

Surrey County Council
Surrey Rail Strategy
North Downs Line Assessment

Final Report | 12 June 2015

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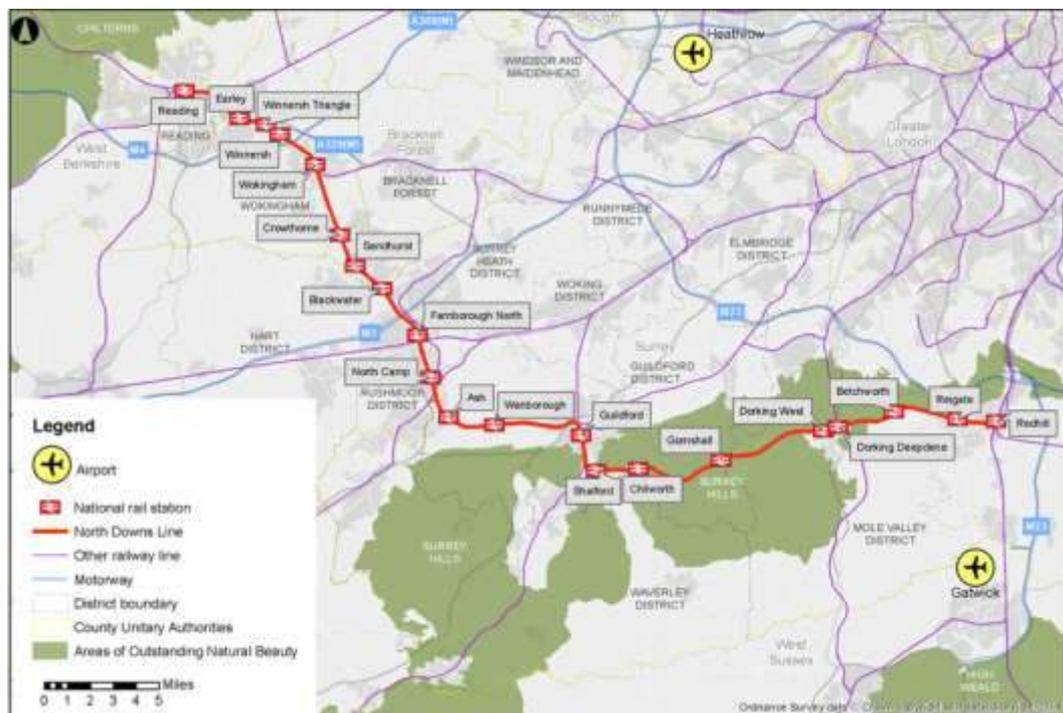
1 Introduction

1.1 The North Downs Line

The North Downs Line runs through Surrey between Reading, Guildford and Redhill. It provides direct access to Gatwick Airport via the Brighton Main Line. The line forms an important orbital route to the south and west of London with connections to London via the Great Western Main Line, the Windsor Lines and the Portsmouth Direct Line.

The North Downs Line links together some of the major population centres in the South East of England such Reading, Wokingham, Blackwater Valley, Guildford, Dorking, Reigate and Redhill. The line passes through the Surrey Hills Area of Outstanding Natural Beauty (AONB).

Figure 1 - The North Downs Line: location and geography



1.2 Background

In 2013, Surrey County Council (SCC) commissioned Arup to develop a rail strategy for the County. The Surrey Rail Strategy identified strengthening ‘local orbital services’ and ‘improving access to airports as two of three priority options for rail in the County. With respect to the North Downs Line, the strategy found:

- service frequencies on the North Downs Line are low and journey times are long (e.g. 45 minutes to Reading from Guildford). With faster and more frequent trains, services could be much more competitive with road and more attractive to potential users;
- services are crowded between Guildford and Reading in the morning peak hour reflecting commuter demand into both centres;

- passenger demand is expected to increase in future, with significant employment growth forecast in Reading, Guildford and Gatwick, all key destinations along the line; and
- capacity improvements could be needed in the medium-long term, particularly in the morning peak between Guildford and Reading.

In November 2014, Network Rail's draft Wessex Route Study also identified the opportunity to improve the North Downs Line and proposed an enhancement to service frequency on the line.

1.3 Study Objectives

The purpose of the North Downs Line Assessment is to set out a long term vision for the North Downs Line, building on the Surrey Rail Strategy and the draft Wessex Route Study.

The overall objectives of the study are as follows:

- Review Network Rail's current proposals for the North Downs Line and consider how they deliver against SCC's wider development objectives.
- Develop a range of alternative options for the longer term improvement of the North Downs Line that have the potential to deliver greater value.
- Undertake an appraisal of these alternative options and their contribution to SCC's objectives.
- Develop a recommendation and preferred approach for the future of the North Downs Line.
- Consult with rail industry stakeholders and provide the basis for SCC's consultation response to the Wessex Route Study and wider engagement with stakeholders.

1.4 Stakeholder Engagement

The North Downs Line assessment has been developed with the input of local stakeholders. A stakeholder forum was held on the 13th of January 2015 to gather the views and priorities of stakeholders. Attendees including each of the County Councils and Local Economic Partnerships (LEPs) directly served by the line.

The interim findings of this assessment have been provided to Network Rail as part of SCC's response to the Wessex Route Study consultation which closed on the 18th of February 2015.

It is intended that the strategy will updated and refined over time, and used by the rail industry and local stakeholders as a guide for future investment.

1.5 Report Structure

The remainder of this report is structured according to the main phases of work undertaken:

- **Section 2** provides a **baseline review** of the North Downs Line, comprising a planning and economic baseline, a transport baseline and an operational baseline.
- **Section 3** sets out the ‘**conditional outputs**’ upon which the strategy is based.
- **Section 4** describes the process of **identifying and assessing options** for improving the North Downs Line.
- **Section 5** presents the **overall strategy** and proposes a timeline for improvement.
- **Section 6** offers some overall **conclusions** of the assessment and proposes some **next steps**.

2 North Downs Line – Baseline Review

2.1 Planning and Economic Baseline

An assessment of baseline conditions has been undertaken to better understand the wider economic potential of the North Downs Line and the prospects for future growth in the demand for rail.

The planning and economic baseline has been prepared on the basis of ‘local catchment areas’ for each of the stations along the line¹. The local catchment areas are defined as the area lying approximately within two kilometres of a station. In practice, passengers will be drawn from a wider area. However, using a two kilometre catchment area is intended to isolate the area most directly benefiting from any improvements to the North Downs Line and avoids overlap with other stations and lines.

A summary of the baseline review is provided in this report. More detailed baseline analysis is included in a separate North Downs Line Baseline Review report.

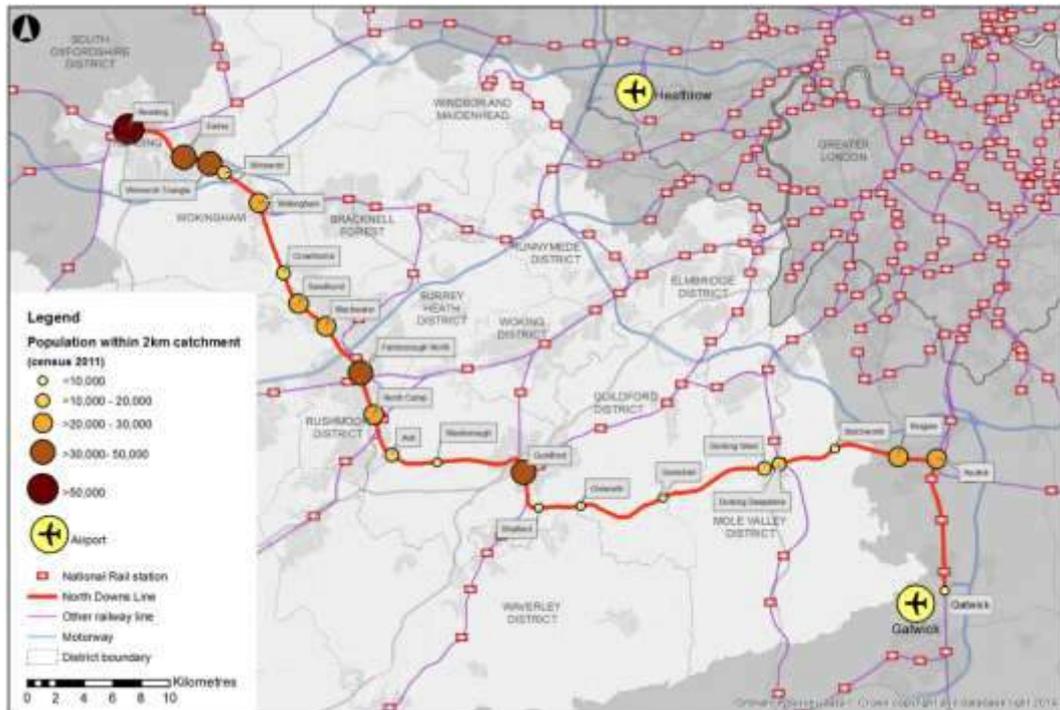
2.1.1 Population

The North Downs Line passes through nine local or unitary authorities (Reading, Wokingham, Bracknell Forest, Hart, Rushmore, Guildford, Mole Valley and Reigate and Banstead) three Counties (Surrey, Hampshire and Berkshire) and three Local Enterprise Partnerships (Enterprise M3, Coast to Capital, Thames Valley Berkshire).

It serves an estimated 392,000 people within a two kilometre station catchment area. Guildford and Reading are the largest towns on the route with around 64,000 and 37,000 people respectively living within the local catchment area. The North Downs Line also serves a number of other important regional population centres such as Wokingham (29,000), Farnborough (34,000), Reigate (24,000) and Redhill (29,000).

The Reading to Guildford section of the line is relatively urban in character with each station having a significant local population of 15,000 people or more. This contrasts with rural character of the Surrey Hills area between Guildford and Dorking which services settlements such as Chilwoth (3,000) and Gomshall (2,000). The distribution of population long the North Downs Line is illustrated in Figure 2.

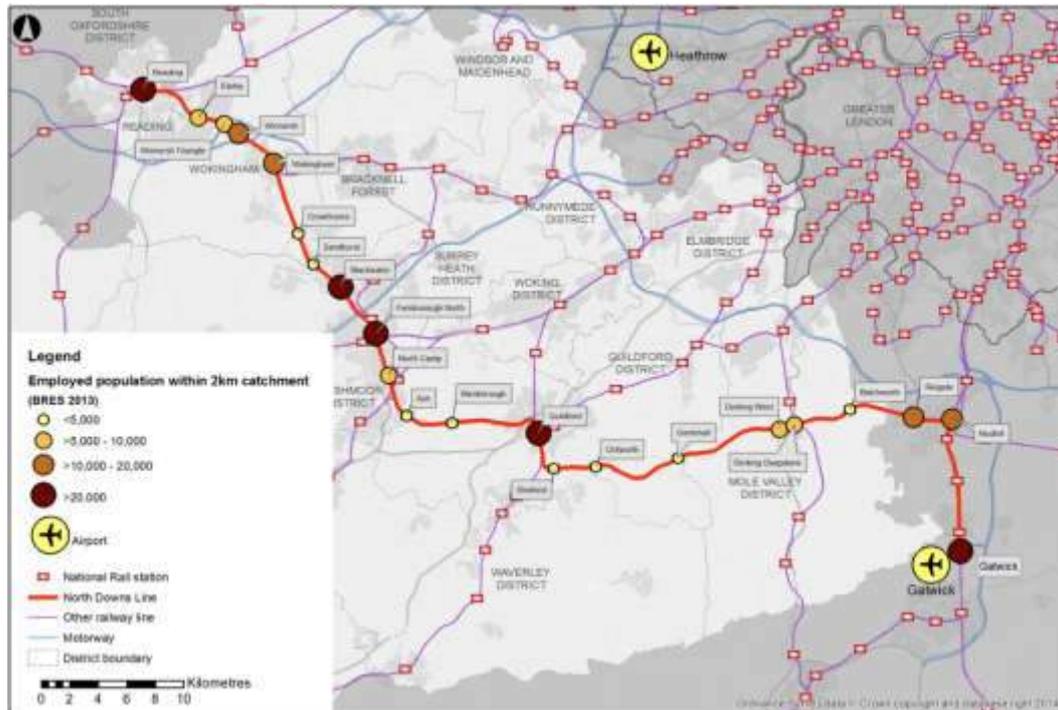
¹ This includes stations on the North Downs Line not currently served by North Downs Line services – Earley, Winnersh Triangle, Winnersh and Wanborough.

Figure 2 - North Downs Line Local Catchment Area Population

2.1.2 Employment

The line serves a strategically important part of the UK economy, providing a direct link between some of the major economic hubs in the South East. In total, there are 290,000 jobs located in close proximity to North Downs Line stations. Reading and Guildford stand out as major employment centres but it is also notable that there are over 50,000 of the 290,000 catchment area jobs are located at Gatwick Airport and the surrounding area.

This area is home to many high technology and high value sectors and businesses. Major economic centres such as Reading and Guildford – as well as employment corridors such as between Reading and Farnborough – have a vital role to play in the UK economy by ensuring balanced growth across London and the wider South East. The distribution of employment along the North Downs Line is shown in Figure 3.

Figure 3 - North Downs Line Local Catchment Area Employment

2.1.3 Economic Profile

Reading to Wokingham

The stations between Reading and Wokingham form part of a functional economic area (covering Reading, Wokingham and Bracknell²) which is noted in the Thames Valley Berkshire Strategic Economic Plan³ as ‘a major centre of economic activity with significant potential for future growth’.

This area is characterised by a strong local economy with a number of small and medium enterprises covering a range of sectors including web-based media, tourism, land-based activities, retail and local services. The area has a particularly strong tech-based (IT based) economy according to a recent report published by KPMG⁴.

In addition, Heathrow is a major employer with over 18,000 of the residents of Thames Valley Berkshire currently working at the airport⁵. A number of European/global business headquarters are located in the Thames Valley Berkshire area. Many of these are long-established, and they are often major employers operating in strategically important sectors – like pharmaceuticals, petrochemicals, energy, food and IT. The area is well connected, with international links via Heathrow Airport, London via the M3 motorway, the Great

² The Thames Valley Berkshire Strategic Economic Plan (March 2014) highlights three functional economic areas in its boundary, each of which have distinct local economies. Reading, Wokingham and Bracknell form one of the functional economic areas.

³ Thames Valley Berkshire Strategic Economic Plan, March 2014

⁴ Tech Monitor UK: Understanding tech clusters and tracking the UK tech sector’s outlook for employment and economic growth, KPMG, 2013

⁵ London Heathrow Economic Impact Study A Report by Regeneris Consulting, September 2013

Western Mainline and the Reading to Waterloo Line, as well as the North Downs Line itself.

Farnborough North to Guildford

The Enterprise M3 Strategic Economic Plan identifies Woking, Guildford, Farnborough and Basingstoke as four major interconnected growth areas highlighting they ‘deliver one third of the jobs and GVA in the Enterprise M3 area’⁶. The area has attracted global businesses, primarily focused on the ICT and digital media, pharmaceuticals, aerospace and defence and professional and business services sectors.

Dorking West to Gatwick (the Gatwick Diamond)

The Gatwick Diamond is a regional development area and part of the Coast to Capital Local Economic Partnership, centred on Gatwick Airport. It takes its name from the approximate geographic shape of the area covered, with London at the top of the diamond and Brighton at the bottom, while stretching east-west between Guildford and Tonbridge. The Gatwick Diamond incorporates seven district and borough Council areas – Crawley, Horsham, Mid Sussex, Espom and Ewell, Mole Valley, Reigate and Banstead, and Tandridge.

The Gatwick Diamond, is a key economic driver and international hub with a hinterland of strategic employment locations with potential for substantial business and residential growth. It currently is home to approximately 45,000 businesses, ranging from global blue-chip companies to small and innovative enterprises, and generates £19.2 billion GDP (2011)⁷. There are six industry sectors which are particularly strong⁸:

- aviation, aerospace and defence;
- advanced manufacturing and engineering;
- financial and professional services;
- life sciences, health technologies and medical devices;
- environmental technologies; and
- food and drink.

2.1.4 Future Growth

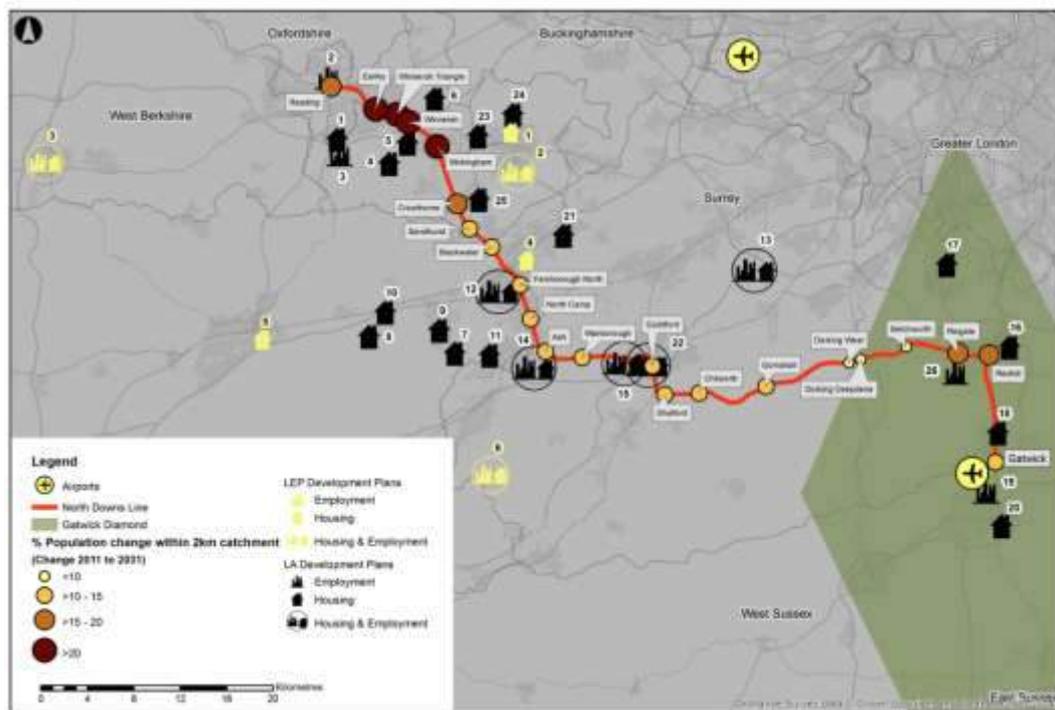
The North Downs Line catchment area is expected to grow rapidly in population and employment. An assessment of future growth suggests that there could be an additional 63,000 people (16% growth) and 34,000 jobs (12% growth) within two kilometres of a North Downs Line station by 2031.

A review of major development sites located in close proximity to the line highlights the potential for growth in and around the urban areas served by the North Downs Line.

⁶ Enterprise M3 Strategic Economic Plan, March 2014

⁷ Coast to Capital Strategic Economic Plan, March 2013

⁸ <http://www.gatwickdiamond.co.uk/the-gatwick-diamond.aspx>

Figure 4 – Major Development Sites

Reading to Wokingham

Provision has been made for housing development at a number of locations around the Reading/Wokingham corridor. For example, the Wokingham Core Strategy⁹ identifies four Strategic Development Locations each of which includes provision for between 1,500 and 3,500 new dwellings.

Farnborough North to Guildford

A number of housing sites have been identified to the west of the North Downs Line in close proximity to Farnborough North, North Camp and Ash stations. These include the Aldershot Urban Extension which includes plans for approximately 4,250 dwellings by 2027¹⁰.

A range of sites have also been allocated for both housing and employment growth in Guildford Borough Council's Draft Local Plan (2014)¹¹. These include the potential for up to 2,100 dwellings and employment and 1,000 sqm of retail floor space at Former Wisley Airfield, and the potential for up to 1,215 dwellings, up to 95,500 sqm of employment space within the Ash and Tongham urban area. Within Guildford itself, there are plans for a major urban extension and further housing and employment development in Guildford Town Centre.

Dorking West to Gatwick (the Gatwick Diamond)

The Coast to Capital Strategic Economic Plan seeks to exploit the 'Gatwick Effect', harnessing Gatwick Airport's potential to act as the catalyst to a cluster of economic activity. Gatwick Airport Ltd. is investing £1.2bn in its current growth plans which will further increase passenger numbers from the current level of 35m

⁹ Wokingham Borough Council, Adopted Core Strategy, January 2010

¹⁰ Rushmoor Borough Council, Adopted Core Strategy, October 2011

¹¹ Guildford Borough Council, Draft Local Plan: Strategy and Sites, July 2014

to 44m¹². The Davies Commission report on options for a new runway will play a major determining role in the future of Gatwick Airport and may place more importance on the North Downs Line's role in providing rail access to Gatwick.

A number of major employment and housing sites are allocated within the Gatwick Diamond area. Reigate and Banstead's Core Strategy aims to deliver a further 46,000 sqm of employment floor space across the borough over the plan period to 2027, with a concentration of 7,000 sqm in Redhill town centre. A total of 1,610 dwellings planned for the Redhill/Reigate area. A further 930 dwellings for the Preston regeneration area and Banstead Village centre, and at least 2,400 dwellings around Horley¹³.

2.1.5 Commuting Patterns

One of the main ways in which the rail network underpins the economy is through the labour market. According to the census, around 18,000 people commute by rail to workplaces located within two kilometres of North Downs Line stations. Around a quarter of these commuters are actually residents of a North Downs Line station with a high probability therefore that these commuters use North Downs Line services to access employment.

There are also 24,000 residents of the North Downs Line local catchment areas who commute to work by rail. Over half of these commuters travel to London, emphasising the importance and value of connections between the North Downs Line and the radial routes into London from Reading, Wokingham, Guildford, Reigate and Redhill.

Table 1 – Rail based commuting flows to/from North Downs Line catchments

	North Downs Line Station Catchment Areas	Rest of Surrey, Berkshire, Hampshire & Reading	Central London	Outer London	Rest of UK
Origin of commuters travelling to jobs located within North Downs Line Station Catchment Areas	24%	35%	9%	12%	21%
Destination of North Downs Line residents commuting to a place of work	18%	16%	53%	6%	7%

¹²Coast to Capital Strategic Economic Plan, March 2013

¹³ Reigate and Banstead Borough Council Adopted Core Strategy, July 2014

Planning and Economic Baseline Summary:

The North Downs Line serves an estimated 392,000 people and 290,000 jobs within a two kilometre catchment area.

