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WSP

LEEDS – HARROGATE – YORK RAIL LINE IMPROVEMENTS

Outline Transport Business Case

04/10/2013

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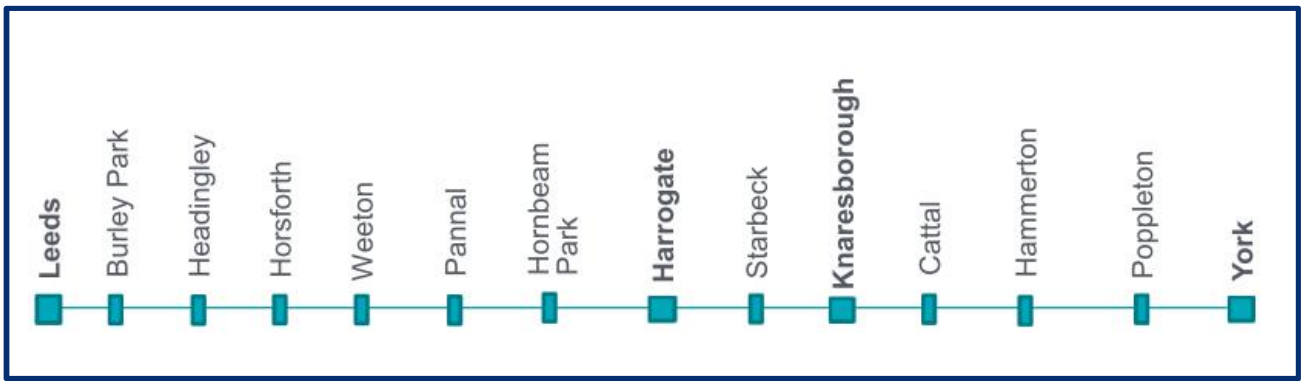
Electrification & Upgrade Business Case Summary



KEY FACTS:

- **The core Benefit to Cost Ratio (BCR) for improvements to the Leeds – Harrogate – York Rail Line, at a forecast capital cost of £93.34m is 3.61. This represents high value for money, and rises to 4.27 with the addition of Wider Impacts.**
- **The best case scenario achieves:**
  - **Service frequency doubled across the whole route, together with early morning and later evening journeys are possible.**
  - **End to end journey time reductions of 15 minutes (or around 19%) and, as a result of the additional demand, generates a positive financial return over the life of the scheme.**
  - **Long-term cost-reduction of operating the line, and with lower cost electric multiple units a positive Revenue:Cost ratio of 1.25.**
- **Over 3 million annual vehicle kilometres are removed from the highway network, with associated social and environmental benefits, along with time benefits for existing road users.**
- **The scheme significantly enhances connectivity and economic productivity between employment, labour and international visitor markets in Leeds, Harrogate and York; driving both local and international competitiveness.**
- **Fast connectivity to both the East Coast Main Line and Trans Pennine Express at Leeds and York is secured, supporting the existing travel to national economic centres and international gateways together with future High Speed 2 (HS2) networks.**

CORE BENEFITS OF ELECTRIFICATION AND UPGRADE

Background

The Leeds – Harrogate – York rail line provides an important transport link accommodating social, business and leisure users; facilitating access to regional employment and labour markets in York, Harrogate and Leeds and across the North of England. The route has significant business, education and commuting travel flows, linking nationally important centres of finance and law in Leeds, conference trade in Harrogate and tourism in York.

The line facilitates access to employment and labour markets in each of the urban centres, where alterative travel by road significantly congested. In terms of road delay per mile, West Yorkshire, Leeds, Harrogate and York have some of the highest values in the country. Despite this the Leeds-Harrogate-York rail line suffers from poor comparative journey times preventing further modal shift This potential however is being undermined by low levels of service frequency, poor (or non-existent) early morning and evening / weekend services, poor rolling stock, and reliability and capacity issues . This is despite significant recent and forecast growth on the line and the potential of the route to facilitate economic growth and modal shift though improved frequency, reduced journey time and improved connectivity.

The line plays a pivotal role in connecting to the East Coast Main Line and Trans Pennine routes at both Leeds and York, and HS2 for wider national connectivity, which is key to future prosperity of each of the key towns and cities on the line.

Appraisal Results

The business case has been developed using industry standard modelling tools, in accordance with Department for Transport (DfT) WebTAG (Web based transport appraisal guidance) and Passenger Demand Forecasting Handbook (PDFH) principles and has been developed in conjunction with discussion and support of all stakeholders.

MOIRA rail timetable software outputs have been linked to a WebTAG compliant appraisal model, covering the key components of transport user benefits and are in line with Network Rail protocol. RailSys timetable modelling of rolling stock options and infrastructure requirements has also been undertaken to ensure deliverable journey times, together with an independent estimate and verification of capital and operating costs.

The Core BCR for the scheme based on electrification capital costs of £93.34m and base passenger numbers as projected at 2019, is 3.61; rising to 4.27 with the addition of Wider Impacts

Sensitivity testing in relation to lower levels of background growth demonstrates a range around the core BCR of 3.0 to 3.61 before the addition of wider impacts, based on the forecast capital cost estimate of £93.34m, and which also allows for inflation, and optimism bias at 66%. In all scenarios, the BCR is greater than 2 and therefore represents high value for money in DfT terms.

The financial case for the scheme is also robust, with revenue greater than additional operating costs when based on local levels of growth, or close to forecast operating costs when based on more conservative DfT forecasts from the National Trip End Model. The scheme also produces long-term efficiency savings compared to the continued use of a more expensive diesel fleet.

Strategic Alignment

The scheme supports existing national policy objectives for a modern low cost railway and in acting now represents a value for money approach by incorporating into planned infrastructure investment and renewals.

As a result of the scheme over 3 million vehicle kilometres annually are forecast to be removed from the highway network. This results in benefits being provided in a number of other areas of the appraisal, particularly around road decongestion and safety, together with associated carbon benefits; each of which are key objectives of local and national policy.

The longer than average travel distances made on the line by most passengers, and the importance of flows to London (with 12% of all trips to/from London), enhances the importance of these benefits compared to other competing alternatives and schemes. Consequent safety benefits are also noted, particularly on the A59 between Knaresborough and York, which has an accident rate 3 times that of the national average.

In addition to the peak decongestion and safety benefits, the significant use of inter-peak services, ensures that the additional journey times savings, and improved reliability, frequency and capacity benefits are felt throughout the day, and not just for peak hour commuters.

