are, these schemes should be brought forward as soon as is practically possible. This category includes:

- A package of works to address Heavy Axle Weight restrictions across routes in London
- A package of works to address the Heavy Axle Weight restriction on the Gospel Oak-Barking line and to make it fit for future freight growth
- Stratford Regulating Point Extension
- Nunhead Junction Improvement
- Gospel Oak Speed Increases
- 'Target 26' (see 3.4.2)
- Gauge Enhancements
    - Formal publication of W10 on the NLL from Kensal Green Junction to Acton Wells Junction
    - Development work for W12 clearance from the Essex Thameside ports across north London

DEPENDENCIES

Several of the schemes within the LRFS portfolio are closely linked, either to one another, or to other ongoing or future railway projects. Delivery timescales for these will therefore be heavily determined by the need to align with other infrastructure developments.

CLAPHAM JUNCTION

A 'short-term' congestion relief scheme is in development for Clapham Junction station, to address passenger overcrowding for at least the next ten years, allowing for a more permanent solution to be identified through the 'long-term' programme in the mean-time (see 3.3.5). The 'short-term' proposal includes the installation of a new modular passenger footbridge towards the London end of the platforms at Clapham Junction, to provide a new interchange route that will ease pressure on the existing bridge and subway. The landing point for this new bridge, on platform 1, is incompatible with the installation of Platform 0, so for the time that it remains in place, it is expected that it will not be possible to deliver the new bay platform. Since congestion was a major immediate problem at Clapham Junction prior to the Covid-19 crisis and will remain an unresolved issue as passenger numbers recover, the footbridge is the greater priority at this point in time. However, the conclusion of the capacity analysis for the LRFS, regarding the sequencing of enhancements, was that interventions for the WLL should be prioritised if the 2033 ITSS is to be realised. It is therefore critical for growth on the WLL that the Clapham Junction Long-Term programme continues to

Source: Network Rail

progress, allowing for the removal of the modular bridge in the early 2030s.

LONGHEDGE JUNCTION SPEED INCREASES

Delivery of this scheme would enhance the benefits of the line speed improvements on the adjacent Kensington and Ludgate lines that are currently being considered by the Southern Region. If funding for a full renewal of the junction, sufficient to achieve a complementary uplift to line speeds, can be secured through the LRFS, it may be possible to align delivery of works at Longhedge Junction with those for the Kensington or Ludgate lines. It may also be possible to upgrade the junction by way of making a contribution to an already planned partial refurbishment, so that the scope can be expanded to an enhanced renewal and delivery brought forward. This scheme should therefore be prioritised for delivery within CP6/CP7 (i.e. by the end of the 2020s).

HARLESDEN JUNCTION DOUBLING

This proposal is intrinsically bound up with the enhancement of Kensal Green Junction. It is therefore envisaged that works at both locations will be packaged together for progression as a single scheme, with the overall purpose of upgrading the NLL-WCML connection to optimise the flow of freight trains through this critical part of the network.

ECML SOUTH BI-DIRECTIONAL CAPABILITY

This proposal is dependent on the signalling capability that will be realised through the East Coast Digital Programme. This is to be delivered in phases over the course of CP6 and CP7. Installing the track layout necessary for freight trains to run up the Down Hertford/Down Slow 2 line from Bowes Park to the Harringay Curve should be developed to achieve efficient alignment with the wider programme. This most likely means that delivery will be required, at the latest, by the time of the completion of the planned Tranche 4 of the East Coast Digital Programme, ‘Progressive Roll-Out and Transition to ETCS’. Freight stakeholders have expressed support for the incorporation of this proposal into the programme itself, by means of a scope variation.

CORE INTERVENTIONS

Although the overall recommendation of the capacity analysis for this study was to propose five enhancements required to accommodate the majority of the 2043 off-peak ITSS, a commentary on which would also be required for the 2033 specification was also provided.

Source: Network Rail

WEST LONDON LINE

The firm conclusion was that the WLL should be the highest priority, with relocation of the AC/DC changeover and Clapham Junction Platform 0 deemed likely to be crucial for capacity even in 2033 with the intermediate level of service (12tph) proposed in the specification. As noted above, Clapham Junction Platform 0 is dependent on the timing of the removal of the modular station footbridge, which in turn relies on the progress of the Clapham Junction Long-Term programme (see 3.3.5). Nevertheless, it should be possible to begin development and design activities in advance of this, as timescales become clearer, so that Platform 0 can be delivered as soon after the bridge removal as possible.

Moving the AC/DC changeover is not bound by any equivalent external dependency and should therefore be the first of the core interventions brought forward for development, design and delivery, following completion and approval of the portfolio business case for the LRFS. Whether the OLE is extended to Shepherd's Bush or Kensington Olympia should not affect timescales in any significant way, with a decision on the preferred option to be made during the course of further development. In addition, the capacity analysis concluded that a 3-minute headway on the WLL is also essential, if freight and passenger services on the route are to grow to the level of the 2033 off-peak ITSS. Given that ETCS deployment on the WLL is currently planned for CP9 (2034-2039), in reality the latter half of the 2030s is the realistic expectation for fully realising the specified capacity uplift. This to some degree mitigates the urgency of bringing forward the two WLL-specific core interventions, though it would be desirable for Clapham Junction Platform 0 and relocation of the AC/DC changeover to have been delivered by the time digital signalling is commissioned on the route.

CAMDEN ROAD

Camden Road Platform 3 will likely be required as soon as there is a need to terminate London Overground services there. It may be possible for a limited number of trains to turn around by running to the Primrose Hill area and reversing, but this would require installation of a new crossover and/or bi-directional signalling on at least one line. Reversal on a running line, where freight often passes through to and from the WCML, is a less viable long-term solution than a dedicated turnback platform would offer.

Source: Network Rail

The requirement for Platform 3 will depend to a large degree on the rate of passenger demand growth on the NLL and whether this continues in future to be concentrated east of Camden Road, as currently expected. It is also closely linked to the capacity constraint at Hampstead Heath Tunnel and how long this remains an obstacle to increasing the number of through services west of Camden Road. Even if a regular Camden Road – Stratford Overground service does not emerge as a future requirement, the performance resilience and operational flexibility a third platform would provide would be immediate benefits of delivery at any time.

There is an aspiration among local stakeholders in Camden for the currently disused track bed to be converted into a community garden, known as the 'Camden Highline'. Network Rail have been collaborating to facilitate this proposal in the short- to medium-term and if an agreement is reached Network Rail will maintain the right to return the infrastructure to operational rail use if required at any point from 2035 onwards.

OTHER SCHEMES

Headway reductions on the NLL and GOB are longer-term requirements and should be progressed with a view to delivery by the 2040s, in line with the Digital Railway Long-Term Deployment Plan.

The LRFS capacity analysis suggested that the enhancement of Kensal Green Junction would not necessarily be essential to accommodate the 2033 off-peak ITSS, which could likely be planned with the current 4-minute margin remaining in effect. A 3-minute junction margin is needed to accommodate the level of hourly capacity represented by the 2043 off-peak ITSS. However, whilst in terms of theoretical capacity provision the scheme (including the associated improvement of Harlesden Junction) may not be essential until the 2040s, the benefits it would provide to real-world operations at any timescale suggest that delivery should not be unduly delayed. Freight stakeholders have therefore expressed a clear view that, in recognition of the criticality of the NLL/WCML connection for cross-London freight flows, this strategy's proposals for Kensal Green and Harlesden Junctions should be developed and delivered as soon as possible.