There will be an additional 63,000 people (16% growth) and 34,000 jobs (12% growth) within two kilometres of a North Downs Line station by 2031.

Guildford and Reading are the largest towns on the route but the North Downs Line also serves a number of important regional population centres – e.g. Wokingham, Farnborough and Redhill.

The Reading to Guildford section is associated with large population and employment catchments which contrasts with rural character of the area between Guildford and Dorking.

Future population and employment growth is expected, particularly centred on the area between Reading and Wokingham.

The North Downs Line serves various major housing and employment developments, particularly around Reading, Wokingham and Guildford.

2.2 Transport Baseline

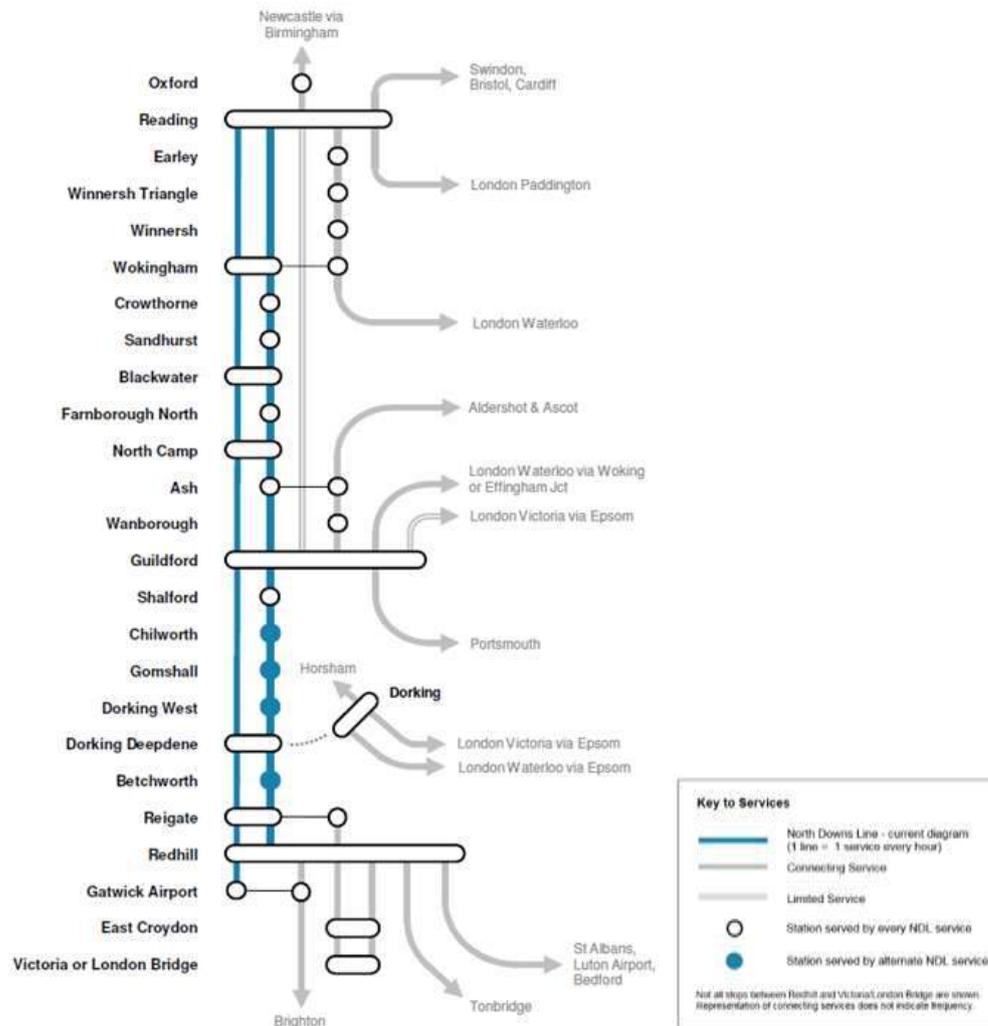
This section considers the strengths and weaknesses of the existing rail service in the context of the wider transport network in this part of the South East.

2.2.1 North Downs Line Services

North Downs Line services are operated by First Great Western. Currently, North Downs Line services comprise one fast service per hour between Reading and Gatwick Airport and a stopping service between Reading and Redhill.

Major stations are served by both the fast and stopping services and therefore receive two trains per hour. Some rural stations are served by alternate stopping services and have an approximate two-hourly service pattern.

Figure 5 - Current Service Pattern



2.2.2 Stations and Usage

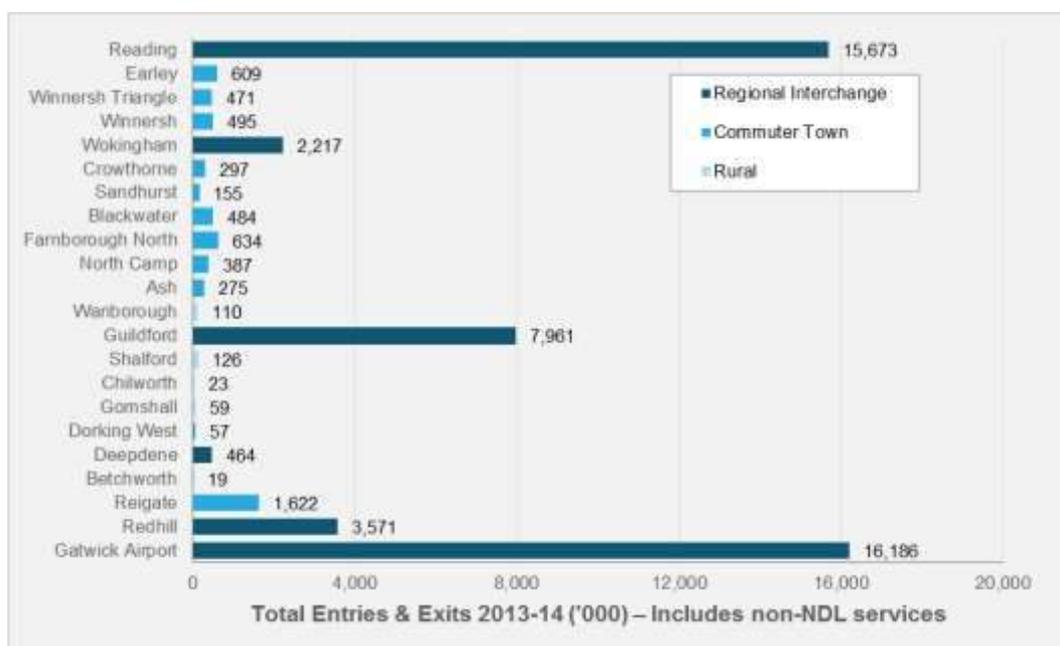
Figure 6 shows the total number of passengers using each station in 2013/14. This data includes passengers using non-North Downs Line services. Stations have been classified into ‘regional interchanges’, ‘commuter towns’ and ‘rural’ stations.

The line is characterised by important trip generators clustered at either end of the line, and a major interchange approximately in the middle (Guildford) with relatively lightly used stations in between. Gatwick and Reading are by far the busiest stations on the route, followed by Guildford, Redhill and Wokingham. These stations are all served by non-North Downs Line services, which account for the vast majority of traffic.

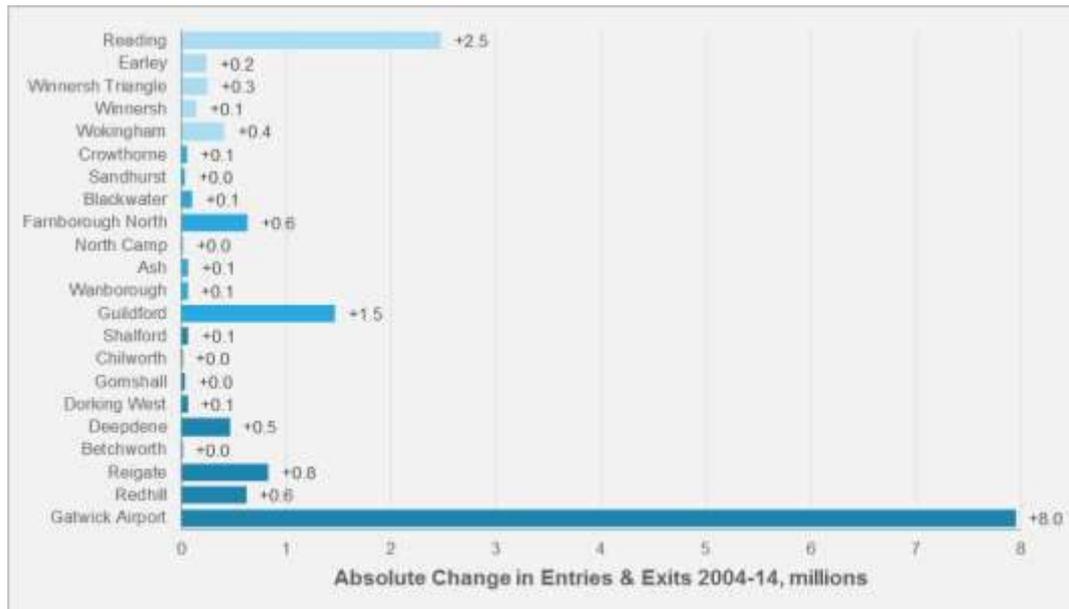
Stations between Guildford and Dorking have relatively low patronage as they are located in rural areas. The area between Guildford and Reading is more built-up and stations are located in urban or suburban areas.

Towards the east, Dorking Depedene, Reigate and Redhill are important centres with high levels of rail demand. In relation to Dorking it should be noted that a scheme is in place to facilitate interconnectivity between Dorking Depedene and Dorking Main Stations. This scheme will provide a seamless rail to rail connection between the two stations in a similar way to changing platforms at a large station. A further 1.2 million people use Dorking Main station each year.

Figure 6 – Station Usage



On average, station usage on the North Downs Line grew by 4.2% per annum in the period 2004-14. This is slightly higher than the Surrey average (3.7%) but lower than the England average (6.0%). The rate of growth was highest at rural stations located between Guildford and Redhill, however in absolute terms these stations have made a relatively modest contribution to growth in patronage in comparison with interchange stations which account for most of the growth in rail demand.

Figure 7 – Growth in station usage

2.2.3 Journey Patterns

Figure 7 uses First Great Western ticket sales data to highlight the busiest flows of passengers on the North Downs Line. Passenger movements are dominated by the major stations: Reading, Guildford and to a lesser extent Gatwick. Around a quarter of journeys on the North Downs Line start or end at Reading.

A high proportion of North Downs Line passengers (56%) use the line to connect to other lines. Less than a third of journeys (30%) are between two North Downs Line stations. The remainder (14%) are through journeys. Access to/from Gatwick Airport accounts for 13% of journeys on the line.

Figure 8 - Passenger Flows (North Downs Line – First Great Western services)



Crowding occurs on peak time services at either end of the line (Reading, Wokingham, Reigate and Gatwick), although the most significant crowding issues tend to occur at Reading.

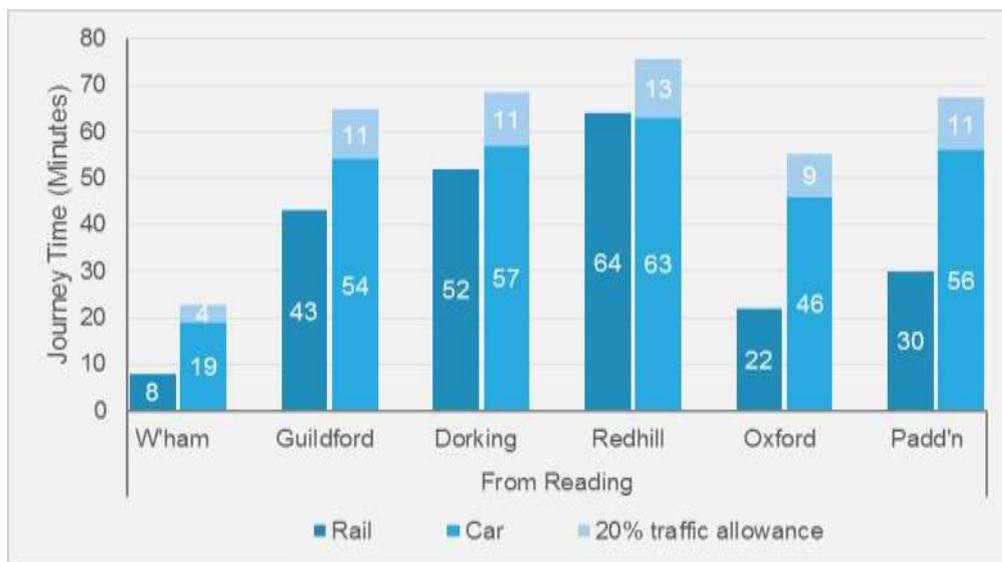
The loading data suggests that there is a requirement for 3-car trains on the majority of peak services. As demand grows, there may be a need for 4-car rolling stock on the busiest services in the absence of peak time frequency enhancements.

2.2.4 Journey Times and Costs

The fast service has a typical journey time of 1 hour 16 minutes between Reading and Gatwick (or 1 hour 4 minutes between Reading and Redhill). The stopping service takes around 1 hour 21 minutes between Reading and Redhill. Average rail speeds are lower between Reading and Guildford (60kph) than between Guildford and Redhill (70kph – fast service) because of the higher frequency of stops on this section.

An analysis of journey times and costs by car and rail has been undertaken for selected origin and destination stations on the North Downs Line as well as for Heathrow, London and Oxford.

Journey times are point-to-point and do not include station access times or waiting times, or time for finding a parking space by car. Peak traffic adds around 15-20% to the road journey times (but higher for Central London) so the travelling by car may be less attractive than the data indicates for many travellers. The charts presented here include a 20% increase on road journey times to take into account average traffic delays.

Figure 9 - Rail-Car Journey Time Comparison

Rail travel between Reading and Guildford is faster than driving, even without taking into account road congestion, and travel between Reading and Redhill or Gatwick has a comparable travel time to driving.

Drive times to the east of Guildford are particularly unreliable because it typically involves travelling on A25 (a single carriageway road passing through towns and villages) or taking a longer route via the M25. Travel to London for the interchange stations along the route is always faster by rail, even before peak time congestion is taken into account.

From Reading, the free-flow drive time to Gatwick is 20 minutes faster than the rail journey time, but when traffic delay is taken into account, the travel times are comparable.

Travel between the two airports using Gatwick Express and Heathrow Express takes 80 minutes, only a 10 minute saving on the (much cheaper) route via the North Downs Line. This is around twice the free-flow drive time. Travel between the two airports involves busy roads such as the M25 – as an indication of the impact of traffic congestion on this journey, the National Express coach is timetabled to take between 65 and 90 minutes (vs 43 mins 'free flow').

Journey times from Heathrow to all destinations considered in this analysis are longer by rail than by car, in free-flow traffic conditions. Current rail access to the airport is oriented towards London, so rail travel from much of Surrey to Heathrow involves routing via Central London. For most stations, access to Heathrow is fastest if connecting to coach links to the airport from Reading (journey time 45 min), Woking (50 min) and Feltham (30 min).

Transport Baseline Summary

There is significant potential to improve the North Downs Line which currently offers modest journey times and a frequency of two trains per hour for busier stations or one train every two hours for rural stations.

The line serves key commuter and leisure markets, provides good opportunities to connect to main line radial routes. The line could play a more prominent role in providing for trips to Gatwick and perhaps to Heathrow with direct rail access from Reading.

Gatwick and Reading are by far the busiest stations on the route, followed by Guildford, Redhill, Reigate and Wokingham. These stations are all served by non-North Downs Line services, which account for the vast majority of traffic.

Intermediate stations between Guildford and Dorking have relatively low patronage as they are located in rural areas; the area between Guildford and Reading is more built-up with stations located in urban or suburban areas.

On average, station usage on the North Downs Line grew by 4.2% p.a. in the period 2004-14. This is slightly higher than the Surrey average (3.7%) but lower than the England average (6.0%).

Overall demand growth has been driven by the growth of larger stations – rural stations show a faster rate of growth but this has a relatively small effect on overall patronage.

Travelling the full extent of the North Downs Line (between Reading and Redhill or Gatwick) is comparatively slow by rail, however journey times between Reading and Guildford are competitive with car. This is without taking into account congestion or parking costs.

2.3 Operational Baseline

The operational baseline provides an overview of the network, capacity constraints and rolling stock.

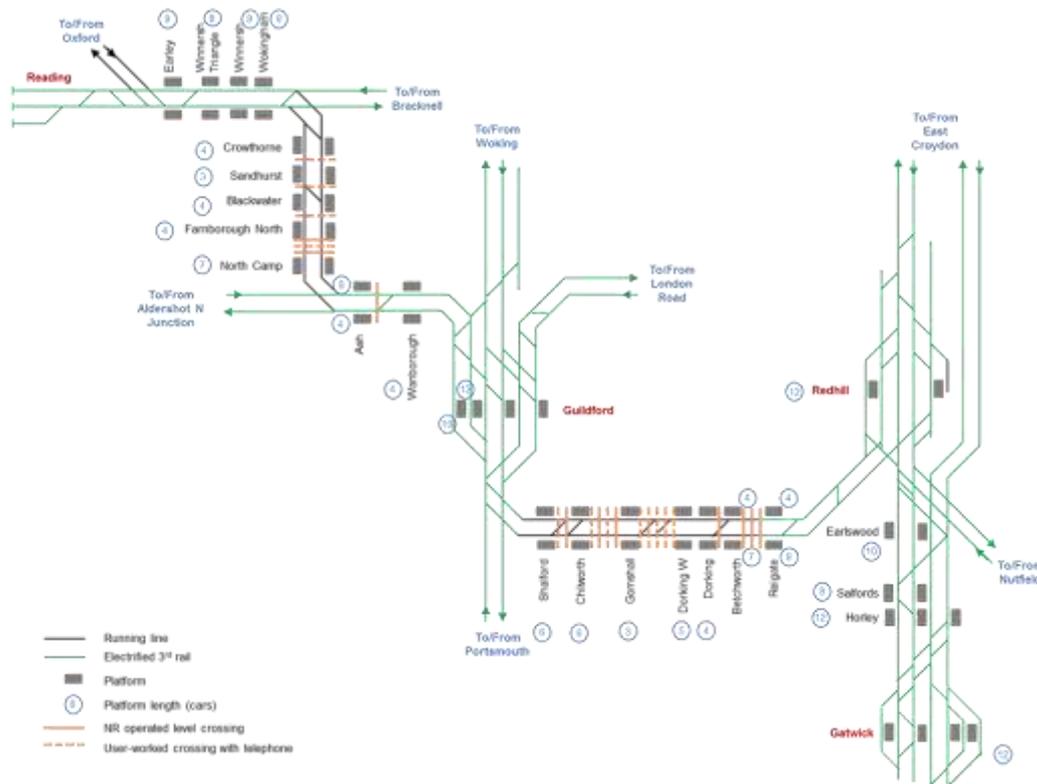
2.3.1 Network Description

The total route length of the North Downs Line is 48 miles. The route is two track throughout. The North Downs Line crosses three radial routes to London (Brighton Main Line, South West Main Line at Guildford and the Windsor Lines routes to Waterloo). The line is already third rail electrified with the exception of two main sections totalling 29 miles (Wokingham and Ash 12 miles and Shalford and Reigate 17 miles).

Some of the longer sections of the route have linespeeds of 50 to 70mph which is sufficient for a stopping service but may be restrictive for a semi-fast service. At all of the intersection locations the line speed is slower however this can be justified as the train will always be stopping at these major stations. There are some sections of 30, 40, 50 mph which, with appropriate infrastructure works, could be raised to reduce overall journey times.

Platforms along the route vary in length significantly from 12 car to 3 car. The current rolling stock is 3 car to meet the shortest platforms.

There are 10 level crossings on the route with automatic barriers at road crossings and 12 user-worked crossings at footpaths. Crossings present a potential issue if service frequencies are increased given that down time for the crossings will increase, with possible implications on road traffic.

Figure 10 - Network

2.3.2 Capacity Constraints

The main capacity constraints are at Reading, Guildford, and Redhill where North Downs Line services interact with mainline services.

Reading station has recently been redeveloped to include 3 turnback platforms. If North Downs Line service frequencies are enhanced then timetable interactions with the services via Bracknell need to be considered, but do not present a significant capacity constraint.

Platform capacity at Guildford is an important capacity constraint. Guildford is the only suitable location for fast services to overtake stopping services. The flat junction move crossing the Portsmouth mainline south of Guildford presents a timetabling constraint.

Redhill has constraints and conflicting moves where services interact with Brighton Main Line and Tonbridge services. Platform capacity is available at Gatwick to turnback services but there are capacity constraints on the Brighton Main Line.

2.3.3 Rolling Stock

First Great Western operate a mix of Class 166 and Class 165 diesel trains on the North Downs Line. The rolling stock is between 22 and 24 years old although all trains underwent refurbishment between 2010 and 2011. The majority of services are provided by 3-car trains.

Operational Baseline Summary

The North Downs Line is non-electrified for two main sections totalling 29 miles - other sections are third rail electrified.

The route is two track with Guildford as the only suitable location for fast services to overtake.

There are 10 level crossings on the route with automatic barriers at road crossings and 12 user-worked crossings at footpaths.

Platforms along the route vary in length significantly from 12 car to 3-car. The current rolling stock is 3-car to meet the shortest platforms.

Some of the longer sections of the route have linespeeds of 50 to 70mph which is sufficient for a stopping service but may be restrictive for a semi-fast service. There are some section of 30, 40, 50 mph which, with appropriate infrastructure works, could be raised to reduce overall journey times.

Key operational constraints are identified as level crossings, platform lengths, capacity at Guildford and between Redhill and Gatwick.

There is scope for increased line speeds, potential for 'in-fill' electrification, and there are planned improvements at Guildford, Redhill and Gatwick stations.