Connectivity

Onward national and international connectivity, through Leeds and York is improved in the short term and in preparation for longer term connectivity to HS2 routes, providing significant journey time reductions in either direction, compared to today.

This is enhanced through provision of additional early morning and evening trains, weekdays as well as at weekends. These maximise the economic return and viability of daily business trips to/from London, assisting regional economic performance, agglomeration, and balance.

Most importantly however, is the fact that the line is well-used and has the ability to provide a high-quality alternative to car and bus travel over the next 60 years. There are significant benefits to existing rail users arising from the end-to end journey time reductions of 15 minutes. This achieves an average time saving per user of greater than 5 minutes, and is important to the economic value and productivity promoted by the scheme compared to alternatives.

Next Steps

The scheme has strong synergy with existing Yorkshire Rail proposals, and especially with the Leeds Southern Station Entrance scheme, and Local Transport and Land Use Plans in Harrogate, Leeds and York.

In the medium-term there is also synergy with Network Rail proposals for additional platform capacity on the lower numbered platforms at Leeds, and signalling upgrade renewals between Harrogate and York There is a requirement to re-double some of the single line sections east of Knaresborough and a separate application is being developed for this from delegated major schemes funding.

The business case addresses or works within existing infrastructure constraints, however it assumes modelled patronage is not constrained by access. Given the location of some stations and the current limited parking availability, access may constrain patronage growth; therefore stakeholders will investigate passenger access to the line in parallel to this business case.

The scheme is strongly supported by each of the stakeholders, and Government approval is therefore sought to commit to electrification of the route at the earliest possible stage so providing a platform for future success and economic vitality of the region. The scheme is therefore recommended to the DfT on the basis of the high level of value for money the positive net financial case, long-term cost reduction in terms of operating the line promoted by the scheme, and national economic benefits for the region and the country.

Introduction

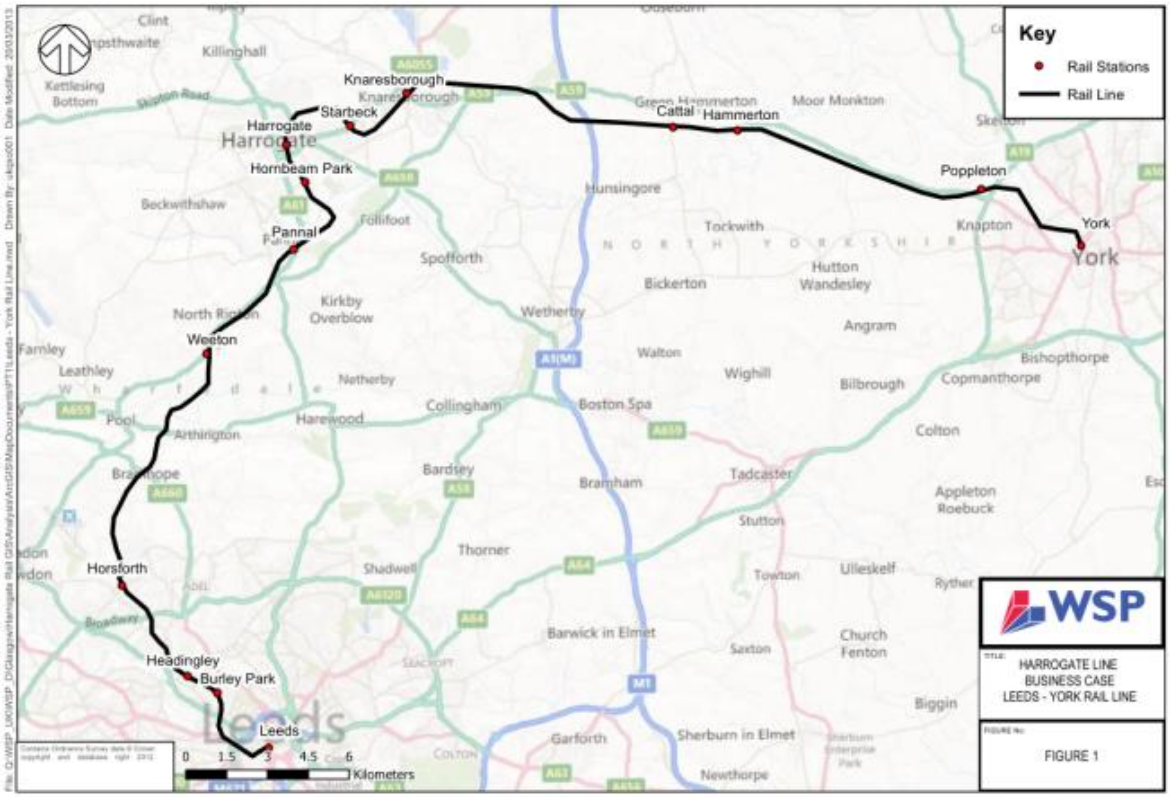
Background

WSP UK Limited (WSP) have been commissioned by North Yorkshire County Council (NYCC), METRO (West Yorkshire PTE), Harrogate Borough Council (HBC) and City of York Council (CYC) to develop an outline business case for improvements to the Leeds – Harrogate – York rail line.

The study has been requested as the line provides an important regional transport link accommodating social, business and leisure users, facilitating access to regional employment and labour markets in York, Harrogate and Leeds, and plays a pivotal role in connectivity to the East Coast Main Line and with the rest of the UK at both Leeds and York and which is key to future prosperity of communities, towns and cities on the line.

Figure 1 shows the route of the line identifying the stations which are served by the rail line.

Figure 1: Leeds – Harrogate – York Rail Line



The study is being undertaken with support from a number of stakeholders including the Harrogate Chamber of Trade and Commerce, Network Rail and the current Train Operating Companies (TOCs) Northern Rail and East Coast who operate on the line.

The authority partnership and Leeds – Harrogate – York Rail Line Officers Group, which is leading this work on behalf of the authorities, is long established, now being in place for over 10 years. As a result of this close working and a number of previous studies, there is a body of evidence available, and a set of clearly defined objectives, set out in the Conditional Output Statement (Appendix B) to this Outline Business Case.

The work has been informed with evidence from METRO and NYCC - including their Rail Strategy, Local Transport Plan 3 and higher - level objectives for the rail network and as set out in the Yorkshire Rail Network Study (2011). The work provides an ideal feed into the Network Rail Long Term Planning Process (LTPP) to provide an understanding of local priorities that can support economic growth.