There are also practical considerations regarding the engineering access required to deliver these enhancements that further support such an approach. Given that Kensal Green and Harlesden Junctions are located in a part of the network with a large amount of complex

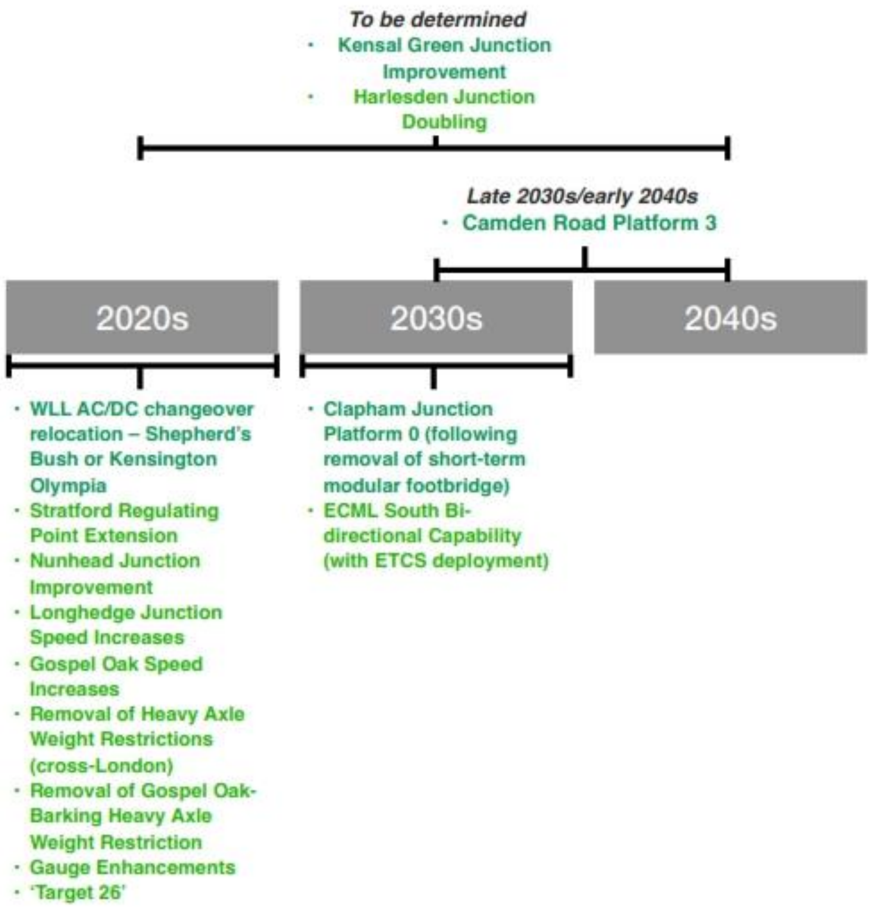

Figure 42: Indicative timeline of options for funders proposed by the LRFS.
N.B. suggested date ranges are extremely high-level and subject to change as schemes develop.

railway infrastructure, where access for engineering works is not easily secured, any opportunity to align delivery with other major works over the course of the next two decades should be taken advantage of.

3.3.5 OTHER WORKSTREAMS

This study has identified several other current areas of activity that are significant for the future development of rail freight in London. This includes elements of infrastructure renewal and enhancement projects or programmes that are already being developed by Network Rail. It also includes other strategic studies carried out under NR's Long-Term Planning Process and the proposals they are expected to put forward. Also noted are industry technical studies that are intended to address operating constraints for rail freight and which, in doing so, would benefit flows in the London area.

VICTORIA RESIGNALLING

Network Rail is renewing the signalling across large parts of the railway network in south London, through a phased programme that will see the re-control of lines formerly signalled from Victoria Area Signalling Centre to the Three Bridges Rail Operating Centre (ROC). Consultation with freight train drivers through this study has identified suggestions for minor signalling improvements at Nunhead and Crofton Road Junction, which would improve the flow of freight trains along the SLL by reducing the extent to which they are made to slow down on approach to key junctions. The proposals for these locations, which fall under the Victoria Phase 5 recontrol area, have been shared with colleagues in Southern Region. They will be considered as Phase 5, which is planned for commissioning in late 2024, is developed.

BATTERSEA AREA LINE SPEED IMPROVEMENTS

The Southern Region is also examining opportunities to increase line speeds through the Battersea area, on lines regularly used by freight. A feasibility study is in progress and will advise on increasing line speeds between Factory Junction and Clapham Junction Platform 2, up to a possible 45mph. Any increases that can be achieved along this route would stand to benefit freight operating between the SLL and the Windsor Lines through Clapham Junction. In addition, a proposal to increase the line speed on the Kensington lines, between Longhedge Junction and Latchmere No. 2 Junction, to 30mph for freight is also in the early stages of development. This is the route for freight flows between the SLL and WLL. The LRFS proposal for speed increases over Longhedge Junction (see 3.3.3), where the Kensington and Ludgate lines converge, would complement these line speed improvements, providing consistently higher line

Freight train approaching the SLL from the Battersea area. Source: Martin Addison - geograph.org.uk/p/5761712 speeds for freight through the Battersea area, where they are predominantly only 25mph at present.

RIPPLE LANE NODAL YARD

This project plans to upgrade the legacy freight yard at Ripple Lane, near Barking, to the standard of a nodal yard, strategically located at the interface of the Tilbury loop (for the Essex Thameside ports) and the cross-London orbital routes. A nodal yard at Ripple Lane would enable multiple freight trains to be regulated in order to achieve high quality paths across London via the NLL and GOB, allowing the best use of limited capacity on these busy lines, maximising the number of paths available for freight trains and providing a platform for future programmes to establish additional passenger capacity on these routes. As discussed in 3.2.1, the ability to hold trains at strategic locations near to where radial and orbital routes meet is key to ensuring the smooth and expeditious flow of freight across London. The project is currently in the design stage of the RNEP (see 2.3.6).

CLAPHAM JUNCTION LONG-TERM

This programme is considering options for a comprehensive redevelopment of Clapham Junction, in order to address both pedestrian capacity around the station and rail network capacity for trains operating through it. It is currently in an early stage of maturity, but depending on the options progressed in future, the programme may eventually incorporate elements that will be of benefit to freight in the area. For example, if grade separation of Falcon Junction is included in the scope, this would be positive for freight flows between the BML and WLL. Long-term interventions to alleviate crowding at Clapham Junction are also a key dependency for the proposed Platform 0 scheme, as a permanent solution will be needed to replace the modular footbridge planned under the Short-term project before the new platform can be installed (see 3.3.4).

ANGERSTEIN CHORD

This proposed scheme would involve the creation of a new chord between the Angerstein's Wharf branch, which provides access to major freight terminals on the North Greenwich peninsula, and the North Kent lines between Charlton and Blackheath. The existing connection off the branch faces eastwards through Charlton, necessitating a lengthy and circuitous route via the North Kent lines for traffic bound for or originating from the West. This accounts for the majority of trains serving Angerstein, with regular timetabled services between the terminal and others around London such as Stewart's Lane, Acton and King's Cross, as well as origins/destinations that are further afield but require a cross-London routeing, Bardon Hill quarry in Leicestershire being just one example.

Stockpiles and hopper facilities for primary and secondary screening, at the Angerstein Wharf terminal. Source: Network Rail

The Kent & Sussex strategic planning team have conducted a pre-SOBC study into potential infrastructure solutions to address these issues. This has involved the development of a strategic case, assessment of feasibility and economic benefits and engagement with stakeholders to prepare the scheme for entry into the RNEP. A Decision to Initiate is now sought for the Angerstein Chord, which would allow it to be taken forward into more detailed development by the Southern Region. The proposed enhancement of the Angerstein's Wharf branch stands to benefit a substantial proportion of cross-London rail freight and is therefore supported by the LRFS.