AC electrification potentially offers faster journey times, but DC electrification will minimise costs and provide more opportunities for inter-working with other routes. Availability and cost of suitable rolling stock may be a key issue.

2.4 Overview

The key outputs from the Baseline review are as follows:

- **The North Downs Line serves a large and growing catchment area –** 63,000 more people and 34,000 new jobs by 2031.
- **The line caters for complex journey patterns and performs multiple roles:**
 - orbital route connecting with lines into London;
 - links key economic centres in the South East;
 - suburban commuting links (including education);
 - important leisure market;
 - connects rural communities;
 - airport access.
- **There is significant potential to improve services –** relatively modest journey times and frequencies with two trains per hour for busier stations or one train every two hours for rural stations.
- **The North Downs Line can play a stronger supporting role in the development of a successful regional economy by:**
 - improving commuter links, growing the leisure market and providing better opportunities to connect to main line radial routes;
 - better providing for trips to Gatwick Airport.

3 Conditional Outputs

3.1 Stakeholder Priorities

As noted, stakeholders were engaged through a North Downs Line forum organised by SCC and stakeholder responses have been reviewed in order to identify a set of key stakeholder priorities. These priorities have been taken into account when developing options and developing the approach to options assessment.

This section attempts to distil the responses of stakeholders into a number of key messages.

- **The role of the North Downs Line assessment** – It is important that the study builds on, but does not duplicate with, Network Rail’s Wessex Route Study. The North Downs Line assessment should have an emphasis on economic development objectives, rather than being a purely transport-based approach.
- **Strategic importance as an orbital route** – Across the region, radial routes into London – both rail and highway – are already strong. In comparison, there is under provision of orbital transport infrastructure. As a result, the orbital highway network is highly congested and travel times by both car and public transport are relatively slow.
- **Economic rebalancing** – Strengthening this orbital route, and improving links between economic centres in the South East, will help facilitate economic growth along this corridor, rebalancing the economy away from reliance of London and its transport network.
- **Economic impact and additionality** – Of interest to Government is not just the growth potential of the region, but the net impact on jobs and housing of improvements to the North Downs Line. As far as possible, the report should seek to articulate the ways in which improvements will unlock new development and deliver economic growth.
- **Airport Access** – The importance of Gatwick as a provider of employment should not be underestimated. For airport access and for travel between Gatwick and Heathrow, the potential of the North Downs Line to replace the ‘V-shaped’ routes in and out of London should be emphasised.
- **Access to Stations** – Conditional outputs should also reflect the importance of ‘access to stations’. The provision of car parking at or near the station needs enhancement in addition to the quality of connections to other forms of public transport.
- **New stations** – Whilst there is a potential conflict between new stations and the goal of minimising journey times, the potential for new stations to contribute to the economic development objectives should be considered.
- **Level crossings** – There is likely to be an important role for the stakeholder group in highlighting with issues related to level crossings. There are, for instance, trade-offs between increasing service frequency and level crossing downtime which can cause local traffic issues. An example of this is the crossing at the intersection of the North Downs Line and the A217 at Reigate.

Elsewhere, Local Enterprise Partnership funding is being used to fund the closure of level crossings where appropriate.

3.2 Conditional Outputs

The North Downs Line assessment applies the concept of ‘Conditional Outputs’ used by Network Rail as part of the Long Term Planning Process. Conditional Outputs set out aspiration for future rail services based on need and provided the basis upon which options for improvement have been developed.

Based on the outcomes of the baseline assessment and the priorities of stakeholders, the following Conditional Outputs were defined:

1. Reduce rail journey times on the North Downs Line

- a. Reduce journey times between Interchange Hubs and Commuter Towns, to/from Gatwick Airport, and to/from London.

2. Improve connectivity for stations on the North Downs Line

- a. Enhance service frequencies between Interchange Hubs, Commuter Towns, Rural Stations;
- b. Maintain at least existing service frequencies for rural stations;
- c. Maximise opportunities for peak time travel at all station types;
- d. Provide new connections at strategically important points on the network.

3. Improve quality of rail service on North Downs Line

- a. Provide sufficient capacity for peak travel demand;
- b. Deliver enhancements to rolling stock quality;
- c. Enhance the quality of stations and station access.

4 Options Assessment

4.1 The Network Rail 'Base Case'

The proposed service specification for the North Downs Line set out in Network Rail's Wessex Route Study is for a three train per hour timetable created by an additional fast service between Reading and Gatwick. This timetable option forms the starting point for the strategy and is the base option against which all other options will be compared.

As described in the Route Study, this option comprises:

- Two fast service per hour operating between Reading and Gatwick Airport.
- A single stopping service per hour operating between Reading and Redhill. The stopping service moves to an hourly 'all stops' pattern with all stations receiving at least one train every hour.

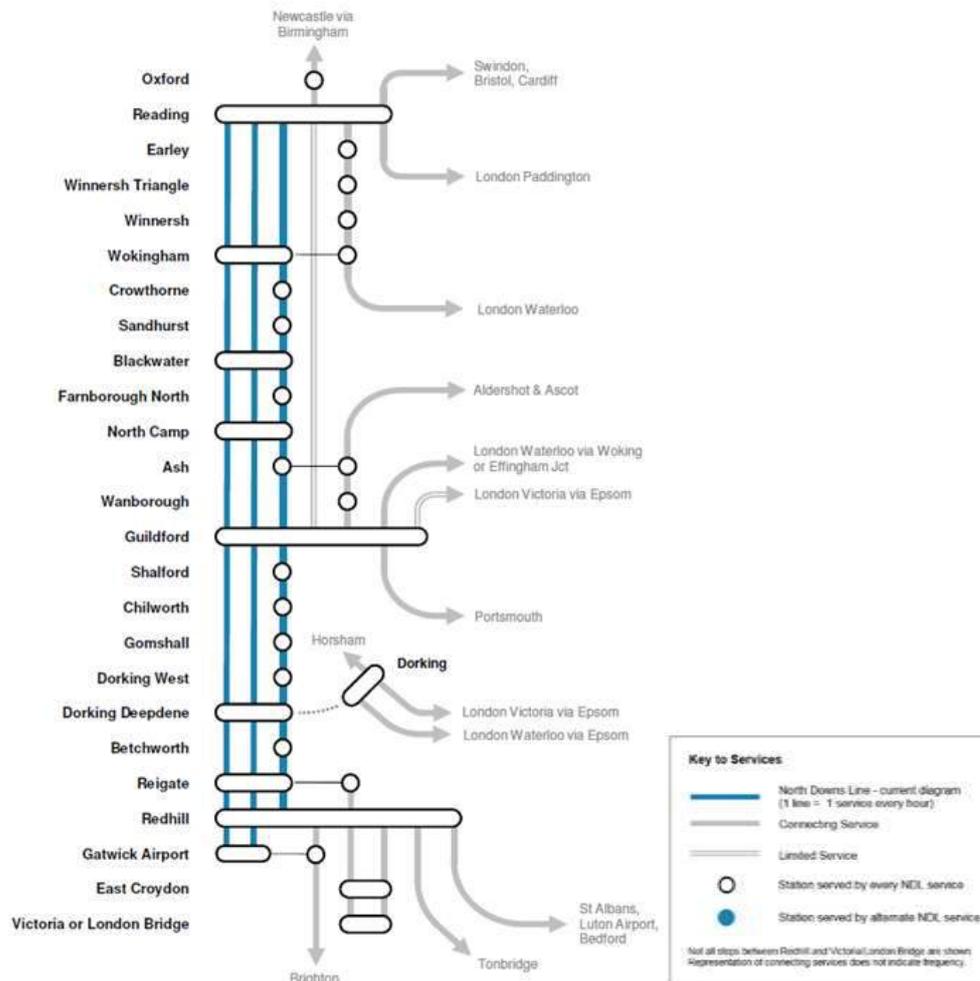
This option can be delivered largely within the constraints of the existing and planned infrastructure and could be implemented following the completion of the planned increase in platform capacity at Redhill (Platform 0) which is programmed for Control Period 5. The exception to this is the potential need to invest in an upgrade of a number of level crossings to reflect the higher frequency of service.

The route study also notes the two main drawbacks of this option:

- Due to limits on platform capacity at Redhill (even following the opening of a new Platform 0 at Redhill), only two services can be operated during peak times. Therefore, it is assumed that the stopping service would operate in the 'off-peak' only.
- With three trains per hour, services have been timetabled such that the fast service overtakes the slow service at Guildford. This requires the stopping service to be held at Guildford for around 15 minutes, increasing journey times.

Network Rail is undertaking further assessment of the potential for a number of possible linespeed improvements.

Maximising the potential of this timetable improvement will require careful timetabling of these services alongside Brighton Main Line services operated by GTR (Govia Thameslink Railway) from 2018. The timetable will need to be optimised to maximise peak time frequencies, minimise journey times and the required layover at Guildford.

Figure 11 - Base Option Service Pattern

4.1.1 Impacts and Value for Money

For passengers the Base Option has the following impacts:

- Users of the larger stations serviced by both fast and stopping services (Reading, Wokingham, Blackwater, North Camp, Guildford, Dorking Deepdene, Reigate, Redhill) would experience an overall increase in frequency from 2 to 3 trains per hour, with the exception of peak hours.
- Access to Gatwick Airport would be improved with 2 trains per hour extended from Redhill to Gatwick.
- In the off-peak, the stopping service will revert to an hourly pattern such that Chilworth, Gomshall, Dorking West, and Betchworth will have one train every hour, rather than one train every two hours.
- In the peak, there will be a reduction in frequency from smaller stations which will impact on commuters using the North Downs Line. Depending on the final timings, this will have a potentially negative impact on commuters and school children using the North Downs Line at peak times.
- Journey times for fast services on the North Downs Line will be largely unchanged.

- The requirement for the fast service to overtake the stopping service at Guildford and the all-stops pattern results in an increased in end to end journey time of 15 minutes in the Reading-Redhill direction and 12 minutes in the Redhill-Reading direction. This is partly mitigated by the opportunity for passengers to change from the stopping service to the fast service at Guildford.

Network Rail's analysis shows that the option has a good business case with a benefit cost ratio (BCR) of 2.0. This places the option in the 'high' value for money category. This indicates that every £1 of financial investment (net of revenues) in extra services results in £2 of benefits to society.

Arup has constructed an appraisal model for the purposes of the North Downs Line assessment in order to compare alternative options. This model has also been used to test the base option. The results of Arup's assessment closely match the Network Rail analysis and gives a BCR or 1.9:1 for the Base Option.

Table 2 - Base Case Appraisal Results

	Network Rail Route Study	Arup Appraisal Model
	£m Present Value (2010)	
Costs		
Investment costs	0.0	0.0
Operating costs	59.7	75.6
Revenue	-27.8	-33.1
Other Impacts (Broad Transport Budget)	-0.04	-
Total Costs	31.8	42.5
Benefits		
Rail User Benefits	64.5	80.0
Non-User Benefits	2.1	3.7
Indirect Taxation Impacts	-3.4	-3.5
Total Quantified Benefits	63.3	80.2
Overall Results		
NET PRESENT VALUE	31.4	37.8
BENEFIT COST RATIO	2.00	1.9

4.1.2 Overall Assessment

In overview, the Base Option represents a significant improvement on the existing service pattern and offers high value for money. The Base Option should therefore be supported as the building block for the long term strategy for the North Downs Line. The generation and assessment of alternative options therefore takes the Network Rail Base Option as its starting point.

4.2 Options Selection

This section details the process of identifying and sifting options to identify a preferred set of interventions for the North Downs Line that ultimately form part of the strategy. This has followed a three stage process.

Stage 1 – A high level sift of options in order to produce a short list for more detailed assessment;

Stage 2 – A more detailed assessment of shortlisted options employing a mix of qualitative and quantitative assessment in order to identify a set of preferred options;

Stage 3 – Prioritisation of the preferred options to identify those proposed for Control Period 6 and those that form part of a longer term vision for the line.

Figure 12 - Options Assessment Approach



4.3 Stage 1 – Identifying the Shortlist

The Stage 1 sift is intended to determine whether an option merits shortlisting for more detailed assessment. Where options have not been brought forward to Stage 2, this tends to be because it aligns poorly with the conditional outputs or because the option has been ruled out on the grounds of feasibility or cost. Additionally, a number of options have been excluded to avoid duplication.

The process of sifting the long list of options to generate a shortlist is set out in Appendix B. The resultant shortlisted options are given in Table 3.

Table 3 - Shortlisted Options

Category	Shortlisted Options
Journey Times	Timetable optimisation
	Reduce signal headways and improve linespeed
	Reduce the stopping service layover at Guildford by delivering enhanced capacity at Guildford
	Introduce express services
Connectivity	Operate stopping services during peak hours
	Increase service frequency to four trains per hour
	Service extensions: Extend fast services from Reading to Oxford
	Service extensions: Extend services to London via the Brighton Main Line
	New stations: an additional stop to the stopping service at a new station at Park Barn in Guildford
	Allow stopping services to call at stations between Reading and

Category	Shortlisted Options
	Guildford not currently served by North Downs Line services
Quality	Increase capacity through train lengthening
	Improve station quality
	Improve access to stations including targeted enhancements of park and ride provision
Cross-cutting options	Infill overhead line AC Electrification

Journey Times

With respect to journey times, there is likely to be significant potential to improve performance, particularly of stopping services, through enhanced line speed and an upgrade to signalling. As noted, Network Rail are already considering the potential to improve line speeds on the North Downs Line. Overcoming platform capacity constraints at Guildford is also likely to be key to delivering a faster and more flexible timetable. Express services may also play a future role in the strategy given the potential strategic advantages of these services. Assuming current rolling stock, express services are likely to be the only option which achieves a significant improvement in journey times of the fast services.

Connectivity

Service frequency

A significant improvement on the Base Option could be achieved by moving to an 'all day' 3 train per hour timetable, avoiding the need to reduce the frequency of the stopping service during peak times. In the longer term there is an appetite for moving to a 4 train per hour timetable with all services operating during the peak. The possible reduction in peak frequencies for small stations is of particular concern to local stakeholders given the reliance of the North Downs Line for commuter and education trips, therefore ensuring a regular service pattern throughout the day is an important consideration.

Crucially, constraints on platform capacity at Redhill are such that a four train per hour option may not be achievable by adding an additional stopping service to the base option timetable.

The box below discusses in more detail the range of possible options for achieving a four train per hour timetable in the future.

Box 1 – Achieving higher service frequencies

Future Timetable Solution – Options for Achieving Four Trains Per Hour

The following options for achieving a four train per hour timetable have been considered:

Option 1 – Intensive Platform Utilisation at Redhill

Description – Increase service frequency from 3 to 4 trains per hour by adding an additional stopping service between Reading and Redhill, turning back in the platform at Redhill. An alternative variant of this option would be to have 3 services running through to Gatwick Airport on the Brighton Main Line with 1 service turning back at Redhill. Either solution would increase platform utilisation at Redhill or therefore consideration has to be given to the feasibility of this option.

Advantages – This option is relatively simple as it builds on the existing service pattern. If the

additional service turns back at Redhill then conflicts with Brighton Main Line services could be avoided.

Disadvantages – This option would result in a very high level of capacity utilisation at Redhill, especially if services are extended on to Gatwick and therefore have to turnback in Redhill twice. It is considered that this option is unlikely to be feasible with the planned layout at Redhill, even with the additional platform 0.

Option 2 – Operate through Services to London

Description - One means of accommodating extra peak time services is to use platform space more efficiently at Redhill by operating North Downs Line services through Redhill and on to London on the Brighton Main Line. There are considered to be two ways of achieving this. Firstly, by replacing the Reigate to London trains, or secondly, by joining North Downs Line services to Tonbridge or Horsham services at Redhill.

Advantages – This option can be achieved with the planned layout at Redhill and would not require any additional infrastructure investment. Extending services to London the North Downs Line will also better serve the important commuter market to London from stations between Guildford and Reigate. The option would provide improved links between Guildford and East Croydon avoiding Clapham Junction. No additional paths to London are required as the North Downs services would run in the path of existing Reigate or Tonbridge services.

Disadvantages / Constraints – By operating trains from the North Downs Line on the Brighton Main Line this may result in significantly increased performance risks by exporting North Downs Line delays on to the heavily used main line. This option may also introduce further complexities by adding an additional train operator on the Brighton Main Line into London Bridge or London Victoria and possible connections between services currently run by different operators. This option would also require the electrification of the line with use of DC or dual voltage rolling stock and therefore cannot be achieved in the short term.

Option 3 – New Turnback Facility at Redhill

Description – Provision of an additional turnback facility at or near Redhill that could be used by two stopping services between Reading and Redhill. This would allow the North Downs Services to Redhill to be independent of the Brighton Main Line, and free up platform capacity at Redhill for the services to Gatwick. Based on a high level review, options for an additional turnback facility may be limited, although there is railway land with sidings to the south west of Redhill which could potentially be linked via a foot bridge to the main platforms. Further feasibility work would be required to determine the achievability of this option.

Advantages – This option enables services to turnback at Redhill without interfering with Brighton Main Line service. It would provide a dedicated branch line to improve network performance. Further performance benefits could be delivered if all North Downs Line services terminated at Redhill such that the North Downs Line and Brighton Main Line are separated. However, this option would break the direct link between North Downs Line stations and Gatwick Airport and therefore does not align well with the objectives of this strategy.

Disadvantages/Constraints – There are potential feasibility and cost issues that require further investigation.

Option 4 – Operate a Fourth Service between Reading and Guildford or Reigate

Description – If a fourth service is operated between Reading and Guildford or between Reading and Reigate then the planned three trains per hour into Redhill can be maintained, while a fourth service is provided for part of the North Downs Line route.

Under the Guildford Capacity Enhancement scheme there would sufficient capacity at Guildford to achieve an additional Reading to Guildford shuttle services.

A high level review shows an additional crossover would be required at Reigate to reverse the services here. This could be provided to the west of the station and level crossing allowing the

service to turnback in platform 1 for passengers to interchange with a Reigate starter for London from the proposed new bay platform.

Advantages – These options enable a fourth service without increasing platform utilisation at Redhill. Although not serving Redhill, the fourth service would be provided on the busiest part of the network between Reading and Guildford.

Disadvantages/Constraints – These options fails to provide a connection to Redhill for all North Downs Line services. By failing to link North Downs Line services directly to the Brighton Main Line this potentially results in passengers being required to change trains twice for services towards Gatwick.

For the Reading to Reigate option, the capital cost of this option is potentially high and it is complicated by the location of the level crossing. There would be constraints for the timing of this services to fit with through movements in both directions at Reigate.

Summary

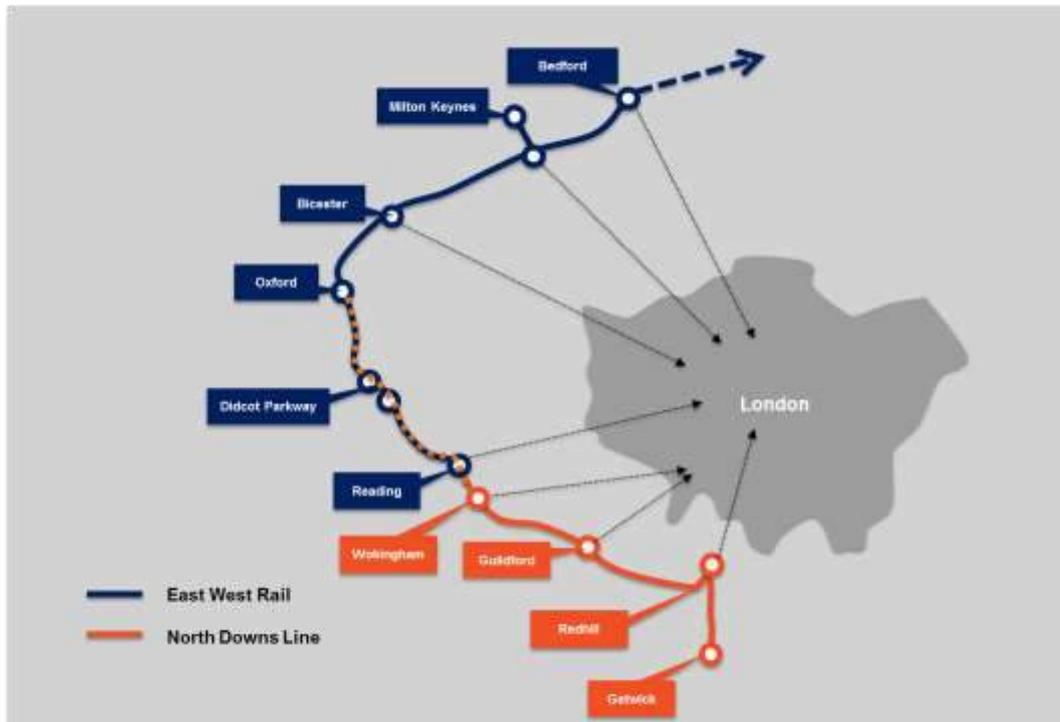
Further feasibility analysis will be required to identify the preferred approach to a four train per hour timetable. For the purposes of this assessment, a four train per hour timetable has been constructed under the assumptions set out in Option 2, given that this option is achievable within the constraints of the planned Control Period 5 layout at Redhill.

It is suggested that these options are considered as part of the long term planning process for Control Period 7. Moving to a four train per hour timetable could be considered as part of an overall programme of modernisation of the line including electrification which is further considered below.

Network Extensions

There is a clear desire amongst stakeholders to maximise connectivity to Gatwick airport and therefore, having additional through running services – either as part of a 3 or 4 train per hour timetable. However, the requirement to turnback services at Redhill in both directions and timing constraints with the Brighton Main Line present a significant operational challenge to providing further services to Gatwick without some substantial infrastructure investment. This would require further work in conjunction with Network Rail to look at the wider requirements for the Brighton Main Line.

To the west, Oxford offers the most attractive option given its strategic importance and the potential to link the two orbital routes to the north and south of London – the North Downs Line and East-West Rail. This is illustrated in Figure 13.

Figure 13 - Possible future orbital network

New Stations

New stations are another way of improving connectivity. Trade-offs between new stations and journey times need to be considered carefully. However, high level consideration of the Park Barn station and its local context suggests there is merit in further consideration of this option.