The line provides for a mixture of journey uses, catering to both local and longer distant markets. Many trips are relatively long distance, with 12% of all trips to/from London, and 8% of all trips to economic centres including Manchester, Newcastle, Birmingham and Edinburgh. This is important in two aspects; one to ensure labour productivity and regional economic agglomeration, but also to ensure easy access for visitors to Harrogate, York and intermediate stations, given the strong tourism, leisure, education and conference markets in the area.

As a result, improvements on the line support both local and national priorities (better journey times, reliability, frequency and capacity) providing benefits for users throughout the day.

The rapid growth in the sub-region and demand for travel on the line has significantly increased to the point where, at certain times, further growth is constrained due to a lack of attractive journey times and capacity on the trains and at stations.

Signalling on the route has recently been modernised between Leeds and Harrogate; £16m has been invested to improve signalling performance. This includes the installation of turnback facilities at Horsforth to permit the operation of a shuttle service between Horsforth and Leeds in the future, and the signalling has been made such as to permit the operation at 75mph in the future.

The shuttle service is expected to start in CP5 (2014-2019), once rolling stock becomes available, although this is not yet committed. The signalling however now permits 4 trains per hour service between Harrogate and Leeds which currently operate at peak times.

Electrification ensures quicker journey times and provides a step change in journey quality for passengers, and together with double-tracking and other infrastructure works is seen as vital to encourage mode shift to rail as well as meeting carbon targets. Rail operational costs are also significantly reduced.

Figure 2: Class 144/155 4 car DMU set on the Harrogate – Leeds – York Line

Typical example of rolling stock quality on the Harrogate line

Background growth in travel, linked to localised growth from additional housing and the expansion of visitor attractions, creates the need for short and longer term solutions to ensure the rail service can not only cope with existing and supressed demand but can deliver the level of service required for the future.

Transport Study

In developing an outline business case for the line, the partner authorities have identified the following elements:

- Identification and evaluation of potential schemes to deliver the Conditional Outputs for the Leeds - Harrogate - York Rail Line;
- Recommendation of the best value for money package of schemes; and
- Production of an Outline Transport Business Case to support funding applications and assist prioritisation of schemes.

There are four key issues to address in undertaking this commission, namely:

- The evidence around how transport influences, and can support, economic growth in West and North Yorkshire together with the other objectives agreed by the authorities for the line itself (Connectivity, Growth & Performance);
- The availability and timing of funding to realise the needs and aspirations for investment in the Leeds – Harrogate - York Rail Line, and how to align with the investment opportunities wherever possible;
- The presentation of a clear, evidence based case for investment; and
- The need to achieve buy-in to the proposed package of improvements from the stakeholders across the North.

This report presents the outputs of reviewing and compiling relevant evidence, research and analysis and provides an assessment of any gaps in base data or previous appraisal. The final consideration is fundamental to the development of the preferred scheme, and consequently throughout the four elements there has been on-going engagement, which will remain at the heart of the process.

This Outline Transport Business Case has been prepared to support improvement of the Leeds - Harrogate - York Rail Line and follows Department for Transport guidance[1].

This forms part of a three stage process which includes the preparation of a Strategic, Outline and Full Business Case to develop a viable strategy to improve the Leeds - Harrogate - York Rail Line, and will also feed into Network Rails Long Term Planning Process (LTPP) both for Regional Urban and Long Distance Market Studies.

Workshops have been held and consultation documents have been issued in spring 2013. These are available on the stakeholder group's SharePoint site, and which can be made available to DfT on request.

Following this introductory chapter, the report goes on to summarise the following:

- A description of existing conditions;
- Rail service scenario option development;
- The strategic case for the improvements to identify what investment is required; and
- A summary of the modelling approach and Results.

A summary of the Business Case's findings and key facts is provided at the end of the report.

[1] The Transport Business Cases – DfT January 2013

Existing Conditions

The Leeds – Harrogate – York Rail Line

The Leeds - Harrogate - York rail line connects Leeds to York via the towns of Harrogate and Knaresborough. The line traverses a mixture of environments, from urban inner city areas with relatively short gaps between stations (south of Horsforth and Hornbeam Park to Knaresborough), compared with the rural isolated stations elsewhere on the line in North Yorkshire.

With the exception of Leeds and York, Harrogate and Knaresborough represent the other major attractors on the route. All other stations are relatively small and are unstaffed apart from Horsforth. However, many of the smaller stations have significant catchment areas, primarily due to good road accessibility to / from the A61 and A59 driving additional rail demand to these locations which is beyond those typically expected from a 1km catchment around the stations.

Stations to the east of Harrogate generally have better facilities on the York bound platform. Real-time passenger information is provided by remote announcements or by a Customer Information System at Harrogate and Poppleton. Parking spaces are relatively limited in number, with greater parking provision at Harrogate, Hornbeam Park and Horsforth, although parking spaces are almost always fully occupied at all locations. Access for disabled passengers is only available at certain stations.

There are 12 intermediate stations on the line between Leeds and York, with free parking provided at all except at Harrogate:

- **Burley Park** - is a relatively small unstaffed urban station located in a largely residential area. It has recently had improvements in waiting facilities and has a self-service ticket machine. Due to its location, the availability of parking and direct integration with other transport modes is limited (only 4 parking spaces but with some cycle parking). Passenger journeys are predominantly commuting trips to and from Leeds. Limited access for disabled with steps to the platform, or a long diversionary route between platforms.
- **Headingley** - is similar to Burley Park in location, station facilities and journey patterns, but with a more dispersed pattern because of the proximity to Leeds Metropolitan University and rugby and cricket grounds.
- **Horsforth** - has modern waiting facilities and ticket office and is access compliant, constructed as part of a recent station redevelopment. There is a car park with 68 spaces.
- **Weeton** - is a small rural station contrasting with the urban stations in West Yorkshire. Waiting shelters are provided, with 16 car parking spaces. The southbound platform is not access compliant.
- **Pannal** - is a small station with limited facilities and a self - service ticket machine, but has parking for 67 cars.
- **Hornbeam Park** - is a larger station and has step free access. The car-park has 10 spaces, but with some shared use with the adjacent office park and hotel. 20 spaces in total are reserved for rail users. There is also a further free 115 space car park adjacent to the station provided by Harrogate Borough Council, which is available to anyone. A self-service ticket machine is provided. The Great Yorkshire Showground is close by.
- **Harrogate** - has a reasonable standard of facilities, including a staffed ticket office which is open daily, chargeable car parking with 117 spaces and is fully access compliant. Harrogate Borough Council has a 813 space multi-storey car park adjacent to the station. There are cycle lockers located in the adjacent car park in addition to those on the Leeds bound platform. The bus station is a short distance away providing onward connectivity to a range of local destinations. A more formal transport interchange in this location is an aspiration of both Harrogate Borough Council and North Yorkshire County Council and is identified in the relevant planning policy documents.
- **Starbeck** - is unstaffed, in a busy urban area, it is access compliant and has a self-service ticket machine. Waiting facilities are provided but there is no car parking.
- **Knaresborough** - is a relatively busy station with limited facilities, no staff presence but with self-service ticket machines, limited parking with 8 spaces but with access to other transport modes including taxi and bus within 500m. There is significant parking in local streets which local partners are also seeking to address.