NUNHEAD JUNCTION

The Kent & Sussex strategic planning team have commissioned a concept-level feasibility study to investigate whether grade separation could be a viable long-term option for enhancing capacity at key flat junctions in south London. This will include an assessment of Nunhead Junction, at the eastern end of the SLL. This is a key location for freight, with flows to and from north Kent (via Lewisham) and the Channel Tunnel (via the Catford Loop) passing through regularly. If grade separation can be demonstrated to be feasible, the de-confliction of moves through this junction could benefit capacity and performance for freight and passenger services.

INFILL ELECTRIFICATION

Source: Network Rail

The SO FNPO team have recently led the production of the Traction Decarbonisation Network Strategy (TDNS), on behalf of the rail industry. In response to the government's legal commitment to decarbonise the economy by 2050, the TDNS was established to recommend which of the three zero-carbon traction technologies (battery, electric or hydrogen) would need to be deployed where and when on the GB rail network in order to remove diesel trains and support the end of CO_2 emissions from rail. The answer to strategic sub-question 5e has been determined on the basis of the recommendations for infill electrification made by the TDNS. This includes key electrification gaps in London (see 3.2.2), as well as route sections outside of London that the major London freight flows use frequently, such as the Thames Haven branch to the port of London Gateway.

The table below summarises (in no particular order) the key TDNS recommendations that directly affect rail freight in London. However, as freight operates nationwide, there are a significant further number of solutions for route sections across the network that are also enablers for the decarbonisation of flows to and from London. For instance, the TDNS also recommends electrification between Reading and Taunton and on the branch lines to the Mendip quarries, on the Western Route. These recommendations, despite being well outside of London, are key to achieving end-to-end zero carbon haulage for the flow of construction materials into London and the South East.

Table 5: TDNS recommendations for London area freight

Recommended traction technology	Route section	NR Route	NR Region	Rationale
Electrification	Carlton Road Junction to Junction Road Junction (connector from the MML to the GOB)	East Midlands, Anglia	Eastern	Provides electrical access for cross-London freight from and to the Midland Main Line and ECML supporting construction material flows.
Electrification	Acton to Cricklewood and Brent Curve Junction	Western, Anglia, East Midlands	Wales & Western, Eastern	Provides freight access from South and West London to the WCML, Chiltern Main Line and Midland Main Line.
Electrification	Thames Gateway Link	Anglia	Eastern	Provides electrical connection from London Gateway Port to Essex Thameside route for container traffic
Electrification	Chiltern Main Line	Central	North West & Central	Significant flows of waste use the route south of Princes Risborough, with occasional trains carrying construction materials using the route between there and Banbury. Also includes Greenford branch and Acton-Northolt line for freight access to Park Royal terminal.
Third rail electrification or battery	Isle of Grain Branch	Kent	Southern	Optimum traction solution requires confirmation as part of scheme to introduce passenger service. It is possible a bi-mode locomotive would be required for freight services.

The TDNS also concluded within its general recommendations for the Southern Region that the role which third rail traction has to play in supporting freight services needs further investigation. Work undertaken in the Kent Route to increase current rates to support heavy electric freight traction using the third rail for services from the Channel Tunnel has shown the potential exists to utilise third rail, but areas where this enhancement is required need to be understood in conjunction with other options. Alongside this, the potential need to deploy AC/DC electric locomotives and the commercial impact this may have on freight operations will require careful consideration going forward. If a solution cannot readily be found and delivered this means there is a potential risk of residual diesel emissions from freight in the Southern region if diesel-electric bi-mode locomotives have to be deployed.

The LRFS supports the progression of the recommendations in the TDNS Programme Business Case, especially those that will contribute to the decarbonisation of freight flows through London.[38]

COUPLER STRENGTHS

Members of the LRFS working group have been involved in the commissioning of a study into freight train wagon and locomotive coupler strengths. This has reviewed the capability of couplers to withstand loads when trains are hauled up gradients, with a view to identifying whether improvements in technology since the standards governing maximum trailing weights were established mean that freight train lengths can be safely extended. This work should provide an answer to strategic sub-question 5c, since restrictive trailing weights are the main constraint to freight train lengthening on routes in London (see 3.2.2).

The study has focused on aviation fuel and construction materials traffic on the WLL, which is severely impacted by the incline towards the northern end of the route. It has concluded that the maximum trailing load on the steepest section of the WLL can be increased from 2215t to 2448t for both 18.3m long and 14.5m long wagons. Further work is recommended to address outstanding issues such as the apparently weaker coupler strengths on many locomotives, when compared with wagons, and, critically, to undertake similar train length extension analysis on other parts of the network. Network Rail will continue to support the progress of this work and will seek to ensure that its recommendations are followed up, so that freight train loads can be maximised as far as possible.

Source: Network Rail

BRAKING CURVES

The Rail Safety & Standards Board have been carrying out work to better understand the braking capabilities of freight wagons. As with the coupler strengths study, this is in part based on the premise that modern wagon technology has made improvements that are not reflected in longstanding railway standards and practices, in this case with regard to signalling and line speeds on the Southern Region. Freight on this part of the network has historically been governed by the '2/3s rule', whereby class 4 freight trains are permitted to run at the signed line speed, but class 6 and 7 trains are restricted to roughly two thirds of that speed. This was originally introduced to account for the longer stopping distances of freight trains, to ensure that heavier trains could safely come to a stop when needed, on a part of the network that features relatively short signal sections. However, it has increasingly come to be viewed as an outdated constraint, as freight train braking technology has improved over the years.

There is therefore a desire on the part of freight stakeholders for the 2/3s rule to be replaced with freight line speeds that better reflect modern train capabilities, allowing for speed

[38] For more information on the Traction Decarbonisation Network Strategy, see https://www.networkrail.co.uk/running-the-railway/long-term-planning/

improvements for class 6 and 7 traffic. Resignalling schemes on the Southern Region have in recent times begun to introduce differential speeds for freight, in place of the 2/3s rule. However, this can have the effect of reducing the line speed permitted for class 4 trains, creating a new form of constraint. Review of freight train braking curves, in order to reliably establish the speeds at which all forms of traffic can safely operate on the Southern Region, is thus needed so that line speeds for freight trains can accurately reflect their capability and do not unnecessarily restrict capacity. Network Rail will continue to support the progression of this analysis, through collaboration with the RSSB and freight industry stakeholders.

SOUTHERN REGIONAL FREIGHT STUDY

The Kent & Sussex strategic planning team are undertaking a study on freight across the Southern Region, the scope of which is closely related to the LRFS. This workstream is an opportunity for further options to support the development of rail freight in south-east England to be identified. Many London freight flows also operate through the Southern Region, which includes the SLL and WLL, therefore the development of a long-term strategy to address constraints for freight there will complement the LRFS.

It will also provide a means of answering outstanding questions regarding freight in south London. For example, whilst the capacity analysis carried out for the LRFS did consider the possible benefits of interventions in the Nunhead area, because this lies right at the edge of the geographic scope of the analysis it was difficult to definitively evidence a requirement for a loop or a change to junction speeds. The ability to align the WLL timetable structure with the BML was also highlighted as an issue requiring further study, but was not directly within the scope of the analysis undertaken. The Southern Regional Freight Study is planning to commission capacity analysis work, the focus of which will be, firstly, freight on the BML, and secondly the north Kent to WLL corridor, via the SLL. This will enable closer examination of these issues and inform more definitive conclusions than were possible within the LRFS.