Quality

There should be a considerable focus on improving North Downs Line stations to improve the actual and perceived quality of the North Downs Line to match stakeholder ambitions for the future role of the line. There are two elements to improving station quality – the quality of facilities and the quality of access.

Some stations, such as Dorking Deepdene, have already been identified as requiring an upgrade to facilities. Coast to Capital LEP funding for the ‘Dorking Transport Package (Phase 1)’ has been confirmed and will provide a welcome improvement to Dorking Deepdene station. There may be further opportunities to provide improved access to the station platforms for those with limited mobility. Additionally, improvements to access arrangements are likely to be warranted at North Camp and Blackwater. There are also examples of stations, such as North Camp, Blackwater and Crowthorne, with excess demand for parking or inadequate park and ride facilities.

Cross Cutting Options

Electrification is the major ‘cross-cutting’ option. Electrification could act as a catalyst to an overall modernisation of the North Downs Line, delivering improved quality of rolling stock, dramatically reducing journey times and increasing opportunities for new network connections.

Box 2 - Electrification

Note on Electrification Options

Three stretches of the North Downs Line are already equipped with third-rail (DC) electrification. There are two non-electrified sections between Wokingham and Ash (12 miles) and between Shalford and Reigate (17 miles). Qualitative consideration has been given to three alternative options for the electrification of the North Downs Line:

- **Full AC or overhead line electrification (OLE)** of the whole of the North Downs Line from Reading to Gatwick and use of AC rolling stock.
- **In-fill AC overhead line electrification** of the remaining non-electrified sections of the North Downs Line and use of **dual-voltage rolling stock**.
- **In-fill third-rail electrification** of the remaining non-electrified sections of the North Downs Line and use of DC rolling stock.

Electrification of the North Downs Line would represent a major long term investment in the Line. Evidence from other electrification schemes in development, suggests that the cost of overhead line electrification could be in the range £1.5m to £2.0m per standard single track kilometre. The primary benefits of electrification are a combination of lower operating cost savings of electric rolling stock and benefits to passengers of faster journey times. The business case for electrification tends to be strongest for networks which are used most intensively. The more frequent the rail service and the higher the demand, the more operating costs savings and passenger benefits will be generated per pound of investment in electrification.

The North Downs Line has moderate service frequencies. Therefore, in respect of electrification, a key advantage of the North Downs Line is the fact that – with an infill scheme – only 60% of the total route length would require electrification. If overhead lines needed to be installed on the entire length of the route, it is highly unlikely that a business case for electrification could be justified at this stage. Therefore, it is considered that the primary choice for the North Downs Line is between the two ‘in-fill’ electrification options.

In the case of infill AC overhead line electrification, using dual voltage rolling stock is a feasible option for the North Downs Line. For example, class 450 trains – operated by South West trains – were built with provision for dual voltage operation and could be converted by fitting a pantograph to the unit. It is considered that a dual voltage train would have broadly the same performance characteristics as ‘DC’ train when operating on third-rail sections and an ‘AC’ train when operating under wires. Dual voltage stock is also an attractive option for the North Downs Line because it would allow services to be extended both onto the Brighton Main Line and beyond Reading to Oxford. In contrast, DC rolling stock would be unable to operate beyond Reading.

The primary rationale for considering a third-rail infill scheme is cost. The unit cost of overhead line electrification varies significantly across different routes. The primary reason for this variation tends to differing requirements for power supply and the requirement for structural works to provide sufficient clearances for the wires. These elements can comprise up to 70% of the total costs of electrification. For the North Downs Line, third rail offers some key advantages by eliminating the need to achieve greater clearances (36 road bridges, footbridges and bridleway bridges have been identified on the non-electrified sections) and the need to provide a new connection to the national grid. However, because there are no recent examples of new third rail electrification in the UK, and no third rail schemes in development, the likely costs of new third rail electrification are unclear.

Despite potentially higher costs, overhead line offers number of key advantages over third-rail.

Network Rail analysis suggests that a 'DC' electric unit could deliver between 2.5 minutes (fast) and 7 minutes (stopper) journey time saving for a fast service (subject to timetabling constraints) and an 'AC' electric unit could deliver between 5 minutes (fast) and 11 minutes (stopper) journey time saving.

There are also a range of operational advantages of overhead line electrification. Overhead line electrification is also more efficient than third-rail which suffers higher rates of energy loss. Third rail also requires more sub-stations than overhead line which offset some of the potential cost savings of a third rail scheme. There are also very important safety issues with third rail that need to be considered. In general, there are significantly higher fatality rates on third rail lines. Investment would be required in preventing access to the line and this is a particular issue for the North Downs Line which has a high number of crossing and footpaths.

Overhead line is the default approach to electrification in the UK. EU regulations on trans-European interoperability of rail determines that new electrification will, in general, need to be overhead line. Although, as a route which is already part third-rail electrified, this would not apply to the North Downs Line.

On balance, infill overhead line electrification is considered to be the most likely option for the North Downs Line. A high level assessment of the economic case for electrification suggests that there could be a good economic case for overhead line electrification assuming capital cost in the region of £1.5m to £1.7m per kilometre of track (including allowance for Optimism Bias). The case would be much weaker if initial cost estimates tend towards £2.0m per kilometre. However, without detailed analysis, it is very difficult to provide any certainty over the likely cost of electrification at this stage. Therefore it is considered that there is merit in retaining third rail electrification as an option should the costs of overhead line electrification prove to be prohibitive to the achievement of a strong business case.

4.4 Stage 2 – Detailed Assessment

4.4.1 Assessment Criteria

The assessment criteria applied to shortlisted options reflects a continuation of the approach taken to the development of the Surrey Rail Strategy and is shown in Table 4.

Table 4 - Assessment Criteria

<i>Impact</i>				
Scoring criteria	Negative Impact (-1)	Neutral Impact (0)	Medium (1)	High (2)
Journey Times	Negative impact on journey times	No impact on journey times	Minor positive impact on journey times	Major positive impact on journey times
Connectivity	Negative impact on connectivity	No impact on connectivity	Minor positive impact on connectivity	Major positive impact on connectivity
Quality	Negative impact on quality	No impact on quality	Minor positive impact on quality	Major positive impact on quality
Economic Impact	Negative wider economic impacts	No significant wider economic impacts	Option has a positive but indirect impact on the economy	Option directly contributes to new development and growth
<i>Feasibility</i>				
Scoring criteria	Low(-1)	Medium (0)	High (+1)	
Deliverability	Option requires significant new infrastructure	Option requires some upgrade to infrastructure and/or timetable recast	Option can be delivered within planned infrastructure with minor changes to timetables	
Cost	Option requires capital investment in excess of £20m or large increase in operating costs	Option requires limited capital investment or increase in operating cost	Option requires no significant increase in capital or operating cost.	
Risk	High risk/uncertainty associated with option	Medium risk/uncertainty associated with option	Low risk/uncertainty associated with option	
<i>Acceptability</i>				
Scoring criteria	Low(-1)	Medium (0)	High (+1)	
Alignment with Stakeholder Priorities	Not generally supported by stakeholders	Support from stakeholders	Strong support from multiple stakeholders	
<i>Value for Money</i>				
Scoring criteria	Poor (-1)	Low or Medium (0)	High or Very High (+1)	
Value for Money	Poor value for money expected (BCR<1)	Good value for money expected (BCR between 1.0	Excellent value for money expected (BCR>2)	

		and 2.0)	
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Each option is further classified according to the timescale over which it could be delivered. The timescales are as follows:

- **Short term:** Option could be delivered by the end of Control Period 5 (2014-2019)
- **Medium Term:** Option could be programmed for delivery Control Period 6 (2019-2024)
- **Long Term:** Long term option for delivery post-CP6 (2024 onward)

4.4.2 Results – Value for Money Assessment

For options involving timetable change, including electrification, a full quantitative economic appraisal has been undertaken as the basis for the value for money assessment.

These are relatively ‘early stage’ appraisals and, for some options, the assessment is based on relatively high level assumptions. For example, capital costs for schemes requiring infrastructure works (including electrification) have been calculated on a ‘per unit’ basis using available benchmarks and therefore caution should be applied when interpreting the results of these assessments.

For non-timetable options, value for money has been assessed qualitatively, applying professional judgement to consider whether the intervention has the potential to deliver value for money subject to detailed assessment.

Timetables

The table below sets out the timetable options that have been tested. The timetables combine a number of different interventions into ‘package options’. However, they have been constructed such that the *incremental* business case for each individual intervention can be appraised.

Each timetable has been modelled using the MOIRA model – the rail industry’s standard tool for assessing the impact of timetable change – in order to test the effect of each option on demand and revenue.

Table 5 - Timetable Options Tested in MOIRA

<i>Diesel Timetable Options Tested</i>		<i>Electric Timetable Options Tested</i>	
1	Network Rail Base Case	-	-
2	Enhanced Base Case (Option 1 with reduced signal headways, Guildford Capacity Enhancement, and line speed enhancement)	2b	Enhanced Base Case Electric (Option 2 assuming DC electric train performance)
3	Enhanced Base Case with Oxford Extensions (Option 2 with two fast trains per hour extended from Reading to Oxford)	-	-
4	NA	4b	Enhanced Base Case with London Extensions (Option 2b with 2 stopping services joining with London-bound Brighton Main Line services to maximise peak time frequency)
5	Four Train Per Hour Timetable (Option 2 with 2 fast and 2 stopping services)	5b	Four Train Per Hour Electric Timetable (Option 5 assuming DC electric train performance and service extensions to London to maximise peak time frequency)
6	NA	6b	Future Electric Timetable Timetable option 2 + increase in frequency to 4 trains per hour assuming DC electric multiple unit performance
7	NA	7b	Future Electric Timetable with Express Service Timetable option 6b with one of the fast services made into an express service stopping only at major stations only.

Detailed timetables for the above options are given in Appendix C. The results of the appraisal for diesel and electric timetable options are dealt with in turn.

Appraisal Results – Diesel Timetable Scenarios

The headline findings of the quantitative value for money assessment of diesel timetable options are as follows:

- Taking the 3 train per hour timetable as the base option (or the ‘do minimum’), delivering a **package of journey time enhancements** on the North Downs Line could have a strong economic case, with a **BCR of 5.2:1**. This option excludes any cost associated with new platforms at Guildford but assumes an indicative capital budget of £25m for signal upgrade and linespeed enhancements but excludes any costs of the Guildford Capacity Enhancement scheme which is a very high cost project justified primarily on the basis of Main Line capacity requirements.
- **Extending fast services beyond Reading to Oxford** to deliver an overall frequency enhancement on this route has a marginal economic case with a **BCR of 1.1:1**.

- Under a diesel scenario, there is also a marginal economic case for a **4 train per hour timetable** with a **BCR of 1.0:1**. In part, this is because a frequency of 4 trains per hour can only be delivered in the off-peak period.

Appraisal Results – The Economic Case for Electrification

The case for electrification of the North Downs Line has been tested under a 3 and 4 train per hour scenario.

The case for electrification is as follows:

- Under a **three train per hour scenario**, there is likely to be a positive case for electrification with a **BCR of 1.7:1**.
- The benefits of electrification are significantly higher under a more frequent **four train per hour scenario** offering a BCR of **2.6:1**.

It should be noted that only a high level assessment of the case for electrification is possible at this stage and further work to establish the likely capital costs is required to provide a more accurate assessment.

Appraisal Results – Electric Timetable Scenarios

A number of alternative timetable options have been tested by comparing different electric timetable scenarios.

The headline findings of the quantitative value for money assessment of electric timetable options are as follows:

- **Increasing frequency from 3 to 4 trains per hour** offers higher value for money in an electrified scenario that under a diesel scenario **with a BCR of 1.6:1**.
- **Extending services to both Oxford and London** as part of a 4 train per hour timetable has a positive economic case with a **BCR of 1.6:1**.
- Altering the stopping pattern of fast services in order to achieve an **express service** between Oxford and Gatwick is likely to offer poor value for money and delivers **overall disbenefits to passengers**. This is because the benefits of faster journey times for those passengers using the major stations of Oxford, Reading, Wokingham, Guildford, Redhill and Gatwick are less than the disbenefits (or costs) incurred by passengers using stations such as Blackwater, North Camp and Dorking who suffer a reduction in overall service frequency.

Detailed appraisal results are also provided in Appendix C.

4.4.3 Results – Overall Assessment

The results of the overall assessment are summarised in Table 6. Applying the scoring criteria set out above, the total scores for the shortlisted options range from 7 to 11. Overall ‘high performing options’ are defined as those with a score of 10 or above, ‘medium performing options’ have a score of 8 or 9, whilst ‘low performing options’ are those with a score of 7. Based on the scoring and timescale the shortlisted options have been ranked.

Detailed assessment tables are given in Appendix D.

Table 6 - Overall Assessment Summary

Option	Overall Assessment	Score	Value for money	Assessment method	Timescale
Timetable Optimisation	A detailed timetabling exercise will be important to maximise the benefits of the Base option. As stated in the Sussex Route Study, <i>'It is important that North Downs services can depart and arrive at Redhill in slots that reduce the layover time at the station, and this requirement will need to be considered carefully in the December 2018 timetable change with GTR.'</i>	11	High	Qualitative	Short Term
Electrification	Electrification should be a major priority for the North Downs Line and would deliver a step change in journey times and quality of service.	11	Med or High	Quantitative	Medium Term
Improve access to stations including targeted park and ride provision	Access improvements will make it easier for passengers to use the line, contributing to demand and encouraging mode shift.	10	Med	Qualitative	Medium Term
Extend fast services from Reading to Oxford	This is an attractive option which fits well with the vision for the North Downs Line and offers significant benefits to passengers.	10	Med	Quantitative	Short Term
Reduce the stopping service layover at Guildford by delivering enhanced capacity	Whilst the primary rationale for additional platforms at Guildford is Main Line capacity, the benefits to the North Downs Line are significant. There is a strong rationale for prioritising this scheme for CP6 to deliver benefits to the North Downs Line, and to avoid the costs of renewals that would otherwise have to be delivered.	10	High	Quantitative	Medium Term
Increase service frequency to four trains per hour	This option delivers a step change in services on the North Downs Line and should be retained as a long term goal for the line. Details of option for achieving this option are provided in box 1.	10	Med	Quantitative	Long Term
Reduce Signal Headways and Improve Linespeed	Whilst the scope and impact of a programme of signal and linespeed upgrades requires further analysis, this option has the potential to deliver journey time savings at relatively low cost and, importantly, strengthens	9	High	Quantitative	Medium Term

Option	Overall Assessment	Score	Value for money	Assessment method	Timescale
	other timetable options.				
Operate stopping services during peak hours	The lack of peak time stopping services is a significant drawback of the Base option. If timetabling constraints can be overcome, there is a likely to be a good case for this option as part of a future electric timetable.	9	Med	Quantitative	Long Term
Allow stopping services to call at intermediate stops between Reading and Guildford	If peak time service frequencies are improved, and journey times enhanced, stopping services at Winnersh Triangle and potentially other locations between Reading and Guildford would improve connections between important employment centres in the region.	9	Med	Qualitative	Long Term
Increase capacity through train lengthening	Targeted deployment of additional rolling stock on crowded services is advised in advance of any future electrification of the North Downs Line.	8	Med	Qualitative	Medium Term
Improve station quality	Improving quality of stations is an important part of the overall strategy for the North Downs Line and therefore should be retained as part of the strategy for the Line going forward.	8	Med	Qualitative	Medium Term
New station at Park Barn in Guildford	The station is of potential strategic importance to the Guildford economy given its potential role in serving Surrey Research Park. The case for the station is likely to rely on Guildford to Ascot services calling at the station given the limited frequency of North Downs Line stopping services.	8	Med	Qualitative	Medium Term
Introduced express services	The loss of frequency results in overall disbenefits suggesting that the North Downs Line does not have sufficient frequency to accommodate express service without significant negative impacts.	7	Poor	Quantitative	Short Term
Extend services to London via the Brighton Main Line	This option offers the potential to make more efficient use of platform space at Redhill such that a higher peak time service frequency can be achieved. However, extending services via the Brighton Main Line may have implications for reliability which would need further consideration.	6	Med	Quantitative	Long Term

4.4.3.1 Preferred Options

The final list of preferred options for the North Downs Line is as follows:

Journey Times

- Timetable Optimisation.
- Extend fast services from Reading to Oxford.
- Reduce the stopping service layover at Guildford by delivering enhanced capacity.
- Reduce Signal Headways and Improve Linespeed.

Connectivity

- New station at Park Barn in Guildford.
- Operate stopping services during peak hours.
- Increase service frequency to four trains per hour.
- Allow stopping services to call at intermediate stops between Reading and Guildford.

Quality

- Improve access to stations including targeted park and ride provision.
- Increase capacity through train lengthening.
- Improve station quality.

Cross-cutting options

- Electrification.

5 North Downs Line Strategy

5.1 Overall Vision

There is significant potential to deliver long term improvements to the North Downs Line to support the ambitions for balanced growth in the South East of England. The overall vision for the line is as follows:

- to strengthen this strategically important route by **minimising journey times between key economic centres** and for travel to Gatwick Airport;
- to **provide new connections to Oxford**, reinforcing the role of the North Downs Line as a key orbital route in the South East of England;
- to deliver **incremental improvements in frequency**, maximising opportunities for commuting to employment centres in the South East and to London;
- to achieve an overall **modernisation of the network built on electrification** of the network, and
- to deliver a **gradual improvement in quality of service** for all passengers.

By achieving this vision, the North Downs Line will contribute significantly to the regional economy by:

- facilitating the expected **continued growth of the region's economy**, particularly focussed on the main economic centres served by the North Downs Line;
- directly **servicing new housing and employment developments** located in close proximity to the Line;
- helping to **achieve a balance between 'locally based' employment and economic activity and commuting to London**;
- fostering agglomeration effects by **facilitating higher levels of commuting and business travel** between employment centres served by the North Downs Line, and
- **strengthening the local visitor economy** and improving access to the Surrey Hills AONB.

5.2 Achieving the Vision

The programme of interventions required to achieve the vision are described below and depicted in Figures 14 and 15.

5.2.1 Short Term

The Base Option offers importance benefits and should be implemented during CP5 (2014-2019) on completion of the platform 0 at Redhill in December 2017, ensuring careful timetabling to **maximise peak time travel opportunities** and to

ensure that a smaller stations are appropriately served given the importance of the North Downs Line for commuter and education trips in rural areas. **Minimising the layover at Guildford** will also ensure that the increase in frequency is not delivered at the detriment of journey times.

As part of a three train per hour timetable, **extensions of services beyond Reading to Oxford** should be considered in order to widen direct access to Gatwick and build on the North Downs Line's role as an orbital route.

In the short term, services should be operated with the existing rolling stock, refurbished to a high standard. Sufficient capacity needs to be provided on these services with **targeted train lengthening**, initially limited to fast services which stop at stations with capacity for 4-car trains.

5.2.2 Medium Term

The first phase of the **Guildford Capacity Enhancement** should be delivered in Control Period 6 (2019-2024) in readiness to deliver future main line frequency enhancements. Bringing forward this enhancement will deliver significant benefits to the North Downs Line whilst also offering efficiencies in the delivery of renewals. Alongside this scheme, a targeted programme of **line speed enhancements** should also be undertaken as well as an **upgrade to signalling** to reduce signal headways and minimise journey times.

There is also likely to be a good case for **prioritising the North Downs Line for electrification** during Control Period 6. The most feasible and beneficial electrification is likely to be infill overhead line (AC) electrification with dual voltage rolling stock, although there is merit in retaining third rail electrification as an option should the costs of overhead line electrification prove to be prohibitive.

With more modern rolling stock, use of Selective Door Opening may be an option for the North Downs Line. However, there are only two stations – Sandhurst and Gomshall – which are 3-car in length and therefore it would seem desirable to **lengthen platforms to a minimum of 4-car capacity**.

A programme of station investment to **improve access to stations** and to **improve station facilities** should be undertaken. Particular attention should be paid to the provision of **park and ride** spaces where existing facilities are heavily used or inadequate. The case for a **new station at Park Barn** merits further investigation and could also be delivered in the medium term.

5.2.3 Long Term

Following electrification, a further step change in the North Downs Line timetable should be delivered. In the long term a frequent, **all-day 4 train per hour timetable** is required to fulfil the potential of the North Downs Line. Achieving a more frequent timetable with faster journey times offers the flexibility to consider different stopping patterns. One option meriting further consideration is to **allow the stopping service to call at additional locations between Reading and Guildford** that are not currently served by the North Downs Line services.

The total package of improvements to the North Downs Line is expected to offer good value for money in aggregate. Compared against the current

timetable, an electrified 4-train per hour scenario with service extensions to both Oxford has a BCR of 1.8:1.