- **Cattal** - is a small rural station with limited facilities and limited car parking through an arrangement with a local landowner (15 spaces).
- **Hammerton** - is a small rural station with limited facilities and a small car park (5 spaces).
- **Poppleton** - is a small village station with limited facilities and a small car park (12 spaces).

Overall, many stations on the Leeds – Harrogate – York Rail Line offer a relatively unattractive waiting environment for passengers and provide limited facilities. For trains stopping at all stations the current maximum train length is 3 cars. Selective door opening is required at some stations when 4 car units are operated.

Figure 3: Weeton Station Platforms

Figure 4: Examples of Cattal on road parking and Poppleton Car Parks at Capacity

Parking provision and rail-heading at several rural stations

Existing Constraints and Interactions

Several key infrastructure constraints exist presently which include:

Leeds

- The Leeds - Harrogate - York Rail Line joins the Airedale & Wharfedale Rail Lines on the approach to Leeds. These services share the use of Platforms 1-5 and the dedicated approach lines A and B towards Leeds station. These services currently have limited interaction with any other services at Leeds, but the relatively high frequency of the combined services and the platform storage requirement places a degree of constraint on future capacity in the Leeds Station area.
- Platform capacity at Leeds station, where the Harrogate trains normally use platform 1, which is also used by Wharfedale electric trains (Ilkley/Bradford/Skipton).

Crimple Curve

- The original Leeds northern route bypassed Harrogate due to using a low-level route along the river valley. A steeply graded and slow speed connection was provided between the two routes to allow direct access to Harrogate Station. This led to the current route having a very tight curve with a 20mph speed restriction immediately south of the Crimple Viaduct. Without major civil engineering works and significant land purchase this constraint will remain.

Starbeck Level Crossing

- The level crossing at Starbeck on the busy A59 road from Harrogate to Knaresborough and causes road congestion. As a result the Working Timetable times services to coincide with each other at the crossing to minimise the impact on highway traffic. This has an impact on train frequency and timetable planning.

Knaresborough Station

- Platform length is 80 metres constraining the use of some unit types.

Knaresborough – York : Single track sections

- The line from Leeds to Knaresborough is double track throughout but then becomes single track between Knaresborough and York except for a further double track section between Cattal and Hammerton where services must currently cross.
- Constrains train frequency and Impacts on performance and punctuality, it is one of the worst performing sections of line on the Northern Rail Network.

York

- The Leeds – Harrogate – York Rail Line services have the dedicated use of Platform 8 and shares capacity on the East Coast Main Line with passenger and freight traffic between York and Skelton Junction.

The following are the other primary factors that determine capacity on the line:

Single Track Section

- This single track section of line between Knaresborough and York, constrains train frequency and has implications for performance and punctuality. This also constrains the ability to optimise the timetable and frequency.

Rolling Stock

- This is currently a mix of low powered diesel units (primarily class 142/144 and 15x) and does not deliver a consistent product to the passenger.
- Virtually all trains are timed for the worst-performing train of the Northern Rail fleet, a class 142. These are underpowered and demonstrate poor levels of acceleration, especially on a steeply-graded route such as the Leeds – Harrogate – York Rail Line.

Line Speeds

- Line speeds on the route are not high, with a maximum of 65 mph on the route, and many instances of lower speeds. Between Leeds and Harrogate the maximum permissible speed does not exceed 60 mph which limits the ability to improve current journey times.
- Between Leeds and Harrogate the signalling has recently been modernised to permit 75mph operation in the future.

Access to the Line

- Existing car park capacity at stations constrains access to the rail services, and potential car parking space at stations is also likely to provide a future capacity constraint. Options for additional parking at Leeds station are also being investigated, and as part of development-led proposals in the City Centre, together with options for new stations.
- Proposals and enhancements for access by bus, walking and cycling as part of Local Land Use Plans and associated Transport Assessments are presently being developed in the vicinity of existing rail stations and, as part of the Harrogate Station Parade Development proposals for enhanced bus and rail interchange arrangements are being considered. This study addresses or works within the infrastructure constraints, however assumes modelled patronage is not constrained by access. Given the current car parking and access at many of the stations this is not the case, so stakeholders are investigating access to the line separately.

Information on the physical characteristics of the route for this study is taken from Network Rail's Rules of the Plan, and Sectional Appendix. Information on recent developments is taken from Network Rail's route plans and route specifications.

As part of this study, and in order to understand some of these constraints in greater detail, separate specific rail performance modelling and examination of the rail infrastructure assets has been undertaken in a parallel study by Tata. This will enable a more accurate assessment of works that may be required to deliver performance improvements, along with the capital cost of electrification, and is attached in Appendix D.

Desired Conditions

The scheme is supported by each stakeholder, and fits well with the local and national key objectives for rail in the north to:

- Support economic growth;
- Improve the quality of the railways;
- Make the railways more accountable; and
- Deliver a more efficient railway.

Conditional Output Specification

Linked to these higher-level objectives, and to maximise the connectivity and economic benefits that the line is capable of providing, the Leeds – Harrogate – York Rail Line Officers Group sets out the following outputs as a priority for the route (the full Conditional Output Specification is included at Appendix B):

- **Connectivity:**
  - Increased frequency with a target of 15 minute even-interval frequency Leeds – Harrogate. 30 minute frequency between Harrogate and York. Frequency includes Saturday and Sunday and evenings.
  - Improved journey times from Harrogate to Leeds and Harrogate to York with an in - train station to station journey time equivalent to 75% of off-peak car travel times.
  - Improved connectivity across the UK via Leeds and York especially to London, including direct services.
  - Extended hours of operation (mornings / evenings and particularly weekends).

- **Capacity:**
  - Sufficient capacity to meet continuing passenger demand growth.
  - To accommodate rising demand from local land use development / economic interventions planned along the line and how these plans are being phased.
  - Accommodate rising demand from other growth drivers, e.g. access to employment, education and health.
- **Performance:**
  - 92.5% of York – Harrogate services and 95% of Harrogate – Leeds should arrive within 5 minutes of planned time, and with aspirations for higher reliability where it can be delivered.