WEST LONDON LINE CORRIDOR RESEARCH REPORT

The Kent & Sussex strategic planning team are also carrying out a study on South London passenger services, which like the LRFS has a dual role as a workstream of the London Rail Strategy as well as a strategic study within the Long-Term Planning Prodess. As part of this study, a research paper focusing specifically on the WLL has been produced, as the first of a potential series of sub-reports to inform the overall South London and Thameslink Services study. This WLL report addresses the challenges for both passenger and freight, in reflection of the critical strategic role of the line as a mixed-use railway. It aims to provide a greater understanding of future growth and capacity concerns along the corridor and looks to identify service change and enhancement opportunities for further development.

Capacity analysis has been undertaken, examining some of the key known issues affecting the WLL. The potential impact of relocating the AC/DC traction changeover and opportunities to enhance freight line speeds have both been assessed. The report identifies a number of options for further development, which align closely with those proposed by the LRFS. These are a relocation of the AC/DC traction changeover, an additional WLL turnback platform at Clapham Junction and signalling headway improvements, all of which are core interventions supported by this strategy.

NORTH LONDON LINE PERFORMANCE SCHEMES

Arriva Rail London (operator of the London Overground), are seeking to develop a number of schemes to improve performance on the NLL. ARL's December 2020 timetable will address this issue by separating the diagramming of the NLL branches, so that the Richmond and Clapham Junction service groups no longer inter-work. The purpose of this is to reduce transference of delay and expedite service recovery by isolating disruption. Whilst this should bring an improvement in performance, it also leaves limited remaining options to build further resilience with existing infrastructure, therefore potential interventions are also being considered. Early development work has been commissioned to assess the feasibility of two such schemes and ARL, TfL and NR are collaborating in support of this.

The first of these seeks to make available an additional useable platform for London Overground NLL trains at Stratford, the eastern terminus of the service. This would improve resilience by reducing the dependence of the timetable on short turnarounds, which currently results from the need to operate ten trains per hour with the use of just two bay platforms. The feasibility work for this proposal is intended to consider the range of possible infrastructure and timetable options that might facilitate use of an additional platform at Stratford.

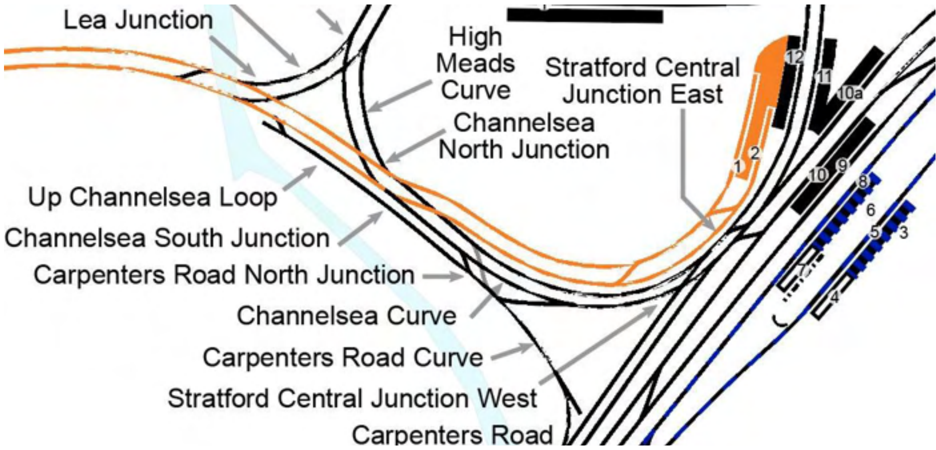

Figure 43: Map of the Stratford area, with bay platforms 1 and 2, used by the NLL Overground service, shown in orange. Source: Franklin Jarrier – cartometro.com

In addition, work is also to be undertaken to consider the creation of a turnback facility at Caledonian Road & Barnsbury station. This would involve the reinstatement of Platform 1, on the southern side of the station, for use by westbound through trains, and the conversion of platform 2 into a central turnback (see fig. 44). The existing ability for westbound through trains to use platform 2 would be retained.

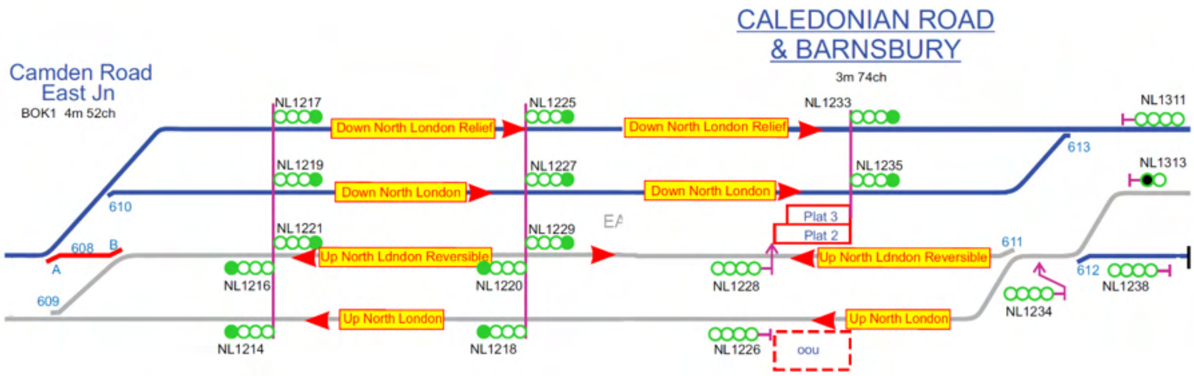

Figure 44: Caledonian Road & Barnsbury area track diagram, with out of use Platform 1 in dashed red lines. Source: Network Rail

These proposals have been presented to freight stakeholders at the LRFS working group. Freight stakeholders are supportive of any scheme that will improve performance on the

NLL, as this will be of benefit to all of the route's users, but there must be certainty that there will be no negative impact to freight operations as a result. Determining how freight would be affected by these proposals is therefore a critical element of the forthcoming feasibility assessment work.

3.3.6 DIVERSIONARY ROUTES

Although the primary focus of the LRFS is the development of the routes used by freight around the London area currently, so that they can accommodate future growth, strategic sub-question 7 was included in the study remit in order to ensure that this strategy does not cater only for primary corridors and routeings as they are today. Diversionary routes are critical to the effective operation of rail freight, enabling the continuation of service when normal routeings are unavailable or perturbed. The possibility that new routeings may become established in future also needs to be considered by long-term planning, including the effect this might have on existing traffic flows.

Alternative routeings for freight trains within London itself are limited but extremely valuable where they do exist. One reason why the freight specification for the capacity analysis that has informed this study was based on the use of Y paths (see 3.1.2) is that flexible routeings for freight paths are a key requirement of effective timetabling. For example, the ability for trains to and from the WCML to run via Gospel Oak and Kensal Green Junction, or alternatively via Primrose Hill, significantly strengthens connectivity with the NLL. The LRFS proposal for a bi-directional route for freight on the ECML South (see 3.3.3) is intended to enhance freight diversionary capability by providing another way for southbound trains to access the orbital routes.

Outside of London, the industry aims to enhance capacity on cross-country routes wherever possible, which in some cases should in the long-term facilitate the release of capacity for London freight. The prime example of this is the ongoing programme to upgrade the Felixstowe to the Midlands & North corridor. This route is currently at capacity for freight and features a series of constraints requiring intervention to enable volumes to be progressively uplifted. Delivery of these enhancements could allow some freight flows, which currently run via London to reach the WCML, to be routed cross-country to join it at Nuneaton instead, freeing up capacity for the forecast strong growth in traffic to and from the Essex Thameside ports and terminals. This would directly benefit London, as the proximity of the Thameside railheads to the city (including the various facilities at Barking, inside the GLA boundary) means that, to a much more immediate extent than Felixstowe, they play an active role in providing employment to Londoners and receiving goods for the London market. Looking further ahead, the new East West Rail line from Cambridge to Oxford has the potential to serve as a new freight corridor and an enabler for growth from Felixstowe to inland terminals nationwide. This would also have the potential to allow more freight capacity on the NLL to be devoted to traffic serving the London and South East region.