Figure 14 - North Downs Line Strategy

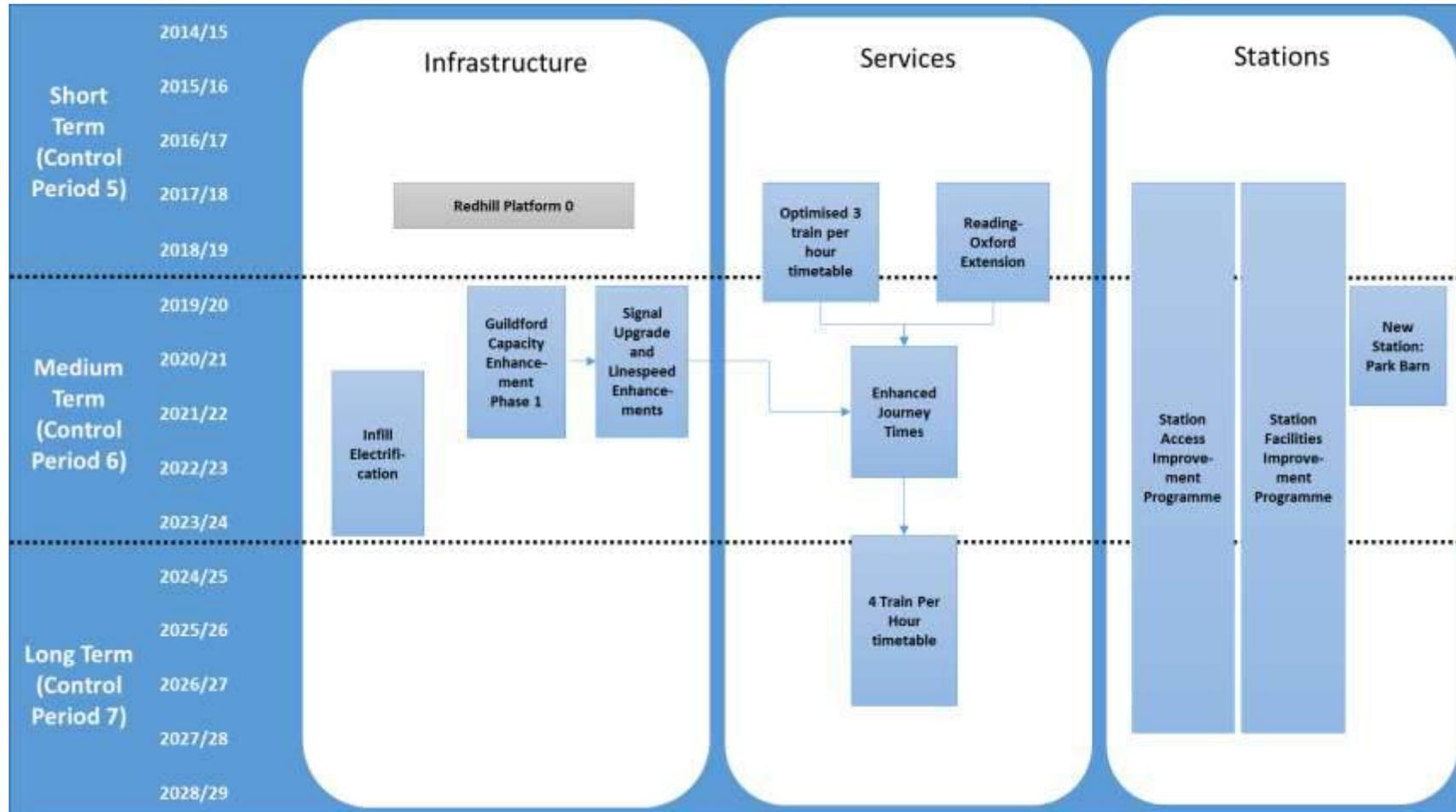
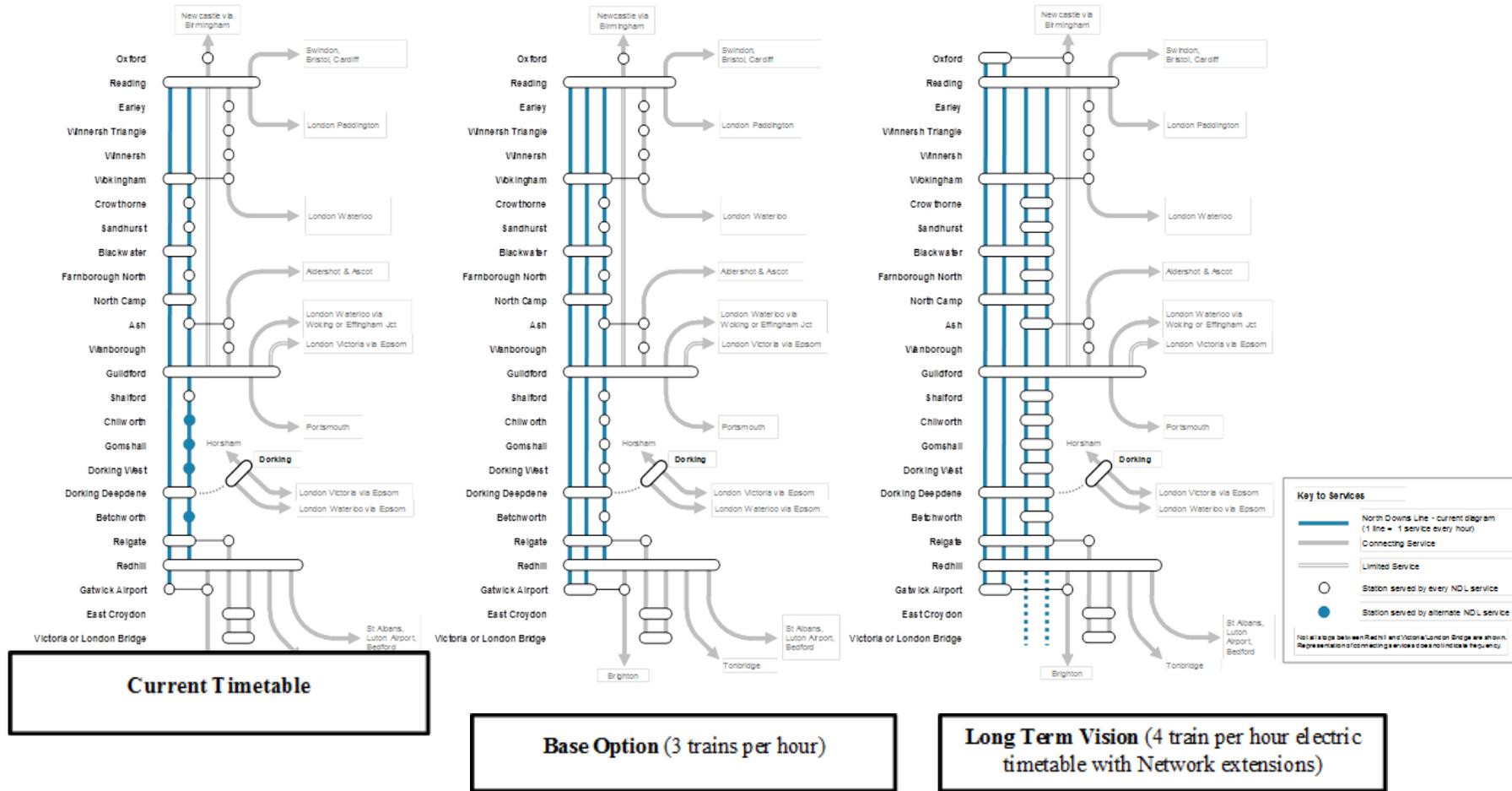


Figure 15 - Future Service Patterns



6 Conclusions and Next Steps

6.1 Overall Conclusions

The North Downs Line links together a number of economically successful towns. The North Downs Line catchment area will therefore play an important role in achieving balanced growth in the South East over coming decades. There are excellent prospects for growth within the natural catchment area for the North Downs Line with population and employment expected to grow strongly, facilitated by major employment and housing developments along the route.

Stakeholders have identified the potential for the North Downs Line to support the growth of the region in the context of a heavily congested highway network. Furthermore, the North Downs Line provides direct access to the UK's second largest Airport. Should the Government's Airports Commission favour Gatwick as the location for a further runway in the south east then future rail access to the airport will assume even greater strategic importance.

The potential of the North Downs Line is currently constrained by sub-optimal journey times and services frequencies. This has been recognised by Network Rail in the Draft Wessex Route Study which proposes a much needed increase in service frequency. This assessment finds a good economic and strategic case for delivering further improvements to the rail service in the short, medium and long term to meet the transport and economic needs of the area.

A strategy for the North Downs Line has been developed to improve service frequencies and journey times. The North Downs Line will continue to serve a range of different rail markets and support the economy in a number of ways. The strategic role of the North Downs Line needs to be strengthened by providing a faster and more frequent service between major economic centres in the South East and Gatwick Airport. Equally it will be important to ensure that smaller settlements are provided with a frequency of services sufficient to serve a growing commuter market both in the South East.

In the long term, delivering a more optimal timetable will benefit from completing the electrification of the line which would improve journey times and make new service configurations possible. Alongside timetable improvements, this assessment also identifies the need to ensure that the quality of service provided to passengers reflects the importance of the line to the economy.

This assessment has identified the need for future investment in the North Downs Line and provides a high level vision and framework for improving the line over the next 15 years. The resultant strategy is intended to act as catalyst for the development of the North Downs Line, providing a focus for stakeholders to engage in the decision making process for rail infrastructure and services.

It is important that the strategy continues to be built upon and refined over time with more detailed analysis and feasibility work. It is therefore further recommended that the North Downs Line Stakeholder Forum is retained as a 'consortium' for the future promotion of the line.

6.2 Next Steps

This assessment and the resultant strategy provides a starting point for a long term programme of investment in the North Downs Line. Such investment will come from a range of local and national sources.

The North Downs Line stakeholder forum, led by SCC, should engage in the rail industry decision making process on an ongoing basis. If improvements are to be realised, there is a need to ensure that the findings of this assessment are considered through the following processes:

- **Network Rail Route Plans for Control Period 6** - Ensure that the benefits of improved services on the North Downs Line are considered when prioritising investment in the Wessex Route. In particular, there is a clear opportunity to accelerate the delivery of increased platform capacity at Guildford to help to deliver the objectives of this strategy, whilst also providing for future main line capacity requirements.
- **Network Rail Electrification Strategy** – Network Rail is currently undertaking its own economic assessment of possible future electrification schemes in the UK. This strategy will influence the way in which schemes are prioritised. It will be important to ensure that consideration is given to the timetable opportunities opened up by the electrification, rather than basing the assessment on the status quo.
- **Franchise specification process and timetable changes** – Upgrades to the North Downs Line timetable and rolling stock will need to be considered as part of the franchise process. The DfT currently negotiating a direct award of the franchise to First Great Western until March 2019. The next opportunity to influence the franchise specification will be the full renewal of the Great Western franchise. This process is expected to begin in 2017. During the consultation process, it will be important to ensure that this strategy is promoted and considered by DfT when developing the specification for the franchise.

Other franchises are also of relevance and the needs of the North Downs Line will need to be considered when timetable changes are introduced by other operators. This particularly applies to the Brighton Main Line and the timetabling of South West Trains and GTR services following the opening of platform 0 at Redhill.

- **LEP funding** – there is an opportunity to fund new stations, station access improvements, station facility improvements and other local interventions (such as level crossing improvements) through the three LEPs served by the North Downs Line. The findings of this assessment should be considered in future updates of the LEP Economic Strategies and when prioritising transport infrastructure schemes and allocating Local Growth Fund monies.

Appendix A

Stakeholder Organisations

A1 Stakeholder Organisations

The following stakeholder organisations participated in the North Downs Line stakeholder forum:

Table 7 - Stakeholder Forum Attendees

Name	Organisation
Stefan Sanders	Arup
Stephen Bennett	Arup
Stephen Bussell	Arup
Councillor Jeff Smith	Blackwater & Hawley Town Council
Stuart Jefferies	Bracknell Forest Borough Council
Stephen Barker	Chiltern Railways
Iain Reeve	Coast to Capital Local Enterprise Partnership
Kevin Travers	Enterprise M3 Local Enterprise Partnership
Tom Pierpoint	First Great Western
Richard Higgins	Gatwick Airport Limited
Donald Yell	Guildford Borough Council
Robert Thain	Hart District Council
Sarah Todd	Mole Valley District Council
Jamie Rockhill	Network Rail
Stephen Wise	Reading Borough Council
Irum Khan	Reigate and Banstead Borough Council
Peter Brooks	South West Trains
Kevin Lloyd	Surrey County Council
Lee McQuade	Surrey County Council
Lyndon Mendes	Surrey County Council
Paul Millin	Surrey County Council
Mark Pearson	Surrey County Council/ Surrey Connects
Rob Fairbanks	Surrey Hills AONB
Richard Tyndall	Thames Valley Berkshire Local Enterprise Partnership
Jamie Dallen	West Sussex County Council
Councillor David Sleight	Wokingham Borough Council
David Wilby	Wokingham Borough Council

Appendix B

Long List of Options

B1 Long List Options Sifting

Table 8 - Long List Options Sifting

Option	Description	Passenger Impact	Delivery Against Conditional Outputs	Infrastructure Requirements	Operational Issues and Resource Requirements	Dependencies	Assessment
Base Option	3 train per hour timetable created through addition of a single fast service between Reading and Gatwick. Stopping services moves to hourly pattern, operating in the off-peak only, with longer journey times due to additional layover time at Guildford.	Step change in service frequency for larger stations served by fast services, and some rural stations which will receive 1 train per hour rather than 1 train every 2 hours. Loss of peak stopping service a significant disadvantage for commuters using rural stations. Significant increase in end-to-end journey time for stopping service mitigated by potential for interchange at Guildford. Improved access to Gatwick enabled by extra through service.	1(a), 2(a), 2(b), 3(a)	No additional infrastructure requirements. Can be implemented following delivery of Redhill Platform 0 (programmed for CP5)	Requirement for fast service to overtake stopping service at Guildford results in significant layover for stopping service at Guildford. Capacity at Redhill and conflicts with Brighton Main Line constrains peak time frequencies – requires careful timetabling. May be potential to optimise timetable to reduce journey times. Requires additional train diagrams and therefore results in higher operating costs.	NA.	Significant improvement delivered within planned infrastructure. NR analysis shows that option has a good business case with a BCR of 2.0. This timetable option forms the starting point for the strategy and is the base option against which all other options will be compared.
1 – Timetable optimisation	Explore the potential to optimise the Base service pattern to minimise journey times and provide maximum stopping services during the day.	Possible minor journey time savings for passengers. Potential to improve timing and frequency of stopping services for benefit of passengers of rural stations.	1(a)	No additional infrastructure requirements.	Potential conflicts with main line services, particularly at Redhill. Difficult to be precise about potential for improvement in absence of comprehensive main line timetabling exercise.	NA	Potential minor benefits at no additional cost – shortlist option.
2 – Reduce signal headways	Significant signal headways have been identified between North Camp and Wokingham Jn also between Reigate and Chilworth. Signalling upgrade and provision of intermediate signalling has the potential to reduce layover and journey times.	Minor journey time savings for passengers, particularly for stopping services.	1(a)	Requires investment in new signalling equipment	Achievement of journey time savings is subject to timetabling constraints but considered likely to be achievable.	NA	Potential benefit subject to business case assessment – shortlist option.
3 – Linespeed enhancements	There are limited sections of track with line speeds of 30 to 50 miles per hour (other than those located at the approach to stations) which, if raised to 70 miles per hour could generate journey time savings.	Minor journey time savings.	1(a)	Requires track upgrade works.	Achievement of journey time savings is subject to timetabling constraints but considered likely to be achievable.	NA	Potential benefit subject to business case assessment – shortlist option.
4a – Reduce	Deliver capacity	This option reduces the layover at	1(a)	Requires delivery of ‘phase 1’	A reduction in the layover	The layover could be	Improvements to North Downs

Option	Description	Passenger Impact	Delivery Against Conditional Outputs	Infrastructure Requirements	Operational Issues and Resource Requirements	Dependencies	Assessment
the stopping service layover at Guildford by delivering enhanced capacity at Guildford.	enhancements at Guildford to reduce the required layover time at Guildford for the stopping service.	Guildford in order to achieve faster end-to-end journey times for the stopping services. This benefits passengers travelling through Guildford on the stopping service. However, the impact of the required layover at Guildford is, in part, mitigated by the opportunity for passengers to change from stopping to fast services for their onward journey from Guildford.		Guildford capacity enhancement (NR Route Study)	should be achievable once Guildford capacity enhancements have been delivered.	minimised further and a more optimum spacing of services achieved if delivered in combination with reduced signal headways and linespeed enhancements and electrification in order to achieve journey time savings on the stopping service.	Line services unlikely to justify scale of investment required at Guildford. However, lack of capacity at Guildford is a significant constraint on realising potential of North Downs Line – shortlist option.
4b – Reduce the stopping service layover at Guildford by splitting the stopping service into two separate services	Requirement for overtaking at Guildford could be eliminated by splitting stopping service into two services between Reading and Guildford and Guildford and Redhill.	There is some potential for re-timing of services by splitting the stopping service to achieve more even headways between fast and stopping services. Through passengers on the stopping service would be required to change trains at Guildford. One of the main benefits of this option is likely to be potential for split service to provide more flexibility to extend services to other locations.	1(a)	No additional infrastructure required.	Possible issues of platform availability at Guildford. Results in less efficient train diagramming solution and therefore additional operating costs.	Option could be combined with service extensions described in Option 12.	Delivers limited benefits as a standalone option and unlikely to deliver value for money given operating cost impact. Option not prioritised but will be considered as part of operational solution for possible service extensions.
4c – Reduce the stopping service layover at Guildford by avoiding requirement for fast services to overtake slow services	Re-time services such that fast services do not need to overtake slow line services. This could be achieved by spacing fast and slow services appropriately at either end of the Line, such that the slow service reaches Reading/Redhill in advance of the following fast service.	This option eliminates the layover at Guildford in order to achieve faster end-to-end journey times for the stopping services, delivering benefits to passengers on the stopping service travelling through Guildford. However, re-timing the services to achieve this option requires the stopping service to depart Reading only a few minutes after the fast services and a few minutes before the Waterloo service. Similarly, fast and slow services would arrive into Redhill around 8 minutes apart. Such headways are likely to make North Downs Line less attractive for commuting trips at either end of the line, for example between Reading and Wokingham.	1(a)	No additional infrastructure required.	Subject to main line timetabling constraints, but unlikely to be problematic.	Achieving this option is aided by options which improve journey times on the stopping service – reduced signal headways, linespeed enhancements and electrification.	Improvements to North Downs Line services unlikely to justify scale of investment required at Guildford. However, lack of capacity at Guildford is a significant constraint on realising potential of North Downs Line – shortlist option.
5 – Introduce express services	Introduce express services between Reading and Gatwick stopping at major	Reduced journey times for many of the busiest flows on the North Downs Line at the cost of reduced	1(a)	No additional infrastructure requirements.	Subject to main line timetabling constraints, but unlikely to be problematic.	Requirement to reduced frequency on some lines likely to	Requires detailed demand and journey time assessment to weight up trade offs, but option could

Option	Description	Passenger Impact	Delivery Against Conditional Outputs	Infrastructure Requirements	Operational Issues and Resource Requirements	Dependencies	Assessment
	interchange stations only. Express service assumed to stop at Reading, Wokingham, Guildford, Redhill and Gatwick.	frequency (in comparison with the Base option) for some larger 'commuter' stations. Potential strategic benefits of improving access to Gatwick and links between regional centres. The combination of paths give a very uneven headway for some of the minor stations left with 2tph spaced close together.				make this option more attractive if part of a future 4 train per hour timetable. Option increases attractiveness of strategic service extension to the West (e.g. Oxford).	deliver benefits and provides a good fit with stakeholder objectives – shortlist option .
6 – Alternate hour stopping service pattern	Deliver the Base option with an alternative hour pattern for stopping services to reduce journey times.	Option delivers some journey time savings for stopping service passengers at the cost of reduced service frequencies for some stations. Leaves remaining services unevenly spaced	1(a)	No additional infrastructure requirements.	Subject to main line timetabling constraints, but unlikely to be problematic.	Option may alleviate timetabling constraints for other options such as a future four train per hour timetable.	Unlikely to be attractive as a standalone option given that the Base option already requires reduction in peak time frequency for rural stations. Option not prioritised but may be considered as part of future 4 train per hour timetable if required to enable other improvements.
7 – Upgraded diesel rolling stock	Replace existing diesel rolling stock with more modern or new diesel rolling stock offering enhanced performance.	Potentially for journey time savings with performance more akin to 'DC' electric unit depending on availability, albeit speed limits of 75mph will limit performance. Option will also deliver improved quality of service for passengers.	1(a), 3(b)	No additional infrastructure requirements.	If an existing fleet type is considered availability of rolling stock may be significantly constrained. New train option likely to require wider fleet procurement given small size of North Downs Line fleet. With a modern or new DMU, selective door opening (SDO) could be considered which would allow longer trains to be operated without the requirement to lengthen platforms in all cases.	Duplicates Option 14.	Likely to result in significant increase in cost for relatively limited benefit and therefore electrification likely to provide a more attractive long term option for achieving faster journey times through rolling stock replacement. Needs to be considered as part of wider rolling stock changes given size of North Downs Line fleet. Option not prioritised . However, in the absence of electrification, fleet replacement will be required before 2030 given that existing fleet has been in service for over 20 years.
8 – Electrification	Electrification of the North Downs Line and replacement of the existing rolling stock with faster electric trains. There are potentially three sub-options for electrification: Electrify entire route with 'AC' overhead wires with deployment of AC rolling stock. Infill electrification with 'AC' overhead wires with	Network Rail analysis suggests that a 'DC' electric unit could deliver between 2.5 minutes (fast) and 7 minutes (stopper) journey time saving for a fast service (subject to timetabling constraints) and an 'AC' electric unit could deliver between 5 minutes (fast) and 11 minutes (stopper) journey time saving. By default, this option is likely to deliver an upgrade to rolling stock and will therefore deliver improved quality of service for passengers.	1(a), 3(a),3(b)	Full electrification would require 48 miles of Overhead Line Equipment. Associated infrastructure costs to provide sufficient clearances for overhead wires. Infill electrification requires 29 miles of OLE and therefore would greatly reduce capital costs. Costs of OLE vary greatly across routes depending on requirements for structural works and power supply and therefore only a rough indication of cost can be provided based on electrification schemes elsewhere in the UK.	Option is subject to the availability of rolling stock. If a new electric fleet is deployed, this is likely to be procured as part of a wider rolling stock procurement. Neither of these issues should be seen as barrier to electrification in the long term if this option delivers value for money. The wider UK electrification programme is focussed on AC. DC electrification – whilst potentially offering	Duplicates Option 14c. An AC-only rolling stock option would eliminate any potential for extension of services on the Brighton Main Line. Similarly, DC-only stock would eliminate the potential for service to extend beyond Reading to Oxford.	The business case for electrification is determined on the basis of a combination of journey time savings, reduced operating costs and environmental benefits. Electrification is a very high cost option but the fact that part of the route is already electrified suggests that there may be a business case for electrification of the North Downs Line. This case will be maximised if delivered in combination with timetable enhancements. In the medium term (in the absence