It is acknowledged by the Officers Group that these outputs are interlinked and will need to be delivered as a partnership of all stakeholders.

Views of Stakeholders

Throughout the Evidence Base and this Outline Business Case document, we have made it clear that the evidence collected is designed to be supportive of, and in line with WebTAG guidance and rail industry processes, and that we have had a clear focus on providing this evidence rather than discussions and aspirations. In understanding what the evidence base around transport in the City Region tells us, it is important to clearly distinguish between views which have been expressed through discussions with stakeholders, and empirical evidence that has emerged from the data review.

This is not because we question what stakeholders have said, far from it, but because we need to be clear where there is the quantified evidence to support these views and where there may be gaps in evidence. It may, in some cases, distinguish perceptions from real situations.

Indeed, it is of particular importance that the study fully reflects the views expressed by stakeholders in any previous recent consultation exercises across the region. These views and perspectives are important, as effective engagement with relevant stakeholders remains one of the main challenges. This is particularly because:

- those stakeholders often contribute their views to many consultations undertaken as part of other activities and processes over time (and therefore need to be consistent in their responses and how these are represented in subsequent studies); and
- they may be responsible for key approvals or decision regarding funding to take schemes forward (so need to fully understand the context of scheme proposals).

An Evidence Base Review has been undertaken to inform the study and this evidence has been obtained through the following:

- Stakeholder workshops to identify existing issues and opportunities;
- Review of existing policy;
- Review of the existing rail work studies already undertaken on the line (and in the wider sub region); and
- Review of potential land development in the vicinity of the Leeds – Harrogate – York Rail Line.

A list of stakeholders can be found as **Appendix C.**

Workshops were held on the 22nd March and 9th April 2013 in Harrogate, independently facilitated by WSP, at which the initial study results were presented and views sought on the existing issues associated with the Leeds - Harrogate - York Rail Line in addition to identifying potential opportunities for implementation on the line.

A SharePoint area was also set-up, and this was used by all stakeholders to assess and review a number of other supporting evidence for assessment and inclusion in the Business Case. Access to this can also be provided to the DfT on request, although we have sought to summarise the key components within the supporting Evidence Base document.

This process allowed agreement to be reached on the preferred and most effective package of measures to be taken through the appraisal process.

Policy Review

The primary policy documents for the partner authorities are the **Local Transport Plans 2011**. There are three relevant Local Transport Plans (LTPs) within the Leeds City Region - West Yorkshire, North Yorkshire and York. Each of the LTPs are fundamental in ensuring that local transport issues are addressed through a framework for which decisions on future investment should be made. Each of the plans:

- Sets objectives for transport to support wider goals and ambitions;
- Establishes policies to help achieve these objectives; and
- Contains delivery vehicles for implementing these policies.

The overarching vision set out in each of the three plans are broadly similar, with each focused on the provision of a fully integrated and efficiently operated transport network that supports the economy, the environment and people's quality of life. All three of the LTP's recognise that there will be significant growth in population levels, jobs and housing in West and North Yorkshire and York over the next 15-20 years, consequently increasing pressures on the transport network.

Leeds is the most significant commuting destination and a main business centre for the Leeds - Harrogate - York Rail Line, particularly for high-level financial and business services, creative industries and public administrative functions. The other main settlements in the City Region are also important economic locations in their own right and are significant commuting destinations. Whilst they have important linkages to Leeds, they also have their own economic specialisms and assets. Each of the urban centres within the City Region draws labour from a strong local catchment. Leeds, Bradford, and York are each net importers of labour. Leeds draws labour from across the whole City Region.

Former land use plans previously identified the need for over 14,000 net additional homes per annum in the City Region between 2008 and 2026, equating to over 250,000 new homes. Almost one-third of these new homes will be located within the Leeds District, although York has also been identified as an increasingly important area of housing growth alongside other areas such as Bradford, Kirklees and Wakefield. The delivery of these housing targets is now being taken forward through the Local Development Framework in each Local Planning Authority.

In Harrogate district, the economy is estimated to value £2.7bn in 2013; over a quarter of the North Yorkshire economy. The economy grew by approx. 8% in the last 10 years, slightly outpacing national growth, although it has not yet recovered to its pre-recession level. The Professional Services sector contributes the most to the economy outside of the public sector, though the Telecommunications and health sectors are the fastest growing. Harrogate boasts an internationally recognised conference and exhibition centre which generates approximately £180 million of economic impact per annum in the District[2].

The district has the highest new business registration rate in North Yorkshire, with 60 new businesses per 10,000 residents aged 16+ established each year, compared to 48 for North Yorkshire as a whole.

The City Region faces substantial population and housing growth pressures.

[2] Harrogate Borough Council Strategic Action Plan (2012-2015)

Securing targeted improvements in transport and connectivity has been deemed as vital to realising the ambitions for the future prosperity, cohesion and sustainability of the Leeds City Region. The transport programme specifically includes new protocols for working with national agencies such as Network Rail and the Highways Agency, establishing long-term funding agreements, and the devolution of major scheme appraisal to the local level for investments under £25million.

By 2021, the Region will aim to have developed and delivered an integrated, reliable and high quality public transport system, contributing to the delivery of the policy outcomes set out in the regions transport strategies.

Published in 2009, **The Leeds City Region's Transport Strategy** builds on the policy framework provided in earlier evidence based strategies and promotes investment in transport networks to strengthen the City Region's economic competitiveness, and to contribute to achieving the nation's carbon reduction targets. Key transport challenges facing the City Region have been identified as severe congestion and overcrowding facing many links in the road and rail networks, increasing commuting trips and distances, many overcrowded rail services at peak periods, declining bus use and reductions in bus networks, and the additional pressures that will ultimately result from planned housing and employment growth.

Priority themes for the Leeds City Region Transport Strategy include:

- Reducing carbon emissions and improving energy resilience;
- Improving strategic connectivity to tackle congestion;
- Developing a strategic framework for demand management; and
- More effective land use policy/transport integration.

The Transport Strategy identifies the continued growth and expansion of the City Region as being a primary reason for an increased level of pressure on the transport network. Particular focus is placed on the impact that considerable patronage growth is having on the rail network.

Although it is acknowledged that rail across the City Region generally offers competitive journey times for trips to the main urban centres in comparison to other modes, there is an acceptance that rail patronage growth has inevitably resulted in service quality issues on some routes as a result of overcrowding affecting several locations during peak travel periods.