3.4 YARDS AND TERMINALS

Strategic sub-questions:

- Is there sufficient provision of freight yards and terminals serving London?
    - Is a southern London orbital nodal yard required and if so where?
    - Is there anything required to enhance the capacity/capability or improve the operations of any of the freight yards in the London area?
    - Is there a need for additional freight terminals serving London in the future and if so, where might these be best located?
    - What railway land suitable for potential future freight use is available in London and where? Is this adequately safeguarded for future freight needs?

Whilst the bulk of this report has focused on the need to develop the rail network for future freight growth, doing so can only be effective if there are sufficient number and standard of yards and terminals for goods to be moved between. Currently, provision of these facilities around London is very much a mixed picture, with good quality nodal yards at certain locations and a wide array of construction railheads, but gaps elsewhere (see 3.2.1). Improvements in this area will require continued collaboration across the rail sector, but are also dependent on a favourable planning environment. Recognition of the vital role played by rail freight on the part of metropolitan and local government is therefore essential.

3.4.1 YARDS

As noted in 3.2.1, freight yards are important staging points for trains moving around the network and are a major asset to effective rail freight operations. Yards that meet modern standards of capability (e.g. 775m standage and W12 loading gauge if used primarily for intermodal traffic, the ability to split and combine construction trains, facilities for crew changes, refuelling etc.) and whose location is of strategic value for the regulation of traffic flows are especially prized. The industry's established aim is to further develop a network of these nodal yards right across the country.[39] The current scheme to enhance Ripple Lane Yard, in Barking, to nodal standard is a prime example of this in action.

SOUTH LONDON NODAL YARD

Ideally, London would be served by a ring of nodal yards at or near to the interface between major freight routes in and out of the city and the orbital routes, operating on similar principles to Wembley and Acton yards (see 3.2.1). However, within a large city, land to develop such facilities where they do not exist is not readily available. The lack of a nodal yard for freight south of the Thames, in particular, is a noted gap in provision for freight around London. This in part reflects the fact that freight through south London flows straight into radial routes, as the layout of the network doesn't create the sort of orbital/radial interface points that are found north of the river. Despite this, the South

[39] *Freight Network Study*, Network Rail (2017)

London Line does interface with the West London Line in a manner somewhat akin to orbital and radial routes around the rest of London, with lines unused by passenger traffic connecting the two routes. The same can be said of the interface between the WLL and the GWML through the Willesden area.

View to the West from Wandsworth Road Station, at the western end of the SLL, looking towards Factory Junction and beyond across the Battersea area. Source: Network Rail

One feature of the rail network layout in south London that is especially notable is the criticality of the West London Line as the sole link for freight from Kent, Sussex, Surrey and south London to the rest of the country. The WLL is the easternmost rail crossing over the river Thames that is available to freight on the national rail network. The majority of freight flows between the north and south of the city are therefore funnelled through this one intensively used orbital route, which interfaces with multiple other orbital and radial routes at each end. Thus, in line with the principles for optimal regulating points laid out in 3.2.1, these areas of route interface at either end of the WLL are in theory the best network locations for facilities to hold trains transiting to and from the Southern Region. As traffic from the South converges in the Battersea area from both the SLL and BML, most of it requiring a northbound path via the WLL, regulating capability in the vicinity is of great value to freight.[40] Trains from the GWML, WCML, NLL and beyond are similarly funnelled into the northern end of the WLL, where maximising regulating capability will again support the availability of freight pathing opportunities.

Although the construction of entirely new nodal yards to enhance this capability is an unlikely proposition in an urban environment, opportunities to develop additional or improved regulating points should be pursued in alignment with the theoretical principles regarding route interface locations described above. At the same time, freight in south London should continue to prioritise improving the speed of transit through this busy area and the maximisation of train payloads to ensure efficiency.

FREIGHT YARD CAPACITY

In addition to the gap in nodal yard provision evident south of the Thames, coverage across London in general is a mixed picture in terms of where freight yards are located and the capacity and facilities offered by those that do exist. Whilst the value of yards as regulating points is key to the role played by Wembley and Acton and the planned enhancement of

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[40] This forms a key part of the rationale behind this strategy's support for Clapham Junction Platform 0, which would remove the need for London Overground services to use the lines between the Latchmere Junctions and Clapham Junction platforms 16 and 17 (see 3.3.2).

Ripple Lane, they are also often needed as places to hold wagons and locomotives for longer periods between workings, rather than just as a staging point en route. This is especially important for the construction materials sector in London, because the nature of the market dictates that rail freight operations are demand responsive and variable in their regularity and the days of the week on which they operate. The strength of the London construction market creates demand for locations that are readily accessible from the many railheads served around the capital, where freight operators can lay over wagons between circuits. The finite capacity of existing facilities to meet this requirement can at busier times be a challenge, therefore the industry remains keen to develop yard capacity in the London area, where opportunities exist.

FREIGHT YARD OPERATIONS

Although the extremely valuable role played by Wembley and Acton yards has been highlighted by this study, some issues were identified, suggesting there may be opportunities to improve their operations further. Acton yard was identified as the number one freight performance hot spot in London, by the baselining exercise carried out for the LRFS. At the LRFS Operational and End User Workshop, stakeholders suggested that Acton Yard is a performance hot spot due to wider performance issues with the Mendip flows and the unique nature of Acton as a very busy area, with a tight yard plan and frequent splitting and joining of trains, all of which magnifies the potential for knock-on delay. However, at the same time Acton's importance means that any performance improvement that can be achieved there has the potential to deliver significant benefits to freight operations and the wider network.

Stakeholders have also raised concerns relating to yard acceptance for trains at Wembley, where finding capacity for pathing in and out can also be a challenge. Suggested measures to alleviate these constraints were for NR Capacity Planning to actively plan yard occupation using the Train Planning System (TPS) software package and the potential reactivation of the currently out-of-use Brent Sidings, to provide additional capacity in the Wembley area.

3.4.2 TERMINALS

The trajectory of growth in the rail freight sector, market forecasting, the long-term public policy environment and industry stakeholder ambitions all suggest there will be a need for additional freight terminals serving London in the future.

A construction materials train at Willesden F sidings, alongside the WCML. Source: Cappagh Group.

CONSTRUCTION

London benefits from a multiplicity of construction sector railheads, some of which are located remarkably close to the city centre, especially when compared with the provision of terminals for other commodities. However, the substantial advantages of being able to convey materials by rail for the vast majority of their journey to construction sites are counterbalanced by a number of ongoing challenges, principally the safeguarding of existing sites in a context where large parcels of land possess huge potential redevelopment value and where development in general results in greater instances of housing in proximity to industrial activity, with the attendant issues that can emerge. The paradox is that these challenges for rail freight terminals are driven by the buoyancy of the very market they serve.

Construction market end users attending the LRFS Operational and End User workshop stressed the importance of safeguarding current sites from the imposition of operating restrictions as a result of inappropriate nearby housing development, especially when it is difficult to open new facilities in urban areas where local residents are likely to complain about noise and pollution. It will continue to be essential for London's growth and regeneration efforts to have strategically located construction materials handling railheads spread across the city. The provision of suitable such terminals in sufficient number will be critical to the extent to which rail is able to meet future demand from the market.