Option	Description	Passenger Impact	Delivery Against Conditional Outputs	Infrastructure Requirements	Operational Issues and Resource Requirements	Dependencies	Assessment
	deployment of dual voltage rolling stock (e.g. Class 450) Infill electrification with 'DC' third rail with deployment of DC stock.			In theory third rail could offer a much lower cost option by eliminating requirement for structures works. However, this is highly uncertain because of limited recent UK experience of third rail electrification and requirements for other costs such as security.	lower capital costs – may not be acceptable to Network Rail given potential safety issues. DC results in greater energy loss and therefore limits the potential for operating cost savings. If infill AC electrification is considered then dual voltage stock would be required. Dual voltage operation is expected to become more common in the UK and existing third rail fleets – such as Class 450 units – are enabled for future conversion to bi-mode if a pantograph is fitted. Selective door opening (SDO) could be considered which would allow longer trains to be operated without the requirement to lengthen platforms in all cases.		of a wider conversion of the South East from DC to AC) infill AC electrification with dual voltage stock is likely to offer the best value for money even if at the expense of slightly higher journey times and slightly reduced energy efficiency. This also guarantees flexibility to extend services onto other line. A third rail option could offer a much less expensive approach to electrification and this option merits a more detailed assessment of feasibility should electrification be progressed. Shortlist option with infill AC electrification considered to be the 'default' option at this stage subject to more detailed analysis.
9 – Operate stopping services during peak hours	Under the Base option, capacity at Redhill is such that the stopping service can operate in the off-peak period only. Under this option, all day stopping services would be re-instated within the 3 train per hour service pattern.	Passengers using smaller stations served only by the stopping service would benefit from peak time services. This would result in a significant increase in frequency of trains per day for these stations and would be of particular benefit for commuters.	2(c)	This option cannot be achieved within existing or planned infrastructure. Even with the construction of platform 0 at Redhill, there is insufficient platform capacity for 3 North Downs Line services during the peak. No feasible option has been identified to increase capacity further at Redhill.	Given infrastructure constraints, the alternative means of accommodating peak time services is to achieve a more efficient use of platforms by linking North Downs Line services with London bound services on the Brighton Main Line. The stopping services may be suited to join with Tonbridge or Horsham service at Redhill or replace the Reigate service to free up platform space and ensure longer trains take the paths to London.	This option could be achieved through extending services beyond Redhill to save platform space and therefore could be delivered in combination with Option 12d.	The lack of peak time stopping services is a significant drawback of the Base option. If timetabling constraints can be overcome, there is a likely to be a good case for this option and therefore it merits further analysis – shortlist option .
10a – Increased stopping frequency by adding stops to proposed fast services	Add stops to fast services to increase frequency from commuter stations such as Ash or Shalford, as well as one or more intermediate stops between Reading and Wokingham such as Winnersh Triangle.	Passengers served by these stations would benefit from enhanced frequency. This would particularly benefit commuters given that off-peak benefitting commuters particularly. This, however, would result in longer journey times, potentially compromising the strategic importance of the North Downs	2(a), 2(c)	No additional infrastructure requirements.	The requirement for the fast line services to overtake slow line services at Guildford limits the potential to add stops to these services.	This option could be more attractive if delivered as part of a 4 train per hour timetable described in Option 11.	Based on patronage data, there are no obvious candidate stations for additional stops. Fast services already stop at the larger stations on the North Downs Line and therefore there is unlikely to be a good case for slowing services to make room for additional stops. Stops between Reading and Wokingham already benefit from

Option	Description	Passenger Impact	Delivery Against Conditional Outputs	Infrastructure Requirements	Operational Issues and Resource Requirements	Dependencies	Assessment
		Line for regional accessibility and airport access.					frequent services to these stations at peak times. This option potentially conflicts with the objectives of many stakeholders to maximise the strategic role of the North Downs Line as an orbital route providing access to Gatwick Airport. Option not prioritised.
10b – Allow stopping services to call at intermediate stops between Reading and Guildford	Allow stopping services to call at stations currently not serviced by North Downs Line services: Wanborough, Winnersh, Winnersh Triangle and Earley.	This option would provide these stations with increased frequency and reduce the requirement for interchange. Improving links to an area of high employment such as Winnersh Triangle could be attractive. Peak time service frequencies to these station are already high. Therefore the benefit for passengers may be limited if stopping services are off peak only. Adding a stop at Winnersh Triangle may be attractive under a more frequent timetable scenario.	2(a)	No additional infrastructure requirements.	Option subject to timetabling constraints. However, there is slack in the stopping service timetable under the Base option because of the requirement to layover at Guildford.	Option could be more attractive if delivered alongside Option 9 (peak time stopping services) and Option 11 (4 trains per hour) such that the stopping service provides a more effective service for commuters.	There may be a good case for adding a stop at Winnersh Triangle given the level of local employment. This option is likely to be more attractive under a more frequent – four train per hour – timetable. Electrification would also improve running times such that the stop could be added without adversely affecting journey times for other movements. Shortlist option.
11 – Increase service frequency to four trains per hour	Move to a 4 train per hour timetable with two fast services, and two stopping services.	If delivered through addition of a stopping service, this option delivers enhanced frequencies for all stations. Alternatively this option could include an express service which would reduce journey times between major stations without the requirement to reduce calls at other stations relative to the Base option. Option also delivers increased capacity.	2(a), 2(c)	Requires Guildford capacity enhancement and also requires investment in signal upgrade to achieve this timetable.	Achieving this option would require a recast of the timetable, potentially impacting on other routes. There is off peak capacity through the three key locations of Guildford Redhill and Reading however whether paths can be found that tie in with the other main line routes that will take priority over these services cannot be guaranteed. A maximum of two trains would be extended to Gatwick because of capacity constraints on the Brighton Main Line. There may be a requirement to slow down fast services by adding additional calls to ensure that fast services do not catch stopping services. This option may require the loss of or retiming of the handful of ECS or freight	Electrification and/or linespeed improvements would help with the timetabling of this option. Can only be delivered in combination with Option 4a. Option could be delivered in combination with Option 5. Increased frequency will improve the case for electrification of the North Downs Line.	Subject to timetabling constraints, this option has the potential to deliver a step change improvement over and above the Base option and merits business case assessment – shortlist option.

Option	Description	Passenger Impact	Delivery Against Conditional Outputs	Infrastructure Requirements	Operational Issues and Resource Requirements	Dependencies	Assessment
					<p>paths</p> <p>An increase in frequency to 4 trains per hour would result in an increase in level crossing down times. This may have a significant impact on traffic at specific locations, the impact of which would need to be carefully managed.</p> <p>Requires additional train diagrams and therefore results in higher operating costs.</p>		
12a – Service extensions: Extend fast services from Reading to Oxford	Extend one or more fast services beyond Reading to Oxford.	<p>Option provides increased frequency of services between Oxford and Reading and reduces requirement for passengers to interchange between Oxford and North Downs Line stations.</p> <p>Extends direct access to Gatwick Airport to Oxford.</p> <p>Option would strengthen the North Downs Line's role as an orbital route connecting major centres in the South East and connecting with East-West rail which forms the orbital route to the north of London.</p>	1(a)	No additional infrastructure required.	<p>Possible timetable constraints and platform capacity issues between Reading and Oxford.</p> <p>Requires additional train diagrams and therefore results in higher operating costs.</p>	Combining this option with option 5 such that it operates as an express service between Oxford and Gatwick may be an attractive option.	<p>Oxford has a population of around 150,000 and therefore this option would enhance access between major economic centres in the South East.</p> <p>The East West Rail project will reinstate and upgrade the railway between Cambridge and Oxford. East West Rail will provide an orbital route to the north of London and therefore plays a similar role to the North Downs Line. Connecting these routes could have strategic advantages and could provide a better alternative to the M25.</p> <p>Option fits well with the objectives for the North Downs Line – shortlist option.</p>
12b – Service extensions: Extend services from Reading to Basingstoke	Extend one or more services beyond Reading to Basingstoke on the Reading to Basingstoke Line.	Option provides higher frequency between Reading and Basingstoke, benefiting passengers travelling into Reading from stations on the Reading to Basingstoke Line. This option would eliminate the need to interchange for travel between North Downs Line stations to Basingstoke.	1(a)	No additional infrastructure required.	<p>Possible platform capacity constraints at Reading and conflicts with services on the Reading to Basingstoke Line.</p> <p>Requires additional train diagrams and therefore results in higher operating costs.</p>	NA	<p>The main benefit of this option would be to improve connections between Basingstoke and Reading which is already served by 4 trains per hour. Basingstoke has a population of around 90,000. The market for travel between North Downs Line stations and Basingstoke may be more limited in comparison with alternative service extension options. This Option does not fit well with strategic objectives for the North Downs Line.</p> <p>Option not prioritised.</p>
12c – Service extensions: Extend fast services from Reading to Heathrow	Extend one or more fast services beyond Reading to Heathrow via Western Access	Western Rail Access to Heathrow would provide a new tunnelled link between the Great Western Main Line between Langley and Iver and Heathrow Terminal 5.	1(a)	Requires the completion of the Western Access route between Reading and Heathrow.	Extended North Downs Line services will need to fit with services to Heathrow from the West. Feasibility would need to be assessed when the	Combining this option with option 5 such that it operates as an express service between Gatwick and	Western Rail Access would provide an estimate journey time of 28 minutes from Reading. Theoretically, the travel time from Gatwick to Heathrow could be in

Option	Description	Passenger Impact	Delivery Against Conditional Outputs	Infrastructure Requirements	Operational Issues and Resource Requirements	Dependencies	Assessment
<i>Heathrow</i>		This option would provide direct rail access between Heathrow and Gatwick for interchanging passengers as well as providing North Downs Line stations with direct links to both airports.			Western Rail access project is further progressed. Requires additional train diagrams and therefore results in higher operating costs.	Heathrow may be an attractive option.	the region of 1hr 36 minutes. This is broadly equivalent to the route via London and Heathrow Express. Therefore, it is considered that benefits to passengers may be limited. Option not prioritised.
12d – Service extensions: Extend services to London via the Brighton Main Line	Extend one or more stopping services per hour to London via the Brighton Main Line to London Victoria or London Bridge This could be achieved by replacing the Reigate services or joining with the Tonbridge or Horsham services at Redhill.	Provides direct services to London for all North Downs Line stations with particular benefits for commuters travelling from intermediate stations between Guildford and Reigate to London.	1(a), 2(a), 2(c)	No additional infrastructure required.	Requires recast of the timetable to align services and avoid conflicts with main line services. This option would eliminate the requirement for stopping services to turnback at Rehill, therefore providing a more efficient use of platforms at Redhill. Requires additional vehicles and results in higher operating costs.	Option could provide a means of releasing platform capacity at Redhill such that stopping services can operate during peak hours. Extending services to London unlikely to be attractive unless peak time services can be achieved.	The baseline review reveals the importance of the market for commuting into London. This option would deliver significant benefits to passengers travelling from stations such as Dorking West who would have a direct service into London. Importantly, by running stopping trains through Redhill, this option could help overcome platform capacity issues, enabling stopping services to run throughout the day. Shortlist option and consider in combination with Option 3.
12e – Service extensions: Extend Reading to Guildford stopping services (option 3b) to Portsmouth Harbour via the Portsmouth Direct Line.	Operate stopping services between Reading and Guildford extended via the Portsmouth Direct Line to Portsmouth Harbour.	Provides a direct service between Reading and Portsmouth thus eliminating the need for passengers to interchange at Guildford.	1(a)	May require Guildford Capacity Enhancement	Conflicts with main line services at Guildford likely.	Option could be achieved if delivered in combination with Option 4b – split services, such that the service between Reading and Guildford is extended to Portsmouth.	The feasibility of timetabling this option is doubtful and it is likely to deliver limited benefits – option not prioritised .
13a – New stations: an additional stop to the stopping service at a new station at Park Barn in Guildford.	A new station located where Egerton Road crosses the railway line, to the west of the A3. Guildford to Ascot services could stop at the station in addition to North Downs Line stopping services.	Provides an additional link between central Guildford and local employment centres, particularly Royal Surrey Hospital and Surrey Research Park. It also serves housing and retail (Tesco supermarket) in the Park Barn area. Offers a rail alternative for travel between west and central Guildford and could cut congestion on the town's roads. Option would add to journey times on the stopping service between Reading and Guildford. However, under the 3 base option, the stopping service would use slack in the timetable required for	2(d)	Construction of new platforms, ticket office, waiting shelter, seating, fencing, lighting access ramps and trackwork and cabling alterations.	Additional stops likely to be achievable within current and future timetables.	Station likely to be much more attractive if delivered in combination with Option 9.	The station is of potential strategic importance to the Guildford economy given its potential role in serving Surrey Research Park. The station is located in relative close proximity to Guildford and would result in slower journey times. The case for the station is likely to rely on Guildford to Ascot services calling at the station given the limited frequency of North Downs Line stopping services. Stopping fast services at Park Barn is unlikely to be an attractive option. However, there is a strong transport and economic rationale for the station suggesting that the business case for the station merits further

Option	Description	Passenger Impact	Delivery Against Conditional Outputs	Infrastructure Requirements	Operational Issues and Resource Requirements	Dependencies	Assessment
		the layover at Guildford.					analysis – shortlist option.
14a – Rolling stock upgrade: Existing diesel rolling stock refurbishment	Undertake a refurbishment of the interior of the existing fleet of trains.	Option improves passenger comfort and contributes positively to passenger perceptions of the quality of service. Helps reduce issues of crowding by providing a more efficient internal layout.	3(b)	No additional infrastructure required.	Option could be delivered more efficiently if part of a wider programme of refurbishment of the Class 165/166 fleets.	Whilst not directly compatible with option 14b or 14c, option may provide a short term solution in advance of future electrification	The existing fleet was refurbished in 2010. An overhaul of the 165s to comply with legislation on persons of reduced mobility (PRM TSI) is planned to take place before 2018. Option already planned and therefore not prioritised for this assessment.
14b – Rolling stock upgrade: Replace existing fleet with modern or new diesel fleet	Replace the existing rolling stock with more modern or new diesel units.	Option improves passenger comfort and contributes positively to passenger perceptions of the quality of service. Helps reduce issues of crowding by providing a more efficient internal layout. Potentially for journey time savings with performance more akin to ‘DC’ electric unit depending on availability, albeit speed limits of 75mph will limit performance.	3(b), 1(a)	No additional infrastructure requirements.	If an existing fleet type is considered availability of rolling stock may be significantly constrained. New train option likely to require wider fleet procurement given small size of North Downs Line fleet. With a modern or new DMU, selective door opening (SDO) could be considered which would allow longer trains to be operated without the requirement to lengthen platforms in all cases.	Duplicates Option 7.	Likely to result in significant increase in cost for relatively limited benefit. In the short term, refurbishment may be a better strategy for improving quality whilst electrification is likely to provide a more attractive long term option for modernisation. Option not prioritised . However, in the absence of electrification, fleet replacement will be required before 2030 given that existing fleet has been in service for over 20 years.
14c – Rolling stock upgrade: Replace existing fleet with modern or new electric fleet	Electrification of the North Downs Line and replacement of the existing rolling stock with more modern or new electric trains. Electrify entire route with ‘AC’ overhead wires with deployment of AC rolling stock. Infill electrification with ‘AC’ overhead wires with deployment of dual voltage rolling stock (e.g. Class 450) Infill electrification with ‘DC’ third rail with deployment of DC stock.	Option improves passenger comfort and contributes positively to passenger perceptions of the quality of service. Helps reduce issues of crowding by providing a more efficient internal layout. Network Rail analysis suggests that a ‘DC’ electric unit could deliver 5 ½ minutes journey time saving for a stopping service (subject to timetabling constraints) and an ‘AC’ electric unit could deliver 9 ½ minutes journey time saving.	3(b), 1(a), 3(a)	Requires electrification of the line as per Option 8.	Operational issues discussed in option 8.	Duplicates Option 8.	Duplicates Option 8 and therefore option not prioritised .
15a – Peak time crowding: Increase	Increase capacity on North Downs Line services through increased service	An increase in service frequency enables the operator to spread demand over a greater number of	3(a), 2(a), 2(c)	Infrastructure requirement dependent on service option in question.	The base option increases frequency from 2 to 3 trains per hour. However, during	Increasing frequency in peak time effectively duplicates	Duplicates Options 9 and 11 and therefore option is not prioritised .

Option	Description	Passenger Impact	Delivery Against Conditional Outputs	Infrastructure Requirements	Operational Issues and Resource Requirements	Dependencies	Assessment
<i>capacity through service frequency enhancement</i>	frequency to 3 or 4 trains per hour during peak times.	services to reduce the level of crowding on peak time services, improving comfort for passengers.		Providing increased capacity through enhanced frequency can help to avoid the requirement to lengthen platforms.	peak hours only 2 trains can operate because of capacity constraints at Redhill. Therefore, operating either 3 or 4 peak time trains is likely to require joining of North Downs Line services with services between Reigate and London in order for a more efficient use of platform space at Redhill.	with Option 9 and/or Option 11. May only be possible to deliver in combination with extended services to London (Option 12b) which in turn requires electrification.	
15b – Peak time crowding: Increase capacity through train lengthening	Increase capacity on North Downs Line services by deploying at least 4-car trains in peak times. This could be achieved by coupling 2 x 2-car 165s or combining a 2-car and 2-car set to make a 5-car train.	An increase in train capacity services to reduce the level of crowding on peak time services, improving comfort for passengers.	3(a)	There are 3 car platforms at Sandhurst and Gomshall. These platforms would need to be lengthened, unless selective door opening is employed which would in turn require upgraded rolling stock. Crowthorne, Blackwater, Farnborough North and Dorking are all 4 car platforms and would need to be lengthened should 5-car trains be required.	Achieving this option may be problematic in the short term because of a limited supply of diesel rolling stock in the UK.	Electrification is likely to mean deployment of 4-car trains by default. Rolling stock upgrade could enable selective door opening which would remove the requirement to lengthen platforms.	Enhancing frequency of services is challenging in the short term. Therefore, providing appropriate train length should be retained as a short term means of providing capacity – short list option .
16a – Station improvements: Improve station quality	Improving the actual and perceived quality of the North Downs Line by improving station facilities. This would need to be considered on a station by station basis but could include general refurbishment, new waiting facilities, retail facilities, staffing and security.	Evidence suggests that passengers place a value on the quality of stations and that improving quality can lead to higher demand.	3(c)	No additional infrastructure requirements.	No operational issues.	NA	Overall satisfaction with First Great Western stations is high at 82%. However, satisfaction with specific attributes such as security, the overall environment, upkeep and repair and the provision of shelter facilities is lower. This pattern is likely to be replicated for the North Downs Line. Identifying specific interventions would require a more detailed review. Some stations – such as Dorking Depedene – have already been identified as requiring an upgrade to facilities. Improving quality of stations is an important part of the overall strategy for the North Downs Line and therefore should be retained as part of the strategy for the Line going forward – shortlist option .
16b – Station improvements: Improve access to stations including targeted enhancements of park and ride	Access improvements could include, increased park and ride provision, new DDA compliant footbridges and lifts, new cycleways, and improved interchange facilities with bus services.	Access improvements will make it easier for passengers to use the line, contributing to demand and encouraging mode shift.	3(c)	No additional infrastructure requirements.	No operational issues.	NA	There is significant potential for the North Downs Line to attract more commuters from car to rail and park and ride is likely to be an important part of this strategy. Identifying specific interventions requires a more detailed review. However, candidate stations with limited or heavily used parking include North

Option	Description	Passenger Impact	Delivery Against Conditional Outputs	Infrastructure Requirements	Operational Issues and Resource Requirements	Dependencies	Assessment
<i>provision</i>							Camp, Blackwater and Crowthorne. Access improvements are also warranted at North Camp, Dorking Depedene and Blackwater, amongst other stations. Shortlist option.

Appendix C

Economic Appraisal Results

C1 Appraisal Assumptions

Appendix C sets out the results of quantitative appraisal of timetable options and electrification. Non-timetable options have been assessed qualitatively.

Table 9 – Appraisal parameters

Item	Assumption
Opening year	Start of CP6 for options with no infrastructure requirements; end of CP6 for options with infrastructure requirements
Appraisal period	30 years for timetable changes; 60 years for infrastructure investment
Demand cap year	2035
Annual demand growth	2.5% p.a. (to 2035)
Fares growth	RPI + 1%
Optimism bias on capex	66%
WebTAG version	November 2014

Table 10 – Operating cost assumptions

Item	Unit cost (2014 prices)	Growth rate
Capital lease charge	£157,500 per veh per year	Constant in nominal terms
Maintenance	£0.60 per veh mile	RPI, capped 2035
VTAC	£0.095 per veh mile	RPI, capped 2035
Fuel consumption	0.83 litres per veh mile, £0.57 per litre 3.15 kWh per veh mile, £0.08 per kWh	WebTAG fuel cost inflation
Staff	£3.48 per train mile	WebTAG earnings growth, uncapped

Table 11 – Capital cost assumptions

	Cost (2014 prices)
Electrification Costs	£1.7m per single track km (assuming 30% risk allowance)
Maintenance of electrified equipment	£5,500 per single track km per annum
Linespeed improvements and signalling upgrade	£20m

Table 12 – Other assumptions

	Cost (2014 prices)
Rolling stock life (diesel / electric)	30 / 35 years
Spares ratio (diesel / electric)	88% / 91%

C2 Timetable Development

The tables below show indicative standard hour timetables for each option tested. Each of the timetable options is subject to further validation.