Literature Review

A number of previous studies have been conducted on the line - the key consultations and results of which are summarised below. This is not an exhaustive list but it covers all the material considerations impacting on improvements to the line, and particular attention is drawn to the examination of options for service enhancement and infrastructure investments.

RailPlan 7: Half Hourly Frequency Tests:

This study showed that with:

Current diesel stock; and

No journey time benefits;

A doubling in frequency of the service would require an extra £3.3m in subsidy a year and would generate an economic BCR of 3.1:1. No allowance was assumed for any capital costs (infrastructure enhancements) in this analysis.

Leeds – Harrogate – York Rail Line Electrification Study

This study showed the journey time benefits that could be delivered with electric rolling stock. Based on the current service pattern it demonstrated an economic BCR of 1.5:1. This calculation is on the basis of electrification not costing more than £1m per single track kilometre.

The report notes that an enhanced service frequency would show a better case because of the operating cost savings of electric trains when compared to diesel trains. It is shown that partial electrification of the route (e.g. Leeds – Knaresborough) would produce operating inefficiencies. Analysis of potential journey time savings shows that an electric unit class 360 – of very similar performance characteristics to the class 333s operating on the Wharfedale line – would deliver a 6 minute journey time saving between Leeds and York.

Northern Route Utilisation Strategy (RUS)

The Route Utilisation Strategy (RUS) covering the north of England noted that 4-car trains would be needed on peak-hour trains by 2020.

Network Rail's Route Specification for the North of England

Several pages are dedicated to the Leeds – Harrogate – York Rail Line. The CP4 (2009-2014) signalling investment is quoted as permitting (from December 2013), shuttles from Horsforth to Leeds, subject to rolling stock availability. No investment is committed for CP5 (2014-2019), save that mention is made of the potential for new stations. The 10 and 30-year horizon do not see any significant changes to the infrastructure (line speed, electrification).

Leeds – Harrogate – York Rail Line Strategy – alternative technologies

Plans have been outlined in recent years for the use of redundant London Underground rolling stock on a third-rail electrified Leeds – Harrogate – York Rail Line, operating to a much higher frequency. The principal drawback highlighted has been that the line would in effect be isolated from the rest of the network, and operational inefficiencies would be created.

Current Performance

This report, only available in draft form at the time of writing this document, illustrates that performance (punctuality) on the Leeds – Harrogate – York Rail Line is poor in comparison with much of the rest of the Northern Rail network. 85% - 88% of trains arrive on time. Northern Rail report punctuality on Leeds - Knaresborough at 95% PPM MAA[3] and Leeds – York (accounting for the single track sections between Knaresborough and York) at 86.88%, making combined performance close to 91%. The reasons cited include the single track sections to the east of Knaresborough and the constrained approach to York, where the Leeds – Harrogate – York Rail Line trains work on the East Coast Main Line.

In addition, Fleet delays, Low Adhesion (autumn), Track Faults, Station delays and Train crew causes were the top 5 delays on the Harrogate line over 12 months Apr 11 - Mar 12.

Network Rail's Plans

As part of the stakeholder engagement, a discussion with the Network Rail Programme Commercial Manager highlighted the current work being undertaken, or planned, by Network Rail. These also provide an opportunity for programming of additional electrification and upgrades on the route, and include plans developed for:

Renewals

During CP5 (2014-2019), the Leeds - Harrogate - York Rail Line between Harrogate and York is to be re-signalled, with the introduction of upgraded equipment to replace the current semaphore signals and token block working. This provides an ideal opportunity to undertake other infrastructure interventions to support capacity and performance outputs highlighted in the Business Case. The level crossings on the route are also being renewed with automatic barriers. Very minor track renewal is planned for the route; and

Leeds: Capacity Enhancements

The capacity of the lower-numbered platforms (1-5) used by Harrogate line trains. Growth on the Ilkley and Skipton routes is such that frequency improvements and longer trains are likely to be needed by CP6 (2019-2024) constraining the capacity in these platforms and on approach lines A and B. The opening of Kirkstall Forge and Apperley Bridge stations will impose additional constraints on the timetable operation of these lines.

[3] The Network Rail Public Performance Measure (PPM) shows the percentage of trains which arrive at their destination on time. MAA is the Moving Annual Average.

The construction of a new platform 0 and associated crossings immediately to the west of existing platforms is believed by Network Rail to be possible, but may not be easy to deliver. In terms of this study, a view will be necessary on the phasing of such improvements; although it appears unlikely that rolling stock synergies may be possible given other services using these platforms will be 6-car EMU's in the future.

£15m - £20m provides a longer Platform 3 at Leeds (GRIP2 estimate) enabling longer trains to access Leeds from Skipton and Ilkley and longer and more trains to access Leeds from Horsforth. This includes remodelling the approaches to Leeds station on the A and B lines, which has synergy with the Harrogate proposals.

Line of Route

The single track sections between Knaresborough and York imposes a constraint on train pathing and on performance. A performance simulation exercise has been carried out as part of this study, to reach an initial view on what infrastructure will need reinstating to permit a doubling of the frequency, but it can be assumed that some of the single track sections on the Harrogate-York section would, at a minimum, be involved. An indicative GRIP0 estimate from Network Rail indicates £12m for track doubling for circa 2-3 miles towards Hopperton Grange.

Line Speeds

It is reported in the modelling and appraisal results section later in this report (and in the Tata Report at Appendix D) that the operation of a high-powered EMU (e.g. Class 365) would permit, without line speed improvements, a reduction in journey time by 8 minutes. It is also noted that the signalling enhancements between Leeds and Harrogate are such as to permit operation at 75mph. Taken together; such an improvement is able to deliver a 15 minute end-to-end journey time saving. Raising the linespeed above 75mph (e.g. to 90mph has little further benefit as a result of the combination of distance between stations and gradient).

An in depth engineering study would be necessary in order to reach a firm view on the feasibility and cost of linespeed improvements to raise the Permanent Speed Restrictions (PSR) along the route. Trackwork (enhanced tamping and possibly some slewing), combined with embankment and structure reinforcements, may also be necessary to permit operation at a higher speed. The achievement of the revised timetable would also require additional sections of double track, because of the revised passing point of trains between Harrogate and York.

In terms of costs for enhancement work, notional figures are £800 per metre of trackwork, £200,000 for every signal and £0.5m for each switch and crossing.

York: Capacity Enhancements

A constraint at York Station is the movement off the Leeds – Harrogate – York Rail Line into the main station via Skelton Junction, the East Coast Main Line and Platform 8 at York. A scheme has been identified for the reinstatement of the avoiding lines for passenger services, and running the Harrogate trains along them, and passive provision made within existing development and signalling in the area. The trains would then arrive in York from the south, possibly terminating at a new platform 12 (where the existing signalling centre is). There is an indicative cost for this work of circa £15m - £20m for a new passenger platform at York.