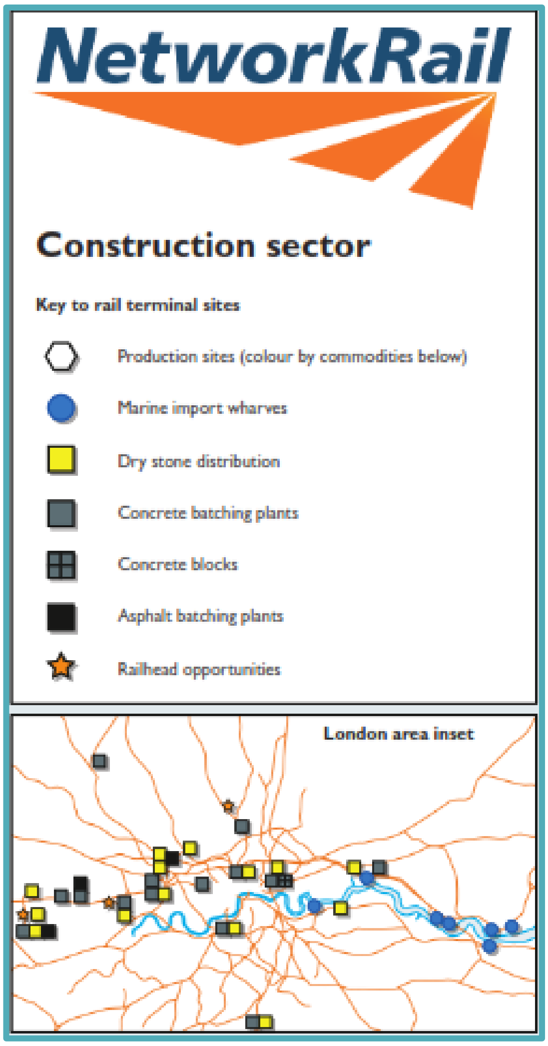

Figure 45: Map of construction terminals in the London area. Source: Network Rail

Network Rail's Freight and Property teams work closely with the wider industry and local stakeholders to support the redevelopment of existing rail terminals in London, in order to optimise tenure on what are often constrained sites, and to identify and progress opportunities for new railheads to be established. Current examples include the recent reopening of the aggregates railhead at Thorney Mill, near Heathrow, and the ongoing development of Willesden F sidings into a major new construction materials site by the Cappagh Group. Network Rail maintains a reserve of strategic freight sites, in order to preserve potentially valuable locations for future rail freight use.[41] One such site, at Plumstead in south-east London, has recently been called down for use by a freight operator and should see traffic commence during 2021.

There are a number of further sites in the London area that are under consideration for expansion or reactivation as rail freight terminals. Opportunities to add additional capacity to the facilities at Neasden and Park Royal have been identified; Cricklewood has seen recent increased use serving the development project at Brent Cross; a new waste facility at Renwick Road, near Ripple Lane in Barking, is being developed; and the second of the two tenanted aggregates sites on the Brentford branch, which is currently served by road haulage only, may be reactivated for rail use.

[41] For more information on strategic freight sites, see https://www.networkrail.co.uk/industry-and-commercial/rail-freight/freight-site-opportunities/

INTERMODAL

In stark contrast to the construction market, rail-connected intermodal terminals are a rarity in London, despite it being the largest population centre in the country, with a demand for consumer goods to reflect this. Britain's major deep-sea ports (Felixstowe, Southampton and London Gateway) are all situated on the south-east of the island at relatively short distances from the capital, but in general, the goods imported through them are rarely supplied directly into London, because supply chains tend to operate on the basis of moving containers first to National Distribution Centres (NDCs) in the centre of England.

Source: Network Rail

Rail currently also lacks a significant share of the NDC to Regional Distribution Centre (RDC) leg, owing to the lack of rail-connected RDCs nationally, including in London and the South East. As a result, supply to the London consumer goods market is heavily dominated by road transport at present. It was suggested at the LRFS Operational and End User Workshop that there is a need to build rail-connected distribution parks, to enable rail to play a more substantial role in supply chains. However, the relative scarcity of land and labour in and around London mean that large-scale new distribution centres are more likely to continue to be established across the Midlands, rather than in the South East of England. An alternative approach may therefore be required in order to grow rail's share of the domestic intermodal market serving London. This could involve the development of a model based around simple modal transfer points, occupying a small footprint and well connected to the road network for rapid last mile delivery. Freight industry stakeholders have highlighted Willesden Euroterminal as a prime candidate for use on this basis, once its role in the materials by rail operation for the construction of HS2 has concluded. Whatever the model, a significant expansion of the domestic intermodal sector will increasingly need to become a feature of the rail freight market in future, if logistics in Britain is to be decarbonised by 2050.

The relatively low rate of growth in rail-connected terminals in the years after the 2008 financial crash is a relevant factor in explaining the lower than forecast growth in intermodal volumes over the past decade. Rail-connected terminals are a key enabler in delivering growth in intermodal traffic, and without a substantial increase in the current number (and total area) of rail-connected warehousing sites across Great Britain, significant growth will not be delivered. This applies especially to London and the South East, which is currently particularly poorly served by such facilities. Recent years have seen positive developments nationally, with new sites opening and proposed developments receiving approvals.[42] This trend will need to be replicated in the South East, although solutions tailored to London's own circumstances and economic geography are likely to be required. Terminal developments also need to be supported by development of the rail

[42] 'UK's intermodal terminals on the rise', RailFreight.com, (17/08/2020)

network, especially gauge clearance, if rail freight is to play a greater role in serving the London consumer good market.

FUTURE TERMINAL CAPACITY FOR LONDON

The continued strength of demand for rail freight services has in recent years depleted the reserve of strategic freight sites in locations serving the London area. The anticipated activation of Plumstead and Chessington South now leaves only Selsdon, near Croydon, as the last such dormant opportunity within Greater London. This may suggest an increasing future need to intensify operations at existing sites in order to meet demand for greater capacity, with some evidence already emerging of such a trend in London.[43] Current proposals to upgrade and reconfigure the aggregates terminal at Bow East, near Stratford, are based on principles of optimising terminal capability whilst reducing its footprint and impact on the local area.[44]

TARGET 26

In addition to enhancements to the handling capacity of rail-connected terminals themselves (i.e. the quantity of material the facility itself can process), there also remains room for improvement to the capability of several railheads and branch lines serving them around London, in terms of the maximum length of train that they can accommodate. A number of railheads are currently routinely receiving trains of fewer than 20 wagons and in certain instances this is due to operable train length constraints arising from sidings infrastructure either within or connecting to them. Establishing a consistent minimum standard of train length capability across all London construction terminals (and ultimately replicating nationwide) would enable many services to be lengthened above what is currently possible. This would in turn ensure a consistent minimum payload for all trains, increasing the efficiency of rail freight even further.

Source: Network Rail

Industry stakeholders view 20-wagon operation of construction trains across the London area, equivalent to a standard load of about 2000t, as an achievable minimum to work towards. This could require enhancements to connecting infrastructure at terminals that do not currently meet this level of capability. The LRFS therefore proposes the development of a cross-London programme of works to realise a consistent operational standard for construction sector terminals. It is envisaged that this workstream would make 20 wagons its threshold train dimension, with an aspiration toward achievement of optimal 26 wagon operation (an established contemporary maxima for single loco operation, as evidenced by trains now

[43] 'Investment increases capacity at King's Cross concrete plant', Rail Business Daily (19th October 2020)
[44] Bow East development proposal; https://www.boweast.co.uk/

operating cross-London serving Essex Thameside terminals).[45] Consideration would also need to be given to the capability of quarries and wharves across the country, from which construction trains operate to terminals in London, as well as any network constraints affecting operable lengths en route (see 3.2.2). This is an additional option for funders to be included in the portfolio SOBC produced as the outcome of this strategy (see 2.3.6).