Table 13 - Eastbound Timetables

		Current		Option 1: Base				Option 2: Enhanced Base Case				Option 2b: Enhanced Base Case, Electric			
		Fast	Slow	Fast	Slow	Fast	Slow	Fast	Slow	Fast	Slow	Fast	Slow	Fast	Slow
Reading	Dep	12:34	13:04	13:05	13:19	13:35		13:05	13:25	13:35		13:05	13:25	13:35	
Wokingham	Dep	12:43	13:13	13:14	13:29	13:44		13:14	13:34	13:44		13:13	13:33	13:43	
Crowthorne	Dep		13:18		13:34				13:39				13:38		
Sandhurst	Dep		13:22		13:38				13:43				13:42		
Blackwater	Dep	12:51	13:25	13:22	13:41	13:52		13:22	13:46	13:52		13:21	13:45	13:51	
Farnboro' N	Dep		13:30		13:46				13:51				13:50		
North Camp	Dep	12:57	13:34	13:28	13:05	13:58		13:28	13:55	13:58		13:27	13:54	13:57	
Ash	Dep		13:38		13:54				13:58				13:57		
Guildford	Arr	13:08	13:47	13:39	14:01	14:09		13:38	14:05	14:08	<--	13:36	14:03	14:06	<--
Guildford	Dep	13:10	13:48	13:41	-->	14:11	<--	13:40	-->	14:10	14:13	13:38	-->	14:08	14:11
Shalford	Dep		13:53				14:16				14:18				14:16
Chilworth	Dep		13:57				14:21				14:22				14:20
Gomshall	Dep		14:04				14:25				14:29				14:26
Dorking W	Dep						14:32				14:37				14:33
Deepdene	Dep	13:26	14:11	13:57		14:27		13:56		14:26	14:39	13:52		14:22	14:35
Betchworth	Dep						14:42				14:45				14:40
Reigate	Dep	13:34	14:19	14:05		14:35		14:03		14:33	14:48	13:58		14:28	14:43
Redhill	Arr	13:38	14:25	14:09		14:39	14:52	14:07		14:37	14:51	14:02		14:32	14:46
Redhill	Dep	13:41		14:12		14:42		14:10		14:40		14:05		14:35	
Gatwick	Arr	13:50		14:21		14:51		14:19		14:49		14:13		14:43	
		Option 3: Enhanced Base Case with				Option 4b: Enhanced Base Case with				Option 5: Four Trains Per Hour					

		Oxford Extension				London Extension									
		Fast	Slow	Fast	Slow	Fast	Slow	Fast	Slow	Slow	Fast	Slow	Slow	Fast	Slow
Oxford	Dep			13:04											
Didcot	Dep			13:20											
Reading	Arr			13:34											
Reading	Dep	13:05	13:25	13:35		13:05	13:25	13:35		12:55	13:05		13:25	13:35	
Wokingham	Dep	13:14	13:34	13:44		13:13	13:33	13:43		13:04	13:14		13:34	13:44	
Crowthorne	Dep		13:39				13:38			13:09			13:39		
Sandhurst	Dep		13:43				13:42			13:13			13:43		
Blackwater	Dep	13:22	13:46	13:52		13:21	13:45	13:51		13:16	13:22		13:46	13:52	
Farnboro' N	Dep		13:51				13:50			13:21			13:51		
North Camp	Dep	13:28	13:55	13:58		13:27	13:54	13:57		13:25	13:28		13:55	13:58	
Ash	Dep		13:58				13:57			13:28			13:58		
Guildford	Arr	13:38	14:05	14:08	←	13:36	14:03	14:06	<--	13:35	13:38	<--	14:05	14:08	<--
Guildford	Dep	13:40	-->	14:10	14:13	13:38	-->	14:08	14:11	-->	13:40	13:43	-->	14:10	14:13
Shalford	Dep				14:18				14:16			13:48			14:18
Chilworth	Dep				14:22				14:20			13:52			14:22
Gomshall	Dep				14:29				14:26			13:59			14:29
Dorking W	Dep				14:37				14:33			14:07			14:37
Deepdene	Dep	13:56		14:26	14:39	13:52		14:22	14:35		13:56	14:09		14:26	14:39
Betchworth	Dep				14:45				14:40			14:15			14:45
Reigate	Dep	14:03		14:33	14:48	13:58		14:28	14:43		14:03	14:18		14:33	14:48
Redhill	Arr	14:07		14:37	14:51	14:02		14:32	14:46		14:07	14:21		14:37	14:51
Redhill	Dep	14:10		14:40		14:05		14:35	14:51		14:10	14:24		14:40	14:54
Gatwick	Arr	14:19		14:49		14:13		14:43	14:57		14:19	14:33		14:49	15:03
E Croydon	Dep								15:08						
Victoria / L. Bridge	Arr								15:30						
Option 5b: Four Train Per Hour Electric								Option 6b: Future Electric Timetable							

		Slow	Fast	Slow									
Oxford	Dep								12:34			13:04	
Didcot	Dep								12:50			13:20	
Reading	Arr								13:04			13:34	
Reading	Dep	12:55	13:05		13:25	13:35		12:55	13:05		13:25	13:35	
Wokingham	Dep	13:03	13:13		13:33	13:43		13:03	13:13		13:33	13:43	
Crowthorne	Dep	13:08			13:38			13:08			13:38		
Sandhurst	Dep	13:12			13:42			13:12			13:42		
Blackwater	Dep	13:15	13:21		13:45	13:51		13:15	13:21		13:45	13:51	
Farnboro' N	Dep	13:20			13:50			13:20			13:50		
North Camp	Dep	13:24	13:27		13:54	13:57		13:24	13:27		13:54	13:57	
Ash	Dep	13:27			13:57			13:27			13:57		
Guildford	Arr	13:33	13:36	<--	14:03	14:06	<--	13:33	13:36	<--	14:03	14:06	<--
Guildford	Dep	-->	13:38	13:41	-->	14:08	14:11	-->	13:38	13:41	-->	14:08	14:11
Shalford	Dep			13:46			14:16			13:46			14:16
Chilworth	Dep			13:50			14:20			13:50			14:20
Gomshall	Dep			13:56			14:26			13:56			14:26
Dorking W	Dep			14:03			14:33			14:03			14:33
Deepline	Dep		13:52	14:05		14:22	14:35		13:52	14:05		14:22	14:35
Betchworth	Dep			14:10			14:40			14:10			14:40
Reigate	Dep		13:58	14:13		14:28	14:43		13:58	14:13		14:28	14:43
Redhill	Arr		14:02	14:16		14:32	14:46		14:02	14:16		14:32	14:46
Redhill	Dep		14:05	14:21		14:35	14:51		14:05	14:21		14:35	14:51
Gatwick	Arr		14:13	14:27		14:43	14:57		14:13	14:27		14:43	14:57
E Croydon	Dep			14:38			15:08			14:38			15:08
Victoria / L. Bridge	Arr			15:00			15:30			15:00			15:30

Option 7b: Future Electric Timetable with Express Services

		Slow	Express	Slow	Slow	Fast	Slow
Oxford	Dep		12:33			13:04	
Didcot	Dep		12:49			13:20	
Reading	Arr		13:03			13:34	
Reading	Dep	12:55	13:06		13:25	13:35	
Wokingham	Dep	13:03	13:15		13:33	13:43	
Crowthorne	Dep	13:08			13:38		
Sandhurst	Dep	13:12			13:42		
Blackwater	Dep	13:15			13:45	13:51	
Farnboro' N	Dep	13:20			13:50		
North Camp	Dep	13:24			13:54	13:57	
Ash	Dep	13:27			13:57		
Guildford	Arr	13:33	13:36	<--	14:03	14:06	<--
Guildford	Dep	-->	13:38	13:41	-->	14:08	14:11
Shalford	Dep			13:46			14:16
Chilworth	Dep			13:50			14:20
Gomshall	Dep			13:56			14:26
Dorking W	Dep			14:03			14:33
Deeptide	Dep			14:05		14:22	14:35
Betchworth	Dep			14:10			14:40
Reigate	Dep			14:13		14:28	14:43
Redhill	Arr		14:02	14:16		14:32	14:46
Redhill	Dep		14:05	14:21		14:35	14:51
Gatwick	Arr		14:14	14:27		14:43	14:57
E Croydon	Dep			14:38			15:08
Victoria / L. Bridge	Arr			15:00			15:30

Table 14 - Westbound Timetables

		Current	Option 1: Base	Option 2: Enhanced Base Case	Option 2b: Enhanced Base Case, Electric
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		Fast	Slow												
Gatwick	Dep	14:03		14:40		15:10		14:40		15:10		14:40		15:10	
Redhill	Arr	14:10		14:47		15:17		14:47		15:17		14:46		15:16	
Redhill	Dep	14:13	14:34	14:50	15:03	15:20		14:50	15:06	15:20		14:49	15:05	15:19	
Reigate	Dep	14:18	14:38	14:56	15:11	15:26		14:55	15:13	15:25		14:53	15:11	15:23	
Betchworth	Dep				15:15				15:17				15:15		
Deepline	Dep	14:25	14:45	15:03	15:20	15:33		15:02	15:22	15:32		15:00	15:20	15:30	
Dorking W	Dep				15:22				15:24				15:22		
Gomshall	Dep		14:53		15:30				15:32				15:29		
Chilworth	Dep		14:59		15:36				15:38				15:35		
Shalford	Dep		15:03		15:41				15:43				15:40		
Guildford	Arr	14:42	15:08	15:19	15:43	15:49	<--	15:18	15:45	15:48	<--	15:15	15:42	15:45	<--
Guildford	Dep	14:44	15:09	15:21	-->	15:51	15:57	15:20	-->	15:50	15:53	15:17	-->	15:47	15:50
Ash	Dep		15:19				16:06				16:01				15:57
North Camp	Dep	14:56	15:23	15:33		16:03	16:10	15:31		16:01	16:05	15:27		15:57	16:01
Farnboro' N	Dep		15:27				16:14				16:09				16:05
Blackwater	Dep	15:02	15:31	15:39		16:09	16:18	15:37		16:07	16:13	15:33		16:03	16:09
Sandhurst	Dep		15:35				16:22				16:17				16:13
Crowthorne	Dep		15:39				16:26				16:21				16:17
Wokingham	Dep	15:10	15:44	15:47		16:17	16:31	15:45		16:15	16:27	15:40		16:10	16:22
Reading	Arr	15:19	15:54	15:56		16:26	16:39	15:54		16:24	16:34	15:48		16:18	16:28

		Option 3: Enhanced Base Case with Oxford Extension	Option 4b: Enhanced Base Case with London Extension	Option 5: Four Trains Per Hour
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		Fast	Slow	Fast	Slow	Fast	Slow	Fast	Slow	Slow	Fast	Slow	Slow	Fast	Slow	
Victoria or L. Bridge	Dep					13:45										
E Croydon	Dep					14:00										
Gatwick	Dep	14:40		15:10		14:26	14:40			15:10	14:26	14:40		14:56	15:10	
Redhill	Arr	14:47		15:17		14:17	14:46			15:16	14:33	14:47		15:03	15:17	
Redhill	Dep	14:50	15:06	15:20		14:35	14:49			15:19	14:36	14:50		15:06	15:20	
Reigate	Dep	14:55	15:13	15:25		14:41	14:53			15:23	14:43	14:55		15:13	15:25	
Betchworth	Dep		15:17			14:45					14:47			15:17		
Deepdene	Dep	15:02	15:22	15:32		14:50	15:00			15:30	14:52	15:02		15:22	15:32	
Dorking W	Dep		15:24			14:52					14:54			15:24		
Gomshall	Dep		15:32			14:59					15:02			15:32		
Chilworth	Dep		15:38			15:05					15:08			15:38		
Shalford	Dep		15:43			15:10					15:13			15:43		
Guildford	Arr	15:18	15:45	15:48	<--	15:12	15:15	<--		15:45	15:15	15:18		15:45	15:48	<--
Guildford	Dep	15:20	-->	15:50	15:53	-->	15:17	15:20	15:47	-->	15:20	15:23	-->	15:50	15:53	
Ash	Dep				16:01			15:27				15:31			16:01	
North Camp	Dep	15:31		16:01	16:05		15:27	15:31	15:57			15:31	15:35		16:01	16:05
Farnboro' N	Dep				16:09			15:35				15:39			16:09	
Blackwater	Dep	15:37		16:07	16:13		15:33	15:39	16:03			15:37	15:43		16:07	16:13
Sandhurst	Dep				16:17			15:43				15:47			16:17	
Crowthorne	Dep				16:21			15:47				15:51			16:21	
Wokingham	Dep	15:45		16:15	16:27		15:40	15:52	16:10			15:45	15:57		16:15	16:27
Reading	Arr	15:54		16:24	16:34		15:48	15:58	16:18			15:54	16:04		16:24	16:34
Reading	Dep			16:40												
Didcot	Dep			16:55												
Oxford	Arr			17:10												
		Option 5b: Four TPH Electric						Option 6b: Future Electric Timetable								
		Slow	Fast	Slow	Slow	Fast	Slow	Slow	Fast	Slow	Slow	Fast	Slow			

Victoria or L. Bridge	Dep	14:45			15:15			14:45			15:15		
E Croydon	Dep	15:00			15:30			15:00			15:30		
Gatwick	Dep	14:26	14:40		14:56	15:10		14:26	14:40		14:56	15:10	
Redhill	Arr	15:17	14:46		15:47	15:16		15:17	14:46		15:47	15:16	
Redhill	Dep	14:35	14:49		15:05	15:19		14:35	14:49		15:05	15:19	
Reigate	Dep	14:41	14:53		15:11	15:23		14:41	14:53		15:11	15:23	
Betchworth	Dep	14:45			15:15			14:45			15:15		
Deepdene	Dep	14:50	15:00		15:20	15:30		14:50	15:00		15:20	15:30	
Dorking W	Dep	14:52			15:22			14:52			15:22		
Gomshall	Dep	14:59			15:29			14:59			15:29		
Chilworth	Dep	15:05			15:35			15:05			15:35		
Shalford	Dep	15:10			15:40			15:10			15:40		
Guildford	Arr	15:12	15:15	<--	15:42	15:45	<--	15:12	15:15	<--	15:42	15:45	<--
Guildford	Dep	-->	15:17	15:20	-->	15:47	15:50	-->	15:17	15:20	-->	15:47	15:50
Ash	Dep			15:27			15:57			15:27			15:57
North Camp	Dep		15:27	15:31		15:57	16:01		15:27	15:31		15:57	16:01
Farnboro' N	Dep			15:35			16:05			15:35			16:05
Blackwater	Dep		15:33	15:39		16:03	16:09		15:33	15:39		16:03	16:09
Sandhurst	Dep			15:43			16:13			15:43			16:13
Crowthorne	Dep			15:47			16:17			15:47			16:17
Wokingham	Dep		15:40	15:52		16:10	16:22		15:40	15:52		16:10	16:22
Reading	Arr		15:48	15:58		16:18	16:28		15:48	15:58		16:18	16:28
Reading	Dep								16:10			16:40	
Didcot	Dep								16:25			16:55	
Oxford	Arr								16:40			17:10	

Option 7b: Future Electric Timetable with Express Services						
	Slow	Express	Slow	Slow	Fast	Slow

Victoria or L. Bridge	Dep	14:45			15:15		
E Croydon	Dep	15:00			15:30		
Gatwick	Dep	14:26	14:43		14:56	15:10	
Redhill	Arr	15:17	14:49		15:47	15:16	
Redhill	Dep	14:35	14:52		15:05	15:19	
Reigate	Dep	14:41			15:11	15:23	
Betchworth	Dep	14:45			15:15		
Deepdene	Dep	14:50			15:20	15:30	
Dorking W	Dep	14:52			15:22		
Gomshall	Dep	14:59			15:29		
Chilworth	Dep	15:05			15:35		
Shalford	Dep	15:10			15:40		
Guildford	Arr	15:12	15:15	<--	15:42	15:45	<--
Guildford	Dep	-->	15:17	15:20	-->	15:47	15:50
Ash	Dep			15:27			15:57
North Camp	Dep			15:31		15:57	16:01
Farnboro' N	Dep			15:35			16:05
Blackwater	Dep			15:39		16:03	16:09
Sandhurst	Dep			15:43			16:13
Crowthorne	Dep			15:47			16:17
Wokingham	Dep		15:37	15:52		16:10	16:22
Reading	Arr		15:45	15:58		16:18	16:28
Reading	Dep		16:10			16:40	
Didcot	Dep		16:25			16:55	
Oxford	Arr		16:40			17:10	

C3 Detailed Economic Appraisal Results

Table 15 - Options compared to current (December 2014) timetable, £m 2010 PV

	Option 1: Base Case	Option 2: Enhanced Base Case	Option 2b: Enhanced Base Case, Electric	Option 3: Enhanced Base Case with Oxford Extension	Option 4b: Enhanced Base Case with London Extensions	Option 5: Four Train Per Hour Timetable	Option 5b: Four Train Per Hour Electric Timetable	Option 6b: Future Electric Timetable	Option 7b: Future Electric TT with Express Service
Costs									
Capital expenditure	0.0	24.3	172.9	23.1	172.9	23.1	172.9	172.9	172.9
Operating expenditure	75.6	116.8	75.1	122.0	146.6	136.2	146.2	401.3	401.3
Revenue	-33.1	-62.5	-96.7	-58.4	-129.0	-57.2	-118.0	-210.7	-180.6
Present Value of Costs (PVC)	42.5	78.6	151.3	86.7	190.4	102.1	201.1	363.5	393.5
Benefits									
User benefits	80.0	193.6	295.5	141.4	358.3	150.6	373.9	632.6	534.6
Non user benefits	3.7	7.2	37.2	7.3	44.2	6.1	41.4	61.6	55.1
Indirect tax	-3.5	-7.4	-16.0	-6.4	-21.3	-6.0	-19.4	-34.7	-29.7
Present Value of Benefits (PVB)	80.2	193.3	316.7	142.3	381.2	150.7	395.9	659.5	560.0
Net Present Value (NPV)	37.8	114.7	165.4	55.6	190.7	48.6	194.7	296.1	166.4
Benefit Cost Ratio (BCR)	1.9	2.5	2.1	1.6	2.0	1.5	2.0	1.8	1.4

Table 16 – Incremental appraisal of diesel timetable options, £m 2010 prices

Incremental Scenario	Option 2: Enhanced Base Case	Option 3: Enhanced Base Case with Oxford Extensions	Option 5: Four Train Per Hour Timetable
Do Minimum	Option 1: Base Case	Option 2: Enhanced Base Case	Option 2: Enhanced Base Case
Costs			
Capital expenditure	24.3	0.0	0.0
Operating expenditure	0.0	46.4	93.2
Revenue	-14.6	-15.2	-20.2
Present Value of Costs (PVC)	9.7	31.2	73.0
Benefits			
User benefits	49.9	33.6	77.0
Non user benefits	3.5	1.2	-1.4
Indirect taxa	-2.4	-1.3	-1.1
Present Value of Benefits (PVB)	51.0	33.6	74.5
Net Present Value (NPV)			
	41.2	2.3	1.5
Benefit Cost Ratio (BCR)			
	5.2	1.1	1.0

Table 17 – Incremental appraisal for electric timetable options, £m 2010 prices

Incremental Scenario	Option 4b: Enhanced Base Case with London Extensions	Option 5b: Four Train Per Hour Electric Timetable	Option 6b: Future Electric Timetable	Option 7b: Future Electric Timetable with Express
<i>Do Minimum</i>	<i>Option 2b: Enhanced Base Case, Electric</i>	<i>Option 2b: Enhanced Base Case, Electric</i>	<i>Option 5b: 4tph, Electric</i>	<i>Option 6b: Future Electric Timetable</i>
Costs				
Capital expenditure	0.0	0.0	0.0	0.0
Operating expenditure	71.5	71.1	255.0	0.0
Revenue	-32.3	-21.3	-92.7	30.1
Present Value of Costs (PVC)	39.1	49.9	162.3	30.1
Benefits				
User benefits	62.8	78.4	258.7	-98.1
Non user benefits	7.0	4.2	20.3	-6.5
Indirect taxation	-5.3	-3.4	-15.3	5.0
Present Value of Benefits (PVB)	64.5	79.2	263.6	-99.6
Net Present Value (NPV)	25.3	29.3	101.3	-129.6
Benefit Cost Ratio (BCR)	1.6	1.6	1.6	-3.3

Table 18 – Economic Appraisal of the Case for Electrification, £m 2010 prices

Incremental Scenario	Option 2b: Enhanced Base Case, Electric	Option 5b: Four Train Per Hour Timetable, Electric
<i>Do Minimum</i>	<i>Option 2: Enhanced Base Case</i>	<i>Option 5: 4tph</i>
Costs		
Capital expenditure	148.6	148.6
Operating expenditure	-41.7	-63.7
Revenue	-34.2	-35.3
Present Value of Costs (PVC)	72.7	49.5
Benefits		
User benefits	102.0	103.4
Non user benefits	30.0	35.6
Indirect taxation	-8.6	-10.8
Present Value of Benefits (PVB)	64.5	128.1
Net Present Value (NPV)		
	50.8	78.6
Benefit Cost Ratio (BCR)		
	1.7	2.6

Appendix D

Detailed Options Assessment and Scoring

D1 Assessment of Shortlisted Options

Appendix D sets out the results of the assessment of all options. As noted, timetable options have

D1.1 Journey Times

Table 19 - Timetable Optimisation (1)

Description		Optimise the delivery of the Base Option service pattern, within existing and planned infrastructure constraints, to minimise journey times and maximise opportunities for peak time travel.	
Multi-criteria Assessment		Notes	Assessment
Impact	Journey Times	Potential for slight improvements in journey times by minimising the stopping services layover at Guildford.	M (+1)
	Connectivity	Option is intended to maximise opportunities for peak time travel by identifying the maximum number of train paths at Redhill for North Downs Line services.	M (+1)
	Quality	No impact identified.	Neutral (0)
	Economic Impact	Impacts on journey times and frequencies are likely to be positive but relatively minor – hence wider economic impacts expected to be negligible.	Neutral (0)
Feasibility	Deliverability	Option represents a timetable refinement within existing infrastructure.	H (+2)
	Cost	No capital costs associated with this option, potential for very minor increase in operating costs if service frequency is increased.	H (+2)
	Risk	Very low risk option.	H (+2)
Acceptability	Alignment with Stakeholder Priorities	Fits with stakeholder priority to minimise journey times and protect peak time service frequencies in the context of the Base Option timetable.	M (+1)
	Value for Money	This is a zero or minimal cost option offering incremental timetable benefits and therefore it is considered that this option delivers high value for money.	H (+2)
Timescale		Option can be delivered in association with the Base Option during CP5 following delivery of Redhill Platform 0.	Short Term
Overall Assessment		Given the likely drawbacks of the Base Option with respect to the requirement for a layover at Guildford and the complex interaction with main line services at Redhill, a detailed timetabling exercise will be important for to maximise the benefits of the Base option. As stated in the Sussex Route Study, <i>'It is important that North Downs services can depart and arrive at Redhill in slots that reduce the layover time at the station, and this requirement will need to be considered carefully in the December 2018 timetable change with GTR.'</i>	

Table 20 – Reduce Signal Headways and Improve Linespeed (2, 3)

Description		Significant signal headways have been identified between North Camp and Wokingham Jn, and also between Reigate and Chilworth. Signalling upgrade and provision of intermediate signalling will improve journey times, particularly for stopping services. Raising linespeeds at targeted locations will also contribute to faster journey times.
Multi-criteria Assessment		Notes
Impact	Journey Times	Significant reductions in journey time potentially delivered, particularly for stopping services. Signal upgrades have the potential save 3 to 4 minutes on a stopping service alone.
	Connectivity	No impact identified.
	Quality	No impact identified.
	Economic Impact	Some indirect wider benefits through improved journey times for commuting and business travel.
Feasibility	Deliverability	There are good prospects to reduce signal headways through provision of intermediate signals and reasonable prospects than line speed can be improved with limited track works. Requires detailed analysis.
	Cost	A high level assessment suggests 16 intermediate signals required between North Camp and Wokingham Jn, and 20 intermediate signals between Reigate and Chilworth. For indicative purposes the economic appraisal allows for £15m for signal upgrades and £5m for track works.
	Risk	Limited complexity although some risks that potential time savings cannot be fully realised due to timetabling constraints.
Acceptability	Alignment with Stakeholder Priorities	Fits with stakeholder priority to minimise journey times.
	Value for Money	The package of journey time savings delivered by this option, in combination with the Guildford Capacity Enhancement scheme, potentially offers very high value for money, assuming that the costs of the Guildford Capacity Enhancement scheme are met elsewhere.
Timescale		Option could be prioritised for investment in Control Period 6
Overall Assessment		Whilst the scope and impact of a programme of signal and linespeed upgrades requires further analysis, this option has the potential to deliver journey time savings at relatively low cost and, importantly, strengthens other timetable options.