These works accommodate passenger growth on the East Coast Mail Line and Trans Pennine corridors and provide synergies and performance benefits for all operators by removing conflicting movements at Skelton Junction one of the main constraints on the Harrogate line and in terms of timetabling on the north approaches to York station.

Key Local Challenges for Transport

Each of the relevant Local Transport Plans (LTPs) and the City Region Transport Strategy identify key local challenges that impact on the realisation of overarching vision and objectives. These are summarised below:

Essentially local challenges result from demographics, domestic journey generators, and from journeys generated by the region as a destination and how these impact on the highway network.

Challenge: Traffic

- **Improved Connectivity and Journey Time Reliability**

Addressing existing traffic and congestion and mitigating future demands, has been identified as a significant issue. Each of the LTP's are focused on significantly improving connectivity and journey time reliability between and within towns and cities

Challenge: Demographics

- **Improving access to all and providing greater equality of opportunity**

The populations of Leeds, Harrogate and York have continued to grow, increasing 7% from the 2001 to 2011 census periods, mainly as a result of increased migration from other regions (particularly from the South East and London) and from beyond the UK.

Projections forecast that the population could grow by a further almost 9% to over 2.8 million by 2021.

The profile of the population stays reasonably static across age groups, apart from a notable percentage shift at the older end of the profile from the 45-64 age bracket into the 65+ bracket, reflecting an ageing population. This places a greater strain on the transport network as it has to accommodate the movement of an increased number of people with changing needs, particularly relating to mobility.

- **Increases in Housing Stock**

An increasing population and changes in household structure and size inevitably results in an increase in the number of required households. A significant proportion of this future housing growth is located in Leeds and Harrogate and this will place further pressures on the already overcrowded transport network. The indicative housing allocations to 2026 across Leeds, Harrogate and York will see a land allocation for an additional 5,540 houses per annum being built of which 35% will be within 3km of a station on the line.

- **Domestic Journey Generators**

Effective access to the major employment centres. These problems will be exacerbated by simultaneous job growth, which have been projected for Leeds, Harrogate and York with Leeds the key driver of increased demand and York and Harrogate providing lower levels of growth.

- **Education**

Leeds, Harrogate and York all support an active education sector, with a number of well-regarded establishments, drawing students and staff from a wide catchment (some internationally). The Harrogate rail line plays an important role in the transportation of students of all ages.

The University of Leeds and Leeds Metropolitan University alongside a number of other Further and Higher Education establishments such as the Leeds College of Building have a combined Leeds student population which is one of the largest in the country at almost 250,000.

York University is highly regarded, being placed amongst the Top 10 in the UK in The Times education review and with a significant student population of around 50,000.

In addition Harrogate is home to the Army Foundation College where 500 staff are deployed and 1300 recruits are based and trained for periods of up to 50 weeks, and Harrogate College (part of the Hull College Group) is situated adjacent to the station at Hornbeam Park.

- **Tourism and Leisure**

Leeds, York and Harrogate form a triangle of venues that capture a number of major international visitor, business, and leisure attractions, including Headingley Carnegie Stadium, Cricket Ground, York Race Course and the Harrogate International Centre. The historic nature of Harrogate and York, coupled with the retail, sporting and city attractions in Leeds provide an ideal mix to draw in both national and international visitors.

This combination of year round and seasonal visitor attractions together with events venues places the twin challenges of managing demand generated by the increase from visitors, and catering for large spikes in demand on event days.

Electrification

Tata Steel Projects were commissioned by WSP Ltd to undertake a feasibility study to define the requirements for the Electrification of the Leeds – Harrogate – York Rail Line between Armley Junction, Leeds and Skelton Junction near York to identify the costs and challenges associated with delivering electrification and to inform the wider business case for the upgrade of the line. The work by Tata considered the over line structures, electrification and power requirements needed to deliver electrification.

In addition to this Tata have completed a rail operations modelling report to consider the train capability for a proposed new timetable developed by WSP as part of the scenario development stage, which is referred to elsewhere in this report. Electrification is necessary to meet the required performance improvements.

Tata Steel Projects have applied the Network Rail National Gauging Database (NGD) to analyse the impact of electrification to the bridges and structures passing over the railway, in order to understand the enhancement works required to achieve clearance for over-head line electrification. ClearRoute was used to assess the electrical clearances at each structure. No electrification system has been decided for the route; therefore an electrical clearance gauge for use within ClearRoute has been based upon current standards and parameters and is consistent with the profile developed for the current Trans-Pennine Electrification project.

Table 1: Breakdown of Cost Estimates

Cost Element	Amount
Overhead Line Equipment (OLE) -	£29,689, 114
Power supplies -	£9,500,000
Track (Lowers, slews, etc.)	£2,604,000
Structures	£19,147,000
Property (Station alterations)	£2,475,000
Telecoms	£2,614,517
Signalling, Crossings & Civils	£868,391
Contractors Base Construction Cost	**£66,898,022**
PLUS	
Network Rail Direct Costs (Possessions, Isolations, Engineering Trains, etc.)	£1,337,960
Contractors Indirect Costs	
Preliminaries	£9,737,862
Design	£4,969,439
Testing & Commissioning	£663,847
Total Construction Cost	**£84,630,670**
PLUS	
Network Rail Indirect Costs	
Network Rail Project Management	£5,924,147
Sponsor	£846,307
Compensation Charges	£1,692,613
Land / Property Costs	£253,892
Total Estimate	**£93,347,629**

The cost estimates have been built up using priced Bill of Quantities with percentage mark-ups for preliminaries, design, T&C etc. to arrive at a total construction cost. This feeds into Network Rail's standard estimate summary sheet where further items (e.g. risk and escalation) are added as required. A check to ensure 'double counting' of cost elements within the Business Case has been carried out by WSP as costs are treated differently in different processes (the Business Case, when compared to the construction cost estimates).

Direct costs are those associated with the direct purchase or delivery of the relevant asset identified (e.g. Track or Power Supplies). Indirect costs are those associated with getting the project to the delivery stage including design fees, project management and at this stage are based on a percentage of the direct cost estimates, in line with standard Network Rail estimation methodology.

Key items have been measured to produce an Order of Magnitude estimate with a level of confidence ±50%. With the exception of structures which are detailed below, items have been priced based on rates obtained for other electrification schemes, including the Trans-Pennine Electrification Project.