LAND USE

However, there will always be a limit to how intensively existing terminals can be utilised, both in terms of their own throughput capacity and rail network capacity for trains to access them. This strategy therefore proposes a comprehensive review of railway-adjacent land across the London area, with a view to the identification and safeguarding of any remaining sites with potential to be of value for future freight use. This exercise will be led by the SO FNPO team, in collaboration with stakeholders engaged through the development of the LRFS, including colleagues at the Greater London Authority (GLA). Building on positive initial engagement between the GLA and NR through this study, both organisations will continue to collaborate on strategic matters relating to rail freight in the London area.

3.5 THE FUTURE OF THE RAIL FREIGHT MARKET

Strategic sub-questions:

- What is needed to ensure that rail freight remains able to support modal shift of freight in London from road to rail?
- What are the potential new markets for rail freight that may emerge over the long-term future and what is needed to support their development?

Much of this report has dealt with how the rail network will need to be developed in the long-term to accommodate freight growth around London. The options identified as part of the LRFS are ultimately aimed at facilitating the realisation of this growth, which is itself to a large degree intended to be an enabler of modal shift, because more freight on rail in most cases means less on the roads. In addition to continuing to grow existing market sectors, though, rail freight will also need to be increasingly responsive to new opportunities and find ways to move different types of goods on the rail network.

3.5.1 HIGH SPEED LIGHT LOGISTICS

With the combined socio-economic trends toward urban repopulation, same-day delivery and urban convenience grocery retail formats, demand for delivery of consumer goods into urban areas is growing. Covid-19 has seen this trend continue and even grow with several carriers, including Royal Mail, reporting significant increases in parcel volumes.

[45] There are a variety of wagon designs employed on contemporary construction flows, featuring a range of actual vehicle lengths; however, for the purposes of this workstream a datum 15m vehicle length would be assumed.

Class 769 tri-mode logistics train. Source: Rail Operations Group

In parallel, concerns over urban air quality and road congestion are challenging established means of distribution; so too the loss of legacy urban distribution space to the very residential development fuelling population growth. Against such a backdrop, promoters believe there is an opportunity for the development of a rail haul offer for consignments of parcels and consumer goods directly into urban centres for onward distribution by zero-carbon delivery vehicles.

Under such a scenario, lighter weight, higher speed (which on some routes would make pathing them amongst passenger trains easier), shuttle frequency freight services could link established national distribution facilities directly into urban logistics hubs developed on the railway estate, or potentially exploit out of hours opportunities at major passenger termini. High Speed Light Logistics by rail has the potential to make a significant contribution to the reduction of emissions, through the reduction of road journeys associated with consumer goods deliveries using predominantly electrically powered trains.

In 2021, Orion, the high-speed logistics business created by Rail Operations Group (ROG), plans to operate a trial between London Gateway and the platforms 9 and 10 of London Liverpool Street. ROG, who have participated in the working group for this study, have advised that Orion has a number of other service offerings, both originating from London and further afield, also in the latter stages of development with strong customer interest. In order to achieve higher speed delivery, significant investment has been made in converting former passenger units, notably Class 319s and their 'flex' equivalent Class 769s (with diesel capability to enable operation on non-electrified routes), which are capable of 100mph running and have the added benefit of being able to operate as 4, 8 or 12 car formations. Planning work undertaken by Orion has already shown that substantial and critical time savings compared with road transport in this sector can be achieved via rail, with the benefits increasing with longer distance journeys making same day delivery viable. The ability to operate into city centres and urban hubs before equivalent road offerings also represents a key aspiration for many prospective customers.

Train interior following conversion to accommodate roll cages.

Source: Rail Operations Group

A number of other potential market entrants have begun publicising plans for the movement of light logistics on the rail network also.[46] ROG attended the LRFS Operational and End User Workshop and presented on their plans for the London Gateway-Liverpool Street trial, in addition to their broader nationwide plans. They expressed confidence, on the basis of discussions with prospective customers, that there is a ready market for rail to claim a stake in once proof of concept has been demonstrated. ROG report that this confidence has only increased recently with the launch of the first Orion unit (see picture above) and the cementing of customer discussions into firm business plans due to commence in 2021 and beyond.

Accommodating this promising new market on the rail network will require access to viable points of delivery within city centres and suitable timetable paths, more akin to class 1 (typically express passenger) than class 4 (freight limited to 75mph), for trains to operate in. The Orion trails will provide a useful indication of the feasibility of using passenger stations for this purpose, as well as valuable learning to drive the optimisation of future operations and capacity allocation. Longer-term, opportunities for light logistics handling facilities to feature in the configuration of revamped London rail freight terminals are within the thinking of NR's Freight Business Development and Property teams. The emergence and growth of the High Speed Light Logistics rail market will require a different approach to the strategic planning of 'traditional' freight flows, given the uniqueness of their operation.

Class 769 tri-mode logistics train. Source: Rail Operations Group

3.5.2 INTERMODAL

The intermodal sector across the GB freight market is expected to experience substantial changes over the coming decades. Freight in general is expected by stakeholders to see a trend of further containerisation and a shift away from the 'Ro-Ro' (Roll on/Roll off) lorry-hauled model towards a greater proportion of 'Lo-Lo' (Load on/Load off) becoming the norm, all of which should favour rail freight compared with its road competition. Although development of rail-connected distribution centres and the expansion of the domestic intermodal market are priorities for the future, additional possibilities include the introduction of modular wagon types and the operation of shorter, faster trains to deliver smaller box types to more centrally located urban terminals. As with the high-speed light logistics market, realising new opportunities in this area will require technological innovation, provision of suitable terminal locations and network capacity in which to operate.

[46] 'New style rail parcels nearer to delivery', Railfreight.com (20/08/2020)

3.6 CONCLUSION

Headline Strategic Question:

How do we accommodate future rail freight requirements in the London area in a context of increasing passenger and freight demand?

Accommodating London's rail freight requirements over the next thirty years demands a multi-faceted approach that will alleviate constraints, increase capacity, improve capability and facilitate growth. This strategy aims to set out a high-level approach for this to be achieved, by presenting options for enhancement schemes to the railway's funders, identifying industry workstreams that should be supported and highlighting the importance of the ongoing development of rail freight terminals and new markets.

Capacity analysis for this study concluded that substantial levels of growth, as specified by both freight and passenger stakeholders, can be accommodated on the London orbital lines by the 2040s, but this is dependent on a series of investments to provide enhanced infrastructure that will enable increased services to operate. This includes a set of core interventions – major schemes to unlock additional capacity that should be developed and delivered gradually over the next twenty to thirty years. These should be supplemented by a range of additional options to deliver incremental boosts to capacity, performance and capability on the routes used by freight around London.

Source: Network Rail

Future growth will also be dependent on the ability of the rail network infrastructure to withstand increasing traffic levels, particularly in the case of the heavier bulk freight flows. Network Rail faces an ongoing challenge in maintaining the track and underline structures over which freight operates. The impact on the planning and funding of maintenance and renewals activity that delivery of the schemes proposed by this study would have will need to be considered during the course of their development.

There are several workstreams already underway across the rail industry that stand to benefit rail freight in London. These deserve continued support and advocacy from freight stakeholders to ensure that their freight benefits are fully realised.

In addition to the improvement of the rail network itself, freight in London will continue to require strategically located yards and terminals. The extent to which opportunities to improve existing facilities and provide new ones for the use of freight trains are grasped will have a major impact on the sector's capacity for growth over the long-term future.