Table 21 – Reduce the stopping service layover at Guildford by delivering enhanced capacity at Guildford. (4a)

Description		Prioritise and deliver ‘Phase 1’ Guildford Station Capacity enhancement (NR Route Study) to reduce the required layover time at Guildford for the stopping service. Phase 1 involves the construction of a new island platform (Platforms 9 and 10) on the west side of the station.
Multi-criteria Assessment		Notes
Impact	Journey Times	Scheme delivers improved timetabling flexibility allowing improved headways and journey time savings for stopping services of around 8 minutes.
	Connectivity	No impact identified.
	Quality	No impact identified.
	Economic Impact	Some indirect wider benefits through improved journey times for commuting and business travel.
Feasibility	Deliverability	Pre-GRIP feasibility study has been undertaken by Network Rail and assessed to be technically feasible dependent upon the number and type of additional platforms that are envisaged.
	Cost	Early stage assessment suggests very high cost option at between £217m and £263m before Optimism Bias. Potential to reduce costs if planned alongside programmed renewals.
	Risk	Early stage feasibility study has identified a number of technical risks to project costs. Also risks that main line capacity cannot be delivered until ‘inner area’ capacity schemes are delivered.
Acceptability	Alignment with Stakeholder Priorities	The layover at Guildford is recognised as a significant drawback of the Base option and the outputs of this scheme fit well with stakeholder objectives for improved journey times.
	Value for Money	The business case for this scheme will be determined primarily on the basis of the need for additional main line capacity. However, the benefits to the North Downs Line are significant. The package of journey time savings modelled (including reduced signal headways and linespeed enhancements) offers very high value for money.
Timescale		Option not prioritised in Route Study but could be delivered during CP6
Overall Assessment		Whilst the primary rationale for additional platforms at Guildford is Main Line capacity, the benefits to the North Downs Line are highly significant. There is a strong rationale for prioritising this scheme for CP6 to deliver benefits to the North Downs Line, and to achieve efficiencies in the delivery of renewals.

Table 22 – Introduced express services (5)

Description		Introduce express services between Reading and Gatwick stopping at major interchange stations only. Express service assumed to stop at Reading, Wokingham, Guildford, Redhill and Gatwick.	
Multi-criteria Assessment		Notes	Assessment
Impact	Journey Times	Reduced journey times for the busiest flows on the North Downs Line with up to 8 minutes saved on end to end journey times.	H (+2)
	Connectivity	Express service would result in a lower frequency of service at Blackwater, North Camp, Dorking Depedene and Reigate. The combination of paths give a very uneven headway for some of the minor stations.	Negative
	Quality	No impact identified.	Neutral (0)
	Economic Impact	Potential strategic economic benefits linked to improved airport access and improved journey times for business travel between regional centres.	M (+1)
Feasibility	Deliverability	Option is deliverable subject to resolving any conflicts with main line services. Total journey time savings may be limited by requirement to overtake slow service.	M (+1)
	Cost	No capital or operating costs associated with this option.	H (+2)
	Risk	Risks relate to potential lost demand due to loss of service frequency and irregular headways.	M (+1)
Acceptability	Alignment with Stakeholder Priorities	Aligns well with stakeholder priorities for the strategic role of the North Downs Line. This option delivers improved access to Gatwick. However, stakeholders are also conscious of the need to maintain a good service from smaller stations.	M (+1)
	Value for Money	Analysis of demand and revenue suggests loss of service frequency outweighs benefit of reduced journey times suggesting this option offers poor value for money.	L (0)
Timescale		Could be delivered immediately but more attractive if delivered as part of a more frequent, 3 or 4 train per hour timetable.	Short Term
Overall Assessment		The option fits well with stakeholder objectives for the strategic role of the North Downs Line connecting major economic centres in the South East and Gatwick Airport. However, the loss of frequency results in overall disbenefits suggesting that the North Downs Line does not have sufficient frequency to accommodate express service without significant negative impacts.	

D1.2 Connectivity

Table 23 – Operate stopping services during peak hours (9)

Description		Under the Base Option, capacity constraints at Redhill are such that only 2 North Downs Line services can operate, limiting the frequency of the stopping service during the peak. This option involves considers how to increase peak time frequency to at least 3 trains per hour.	
Multi-criteria Assessment		Notes	
Assessment			
Impact	Journey Times	No impact identified.	Neutral (0)
	Connectivity	Passengers using smaller stations served only by the stopping service would benefit from more peak time services, delivering a significant increase in frequency.	High Impact (+2)
	Quality	By increasing frequency, this option also delivers higher peak time capacity.	Neutral (0)
	Economic Impact	Some indirect wider economic benefits for rural towns and villages which rely heavily on the North Downs Line.	M (+1)
Feasibility	Deliverability	This option cannot be achieved within existing or planned infrastructure. Even with the construction of platform 0 at Redhill, there is insufficient platform capacity for 3 North Downs Line services during the peak. The alternative means of accommodating peak time services is by linking North Downs Line services with London bound services on the Brighton Main Line. This in turn would require electrification of the North Downs Line and use of DC or dual voltage rolling stock.	L (0)
	Cost	Assuming the capital costs of electrification are met separately, this option requires an increase in operating costs linked to the requirement to operate units between Redhill and London.	M (+1)
	Risk	Whilst this is achievable in theory there are significant timetabling risks related to platform availability at Redhil to split and join services. This option requires a complete recast of the timetable.	M (+1)
Acceptability	Alignment with Stakeholder Priorities	Stakeholders are acutely aware of the potential impact of losing peak time services.	H (+2)
	Value for Money	If achieved through network extensions, under an electrified scenario, this option offers positive value for money with a BCR of 1.6.	M (+1)
Timescale		Can only be delivered following electrification and therefore this is considered a long term option.	Long Term
Overall Assessment		The lack of peak time stopping services is a significant drawback of the Base option. If timetabling constraints can be overcome, there is a likely to be a good case for this option as part of a future electric timetable.	

Table 24 – Allow stopping services to call at intermediate stops between Reading and Guildford (10b)

Description		Allow stopping services to call at intermediate stops not currently served by North Downs Line services.	
Multi-criteria Assessment		Notes	Assessment
Impact	Journey Times	Stop adds around 2 minutes to a journey time on the stopping service between Reading and Guildford.	Negative (-1)
	Connectivity	Improves service frequencies to Guildford and Reading for the stops added to the service. Also provides new direct connections to other North Downs Line stations.	M (+1)
	Quality	No impact identified.	Neutral (0)
	Economic Impact	Positive impacts expected given the level of employment and population in the catchment area of stations such as Winnersh Triangle and Earley.	M (+1)
Feasibility	Deliverability	Possible timetable implications but an additional stop is considered to be feasible and journey time improvements would make this option more achievable.	H (+2)
	Cost	No cost implications – overall revenue impact expected to be positive.	H (+2)
	Risk	Limited operational risks.	H (+2)
Acceptability	Alignment with Stakeholder Priorities	Option supported by local stakeholders provided that journey times are not significantly adversely affected.	M (+1)
	Value for Money	Detailed value for money assessment is required although it is expected that the options would offer value for money provided journey times are not significantly adversely affected.	M (+1)
Timescale		Option would be more attractive if delivered in combination with a four train per hour timetable at peak times (such that there would be two stopping services). Improved journey times as a result of electrification would also benefit this option. Therefore, this option may be considered a long term option.	Long term option
Overall Assessment		If peak time service frequencies are improved, and journey times enhanced, stopping services at Winnersh Triangle and potentially other locations between Reading and Guildford would improve connections between important employment centres in the region	

Table 25 – Increase service frequency to four trains per hour (11)

Description		Move to a 4 train per hour North Downs Line timetable with two fast services, and two stopping services.	
Multi-criteria Assessment		Notes	Assessment
Impact	Journey Times	Option assumes Base Option stopping pattern is retained such that there is no impact on journey times. However, this option does offer the potential to move to an alternate hour stopping pattern in order to reduce journey times on the stopping service.	Neutral (0)
	Connectivity	If delivered through addition of a stopping service, this option delivers enhanced frequencies for all stations.	H (+2)
	Quality	By increasing frequency, this option delivers an overall increase in peak time capacity.	M (+1)
	Economic Impact	Some indirect wider economic benefits linked to improved service frequencies, particularly for commuters.	M (+1)
Feasibility	Deliverability	Achieving this option would require a recast of the timetable, potentially impacting on other routes.	M (+1)
	Cost	No infrastructure costs. Requires additional train diagrams and therefore results in higher operating costs.	M (+1)
	Risk	Risks relate to timetabling feasibility. There is off peak capacity through the three key locations of Guildford, Redhill and Reading. However, whether paths can be found that tie in with the other main line routes that will take priority over these services cannot be guaranteed.	M (0)
Acceptability	Alignment with Stakeholder Priorities	Aligns well with stakeholders desire to deliver a step change in services. However, an increase in frequency to 4 trains per hour would result in an increase in level crossing down times. This may have a significant impact on traffic at specific locations, the impact of which would need to be carefully managed.	H (+2)
	Value for Money	Increasing service frequency from 3 to 4 trains per hour has a BCR of 1.0 in a diesel scenario or 1.6 in an electrified scenario.	M (+1)
Timescale		Whilst there are no barriers to achieving this option in the short term a four train per hour timetable is only likely to be attractive if achievable at peak times. Therefore this option is best suited to a future electric timetable with service extensions beyond Redhill.	Long Term
Overall Assessment		This option delivers a step change in services on the North Downs Line and should be retained as a long term goal for the line.	

Table 26 – Extend fast services from Reading to Oxford (12a)

Description		Extend one or more fast services beyond Reading to Oxford.	
Multi-criteria Assessment		Notes	Assessment
Impact	Journey Times	Minor journey time saving for through passengers travelling between North Downs Line stations and Oxford.	M (+1)
	Connectivity	Option provides increased frequency of services between Oxford and Reading and reduces requirement for passengers to interchange between Oxford and North Downs Line stations. Provides a direct service to Gatwick from Oxford. Opportunities to stop at intermediate stations such as Didcot Parkway.	H (+2)
	Quality	No impact identified.	Neutral (0)
	Economic Impact	Some indirect wider economic benefits by improving links between major economic centres in the South East and improving access to Gatwick.	M (+1)
Feasibility	Deliverability	Possible timetable constraints and platform capacity issues between Reading and Oxford.	M (+1)
	Cost	No infrastructure costs. Requires additional train diagrams and therefore results in higher operating costs.	M (+1)
	Risk	Limited risks relating to timetabling conflicts.	M (+1)
Acceptability	Alignment with Stakeholder Priorities	This option aligns well with stakeholder vision for strategic role of North Downs Line. The would strengthen the North Downs Line's role as an orbital route connecting major centres in the South East and connecting with East-West rail which forms the orbital route to the north of London.	H (+2)
	Value for Money	Analysis suggests there may be a value for money case for this service. The appraisal has a BCR of 1.1:1	M (+1)
Timescale		Could be delivered in the short term subject to timetabling constraints and franchise change.	Short Term
Overall Assessment		This is an attractive option which fits well with the strategic vision for the North Downs Line and offers significant benefits to passengers.	

Table 27 – Extend services to London via the Brighton Main Line (12d)

Description		Extend one or more stopping services per hour to London via the Brighton Main Line to London Victoria or London Bridge This could be achieved by joining the North Downs Line stopping service with the Tonbridge or Horsham services at Redhill, or be joining with/replacing the Reigate to London services.
Multi-criteria Assessment		Notes
Impact	Journey Times	Minor journey time saving for through passengers travelling between North Downs Stations to London via Redhill.
	Connectivity	Provides direct services to London for all North Downs Line stations with particular benefits for commuters travelling from intermediate stations between Guildford and Reigate to London.
	Quality	No impact identified.
	Economic Impact	Some indirect wider economic benefits by improving commuting links to London which accounts for the largest commuter flows.
Feasibility	Deliverability	Option is dependent on electrification. Requires recast of the timetable to align services and avoid conflicts with main line services. Extending services on the Brighton Main Line may have significant performance implications.
	Cost	If North Downs Line services join with London bound services at Redhill, additional vehicle mileage will be incurred.
	Risk	Whilst this is achievable in theory there are significant timetabling risks related to platform availability at Redhill to split and join services. This option requires a complete recast of the timetable.
Acceptability	Alignment with Stakeholder Priorities	Aligns well with stakeholder priorities because of importance of London commuting market.
	Value for Money	Under an electrified scenario, if services join with London bound services at Redhill – enabling 3 trains per hour to operate during the peak – this timetable change potentially offers positive value for money with a BCR of 1.6:1
Timescale		Can only be delivered following electrification and therefore this is considered a long term option.
Overall Assessment		This option leads to more efficient use of platform space at Redhill which could enable a higher peak time service frequency. However, there are significant operational barriers to achieving this option.

Table 28 – New station at Park Barn in Guildford (13a)

Description		The proposed station at Park Barn provides an additional link between central Guildford and local employment centres, particularly Royal Surrey Hospital and Surrey Research Park. The station would be located where Egerton Road crosses the railway line, to the west of the A3. Guildford to Ascot services could stop at the station in addition to North Downs Line stopping services.
Multi-criteria Assessment		Notes
Impact	Journey Times	Stop adds around 2 minutes to a journey time on the stopping service between Reading and Guildford.
	Connectivity	Offers a rail alternative for travel between west and central Guildford and could cut congestion on the town's roads
	Quality	No impact identified.
	Economic Impact	The new station would be expected to have a very significant positive impact on the growth of Guildford.
Feasibility	Deliverability	Requires detailed assessment although no major barriers to deliverability identified.
	Cost	No cost estimates available. However, a new station is likely to be a medium cost scheme with capital costs in the region £5m to £20m.
	Risk	Capital project with risks to cost. Some risks to future timetabling.
Acceptability	Alignment with Stakeholder Priorities	Strong support from local stakeholders.
	Value for Money	Detailed value for money assessment is required although the scale of local employment development suggests there could be a good value for money case for the station.
Timescale		Option could be delivered in the medium term.
Overall Assessment		The station is of potential strategic importance to the Guildford economy given its potential role in serving Surrey Research Park. The case for the station is likely to rely on Guildford to Ascot services calling at the station given the limited frequency of North Downs Line stopping services.

D1.3 Quality

Table 29 – Increase capacity through train lengthening (15b)

Description		Increase capacity on North Downs Line services by deploying at least 4-car trains in peak times. This could be achieved by coupling 2 x 2-car 165s or combining a 2-car and 2-car set to make a 5-car train.	
Multi-criteria Assessment		Notes	Assessment
Impact	Journey Times	No impact identified.	Neutral (0)
	Connectivity	No impact identified.	Neutral (0)
	Quality	An increase in train capacity services to reduce the level of crowding on peak time services, improving comfort for passengers.	H (+2)
	Economic Impact	Very minor wider economic benefits expected	Neutral (0)
Feasibility	Deliverability	Deliverable subject to availability of rolling stock which is likely to be highly constrained in the short term.	M (+1)
	Cost	Some additional operating costs due to increased fleet size and mileage.	M (+1)
	Risk	Low risk option.	H (+2)
Acceptability	Alignment with Stakeholder Priorities	Aligns well with overall objectives to deliver a high quality service.	M (+1)
	Value for Money	Detailed assessment of current and future train loadings required, although targeted provision of increased capacity is likely to offer value for money.	M (+1)
Timescale		Achieving this option in the very short term may be challenging due to shortages of rolling stock. Electrification of the Great Western Main Line offers the opportunity for redeployment of stock to the North Downs Line.	Short term
Overall Assessment		Targeted deployment of additional rolling stock on crowded services is advised in advance of any future electrification of the North Downs Line.	

Table 30 – Improve station quality (16a)

Description		Improving the actual and perceived quality of the North Downs Line by improving station facilities. This would need to be considered on a station by station basis but could include general refurbishment, new waiting facilities, retail facilities, staffing and security. Identifying specific interventions would require a more detailed review. Some station – such as Dorking Depedene – have already been identified as requiring an upgrade to facilities.
Multi-criteria Assessment		Notes
Impact	Journey Times	No impact identified.
	Connectivity	No impact identified.
	Quality	Overall satisfaction with First Great Western stations is high at 82%. However, satisfaction with specific attributes such as security, the overall environment, upkeep and repair and the provision of shelter facilities is lower. This pattern is likely to be replicated for the North Downs Line.
	Economic Impact	No impact identified.
Feasibility	Deliverability	Detailed analysis required although there is likely to be significant scope to deliver improvements.
	Cost	Cost depends on scope of improvement but likely to be a medium cost option.
	Risk	Low risk option.
Acceptability	Alignment with Stakeholder Priorities	Aligns well with overall objectives to deliver a high quality service.
	Value for Money	Targeted delivery of improvements likely to offer good value for money.
Timescale		An ongoing programme of improvement could get underway during CP5 but in general considered a medium term intervention.
Overall Assessment		Improving quality of stations is an important part of the overall strategy for the North Downs Line and therefore should be retained as part of the strategy for the Line going forward.

Table 31 – Improve access to stations including targeted enhancements of park and ride provision (16b)

Description		<p>Access improvements could include, increased park and ride provision, new DDA compliant footbridges and lifts, new cycleways, and improved interchange facilities with bus services.</p> <p>Identifying specific interventions requires a more detailed review. However, candidate stations with limited or heavily used parking include North Camp, Blackwater and Crowthorne. Access improvements are also warranted at North Camp, Dorking Depedene and Blackwater, amongst other stations.</p>	
Multi-criteria Assessment		Notes	Assessment
Impact	Journey Times	Minor improvements in journey times by improving interchange facilities	M (+1)
	Connectivity	Delivers improved access to the network although overall impact expected to be small.	M (+1)
	Quality	Improving access is part of the overall quality of service	H (+2)
	Economic Impact	Very minor wider economic benefits expected	Neutral (0)
Feasibility	Deliverability	Detailed analysis required although there is likely to be significant scope to deliver improvements.	M (+1)
	Cost	Cost depends on scope of improvement but likely to be a medium cost option.	M (+1)
	Risk	Low risk option.	H (+2)
Acceptability	Alignment with Stakeholder Priorities	Aligns well with overall objectives to deliver a high quality service and to encourage mode shift.	M (+1)
	Value for Money	Targeted delivery of improvements likely to offer good value for money.	M (+1)
Timescale		An ongoing programme of improvement could get underway during CP5 but in general considered a medium term intervention.	Medium Term
Overall Assessment		Access improvements will make it easier for passengers to use the line, contributing to demand and encouraging mode shift.	

D1.4 Cross-cutting options

Table 32 – Electrification (8)

Description		Electrification of the North Downs Line and replacement of the existing rolling stock with faster electric trains. The most likely approach to electrification is to deploy ‘AC’ overhead wires as an infill scheme with dual voltage stock.	
Multi-criteria Assessment		Notes	Assessment
Impact	Journey Times	Arup’s timetable analysis suggests that, conservatively, a 6 minute journey time savings could be delivered assuming DC or dual voltage stock.	H (+2)
	Connectivity	No impact identified.	Neutral (0)
	Quality	By default, this option is likely to deliver an upgrade to rolling stock and will therefore deliver improved quality and capacity.	H (+2)
	Economic Impact	Significant indirect wider economic benefits linked the journey times and overall modernisation of rail services.	H (+2)
Feasibility	Deliverability	Option is deliverable but review of structures clearances required. No technical barriers to use of dual voltage stock but availability of rolling stock could be challenging.	M (+1)
	Cost	This option has a high capital cost estimated to be in the range £87m to £145m assuming no depot costs. There may be considerable potential to reduce costs if a third rail scheme is considered although there are technical and safety barriers to achieving this. Costs are lower if considered on a whole life basis.	L (0)
	Risk	Very significant cost risks – requires detailed assessment of potential structures costs and power supply issues.	M (+1)
Acceptability	Alignment with Stakeholder Priorities	There is general support for electrification amongst stakeholders	H (+2)
	Value for Money	The case for electrification is highly dependent on the capital cost of the scheme, as well as the future frequency of service. Even using relatively conservative assumptions, our analysis suggests electrification may offer good value for money with a benefit cost ratio of between 1.7 and 2.6	M (+1)
Timescale		Electrification could be prioritised for CP6. However, given the timescales of an electrification scheme and the backlog of electrification schemes in the UK, it is unlikely that electric trains would operate until CP7.	Medium to Long Term
Overall Assessment		Electrification should be a major priority for the North Downs Line and would deliver a step change in journey times and quality of service.	