There are a number of clear opportunities for new-to-rail freight markets to take off in the next few years and there are likely to be many as yet unforeseen trends that will emerge over the next three decades. The network in the London area will need to be responsive to new sources of demand for the mode shift benefits of rail use to spread even further through the logistics sector.

PART 4: OPTIONS FOR FUNDERS

This section summarises all of the options for funders proposed by this report, which are intended to make up the portfolio of schemes developed collectively into a Strategic Outline Business Case.

Order of magnitude cost range estimates for the core interventions and several of the additional options have been produced by Network Rail's Southern Region Capital Delivery function. These are presented here according to the following categories, to provide a high-level indication of the scale of capital investment that is expected to be required:

High	Mid-range total cost estimated to be **>£50m**
Medium	Mid-range total cost estimated to be **£25m - £50m**
Low	Mid-range total cost estimated to be **<£25m**

There is a high level of uncertainty associated with cost estimates based on conceptual designs. The categories shown for these schemes under 'Order of magnitude estimated cost' are included for indicative purposes only. Anticipated Final Costs for each project or package of works are expected to be refined to a much greater level of detail as they progress through the enhancements pipeline.

An indication of the key benefits that each option proposed in order to deliver is also included in the table below. As with costs, further work will be required to develop a more detailed understanding of these if they are to continue successfully through to delivery. This is intended to be a focus for the portfolio SOBC that will be produced to support this strategy's proposals. For instance, capacity analysis as part of the LRFS has demonstrated many of these schemes will contribute to the accommodation of future freight and passenger growth on the orbital lines, as represented by the ITSS. As the business cases is developed for them, there will be a need to provide assurance that full end-to-end freight paths, beyond the geographic scope of this study, can be planned to make use of that capacity. It is also possible that further benefits beyond those anticipated at the strategic level may be identified for these schemes during the course of detailed development.

Option	Description	NR Region	NR Route	Line	Order of magnitude estimated cost	Key benefits	Delivery required by
Camden Road Platform 3	Reinstatement of Platform 3 at Camden Road station so that the existing Platform 2 can be converted to a centre turnback	Eastern	Anglia	NLL	Medium	Capacity Performance Operational flexibility	Late 2030s/early 2040s
Kensal Green Junction Improvement	Upgrade to junction layout to provide a speed increase sufficient to achieve a 3-minute junction margin	Eastern	Anglia	NLL	Low*	Capacity Performance	2040s**
WLL AC/DC changeover relocation – Shepherd's Bush	Relocation of the existing West London Line AC/DC changeover From North Pole to Shepherd's Bush	Southern	Sussex	WLL	Medium	Capacity Performance	2020s
Clapham Junction Platform 0	Reinstatement of former platform 1 at Clapham Junction (to become platform '0'), to provide additional turnaround capacity for WLL Overground service	Southern	Wessex	WLL	High	Capacity Preservation of freight regulating capability Performance	2030s (following removal of short-term modular footbridge)
Harlesden Junction Doubling	Reinstatement of former four-track formation where WCML Slow lines and City lines pass under Dudding Hill line bridge	North West & Central	Central	NLL/WCML	High	Capacity Performance	2040s (with Kensal Green Jn)
WLL AC/DC changeover relocation – Kensington Olympia	Relocation of the existing West London Line AC/DC changeover From North Pole to Kensington Olympia	Southern	Sussex	WLL	High	Capacity Performance Optimal changeover location for freight	2020s
Stratford Regulating Point Extension	Enhancement to existing capability to regulate freight trains in the Stratford area, so that a westbound 775m freight train can be held at interface of the NLL and GEML	Eastern	Anglia	NLL/GEML	Medium	Capacity Performance Train lengthening	2020s

Nunhead Junction Improvement	Upgrade to junction layout to provide a speed increase on the route towards Lewisham, removing existing constraint to the flow of freight through Nunhead	Southern	Kent	SLL	Low	Performance Train payloads	2020s
Longhedge Junction Speed Increases	Increase from current 25mph junction speed to align with potential speed increases on Ludgate and Kensington lines	Southern	Kent	SLL/WLL	TBC	Performance	2020s
Gospel Oak Speed Increases	Speed increase from current 20mph on all routes through Gospel Oak	Eastern	Anglia	NLL/GOB	TBC	Performance	2020s
ECML South Bi-directional Capability	Track alterations to provide routeing option from Bowes Park to the Harringay Park Curve	Eastern	East Coast	ECML	TBC	Operational flexibility Train lengthening Capacity	2030s (following ETCS deployment)
Removal of Heavy Axle Weight Restrictions (cross-London)	Structures works at multiple sites across London to enable speed restrictions to be lifted	Eastern & Southern	Anglia & Wessex	NLL, Dudding Hill line, Windsor lines, Ludgate lines	TBC	Performance Train payloads	2020s
Removal of Gospel Oak-Barking line Heavy Axle Weight Restriction	Structures works at multiple sites along the GOB route to enable speed restrictions to be lifted	Eastern	Anglia	GOB	TBC	Performance Train Payloads Capacity (removal of constraint to growth)	2020s
Gauge Enhancements	W12 clearance from Essex Thameside ports to the WCML and GWML	Eastern	Anglia	NLL, GOB, Essex Thameside	TBC	New flows	2020s
'Target 26'	Enhancements to connecting infrastructure of construction terminals to facilitate a minimum standard of 20-wagon operation,	Cross-London	Cross-London	Cross-London	TBC	Train lengthening	2020s

	with an aspiration for 26 wagons wherever achievable						

Core interventions
Additional options

*If Harlesden Junction Doubling is not progressed, there will still be a need for some intervention to increase speeds over Harlesden Junction in order for the benefits of the Kensal Green Junction Improvement scheme to be realised. This would increase the costs of the Kensal Junction Improvement scheme, though most likely to a lesser extent than the cost of the full doubling of Harlesden Junction.

**Kensal Green Junction Improvement (and by association Harlesden Junction Doubling) were deemed by the capacity analysis for this study to be necessary to accommodate the timetable solution modelled with a reference year of 2043. 'By the 2040s' is therefore stated as the required delivery timescale in terms of pure theoretical capacity. However, the high priority given to these interventions by freight stakeholders, the practicalities of network access for delivery and their immediate benefits beyond pure capacity (i.e. additional paths) suggest that they should be developed as soon as possible.

PART 5: APPENDICES

Please see separate attachment, containing the following appendices:

APPENDIX A: CONCEPTUAL DESIGN SKETCHES

1. Initial conceptual design sketch of the proposed Stratford Regulating Point Extension scheme
2. Initial conceptual design sketch of the proposed Nunhead Junction Improvement scheme
3. STE-T02986-SKT-TR-001 – conceptual design sketch of the proposed Kensal Green Junction Improvement scheme
4. STE-T02986-SKT-TR-002 – conceptual design sketch of the proposed Camden Road Platform 3 scheme
5. STE-T02986-SKT-TR-004 – conceptual design sketch of the proposed relocation of the West London Line AC/DC Changeover (first of 5)
6. STE-T02986-SKT-TR-005 – conceptual design sketch of the proposed relocation of the West London Line AC/DC Changeover (second of 5)
7. STE-T02986-SKT-TR-006 – conceptual design sketch of the proposed relocation of the West London Line AC/DC Changeover (third of 5)
8. STE-T02986-SKT-TR-007 – conceptual design sketch of the proposed relocation of the West London Line AC/DC Changeover (fourth of 5)
9. STE-T02986-SKT-TR-008 – conceptual design sketch of the proposed Harlesden Junction Doubling scheme
10. STE-T02986-SKT-TR-009 – conceptual design sketch of the proposed relocation of the West London Line AC/DC Changeover (fifth of 4)

APPENDIX B: LONDON LONG-TERM DIGITAL DEPLOYMENT PLAN