Costs for achieving Overhead Line Equipment (OLE) clearances at structures have been priced on a structure by structure basis, using information obtained from the Structures Workshop. These have been priced using 'Elemest', which is an in house estimating tool where key variables are entered (e.g. bridge width and span) to provide a high-level realistic cost.

The estimates provided by Tata, summarised below and shown in detail in **Appendix D,** contain a full list of assumptions and exclusions, but listed below are the key assumptions used in the preparation of the estimate:

- The estimate has been priced to 3rd Quarter 2013;
- The full construction estimate includes a risk mark-up of 40% (which is excluded for this stage of appraisal);
- The full construction estimate excludes Optimism Bias (which is added during the appraisal process);
- Contractors and Network Rail Indirect Costs are calculated using a fixed percentage of the construction costs at Preliminary, Design and Test/Commissioning Stage.
- It has been assumed that the works will be undertaken by Network Rail as part of the Trans-Pennine Electrification Project (TPE) project. As such addition costs for undertaking the works as a "3rd party" project have not been added into the estimate;
- It has been assumed that level crossings already conform to current standards. Allowance has only been made for additional signs warning of OLE;
- No allowance has been made for signalling immunisation costs (Assumes recently re-signalled sections are compliant and that the semaphore areas will not be significantly affected or will be replaced before or alongside electrification); and
- No allowance has been made for double tracking the single sections of line (this is outside the immediate scope of this study).

Figure 5: Illustration of overhead rail electrification catenary

Rail Service Scenarios Tested

Using the objectives set out in the Conditional Output Specification (COS), and detailed in the previous section, a number of scenarios were developed for consideration as part of this study.

Further details of all options appraised are provided in Appendix A, but are also summarised in terms of key differences in this section. All options were outlined, considered and then reviewed at a key stakeholder workshop on 9th April 2013 which was based on the outline optioneering and sifting process, advocated in WebTAG (Unit 2.1).

This was undertaken in terms of comparative and standardised use of MOIRA rail timetable software for each of the options below; and options were sifted in terms of demand, revenue and operational costs. The scenario that performed most favourably in overall Cost : Revenue terms was taken forward for further and fuller appraisal, based on the fact the deliverability and financial optimisation of the preferred scenario is the overarching and shared objective across all stakeholders.

Work was also undertaken to optimise weekend and evening service provision, from a revenue and cost point of view.

Preferred Scenario

Following the high level financial and operational sifting across over 10 different options the following scenarios have been appraised in greater detail as part of this Business Case:

Preferred Scenario (Scenario 5)

- 15 minute journey time reduction. The journey time reduction is 7/8 minutes either side of Harrogate, as per RailSys modelling.
- 4 trains per hour Leeds – Harrogate, of which 2 continue to York, all stations between 0600 and 2000.
- 2 trains per hour Leeds – Harrogate, of which 1 continues to York, all stations from 2000 to 0030 and at weekends to optimise service efficiency.
- Departures at 0520 Harrogate – Leeds and 0515 Harrogate – York to connect with the London trains from Leeds and York.
- In the morning and evening peaks, one of the Harrogate trains is extended to and from Knaresborough.
- Based on December 2013 timetable on all other services at York and Leeds and including the direct Harrogate – London service.

Scenario 5 – This scenario assumes the introduction of electric multiple units enabling a more efficient service timetable to be introduced. There is synergy with additional benefits of Cross Pennine Electrification and East Coast Main Line (ECML) enhancements (although these are excluded from the MOIRA modelling as timetabling remains uncertain, and to ensure consistency with the Do Nothing scenario).

A further 5 variants of these scenarios were also tested, and as reported in Appendix A, meaning that over 10 different options were appraised in reaching this conclusion.

Do Nothing – Retain current levels of service provision. Additional benefits of Cross Pennine Electrification and ECML enhancements are not presently incorporated into MOIRA given uncertainty, and representing a conservative forecasting assumption as to the benefits of the upgrade to the Leeds – Harrogate – York line. It is also worth noting that the Do Nothing becomes increasingly expensive to operate over time; as fuel and DMU costs are expected to increase over and above those associated with high-powered EMU's.

This is demonstrated in the results shown in Table A1 of Appendix A, and which shows the poor Revenue : Cost performance of enhanced DMU options on the line, and the contribution the scheme detailed in Preferred Scenario 5 makes towards a more operationally efficient rail network.

The Strategic Case

Introduction

This element of the business case identifies the need for any form of investment, either now or in the future, and therefore identifies the business need for a project. This chapter follows the format of the DfT's guidance document contained within the 'Five Cases', and appraises the following key indicators:

- Business Strategy;
- Problem Identified (as fully detailed in the supporting Evidence Base document);
- Impact of not changing;
- Objectives / Measures for success;
- Scope;
- Constraints;
- Inter-dependencies;
- Stakeholders; and
- Options.

Business Strategy

The scheme is being jointly promoted by North Yorkshire County Council, METRO (West Yorkshire PTE), Harrogate Borough Council and City of York Council, and aims to provide increased connectivity through increased frequency, improved journey times, improved connectivity across the UK and extended hours of operation.

The stakeholders also aim to increase capacity to accommodate continuing passenger growth, drive mode shift and promote carbon savings in line with LTP (and national objectives).

The scheme is also pivotal in helping to support strategic and local land use development and economic interventions planned along the line, and to accommodate rising demand for access to employment, tourism, education and healthcare facilities in addition to improving the performance of the line in terms of service reliability. This is particularly important given high levels of development viability in areas served by the line, and typically high levels of delay per mile in terms of road-based congestion. Indeed the Leeds-Bradford conurbation is the most congested conurbation in the UK on a delay per mile basis[4].

Increasing the capacity of the line will offer opportunity for rail services to accommodate an increased number of passengers with associated revenue, with the service capacity increase able to support economic development along the rail line corridor, and which is the key driver behind the West Yorkshire Rail Network Study, and wider CP5 (2014-2019) Network Rail plans, such as the Northern Hub.

Problem Identified

The Leeds - Harrogate - York Rail Line is currently served by relatively low power Class 142/144/15x diesel multiple units. These are inefficient when compared with more modern electric rolling stock both in terms of operational costs and journey times with improved acceleration provided by the more powerful electric units.

Their performance places a limit on the degree to which journey times and frequency uplifts can be improved, and thus demand, connectivity and business impacts are all constrained. They also provide a lack of consistency of product for passengers, based on mixed unit provision; between services and across the week.

[4] Tom Tom Quarterly Congestion Index – October 2012) 28 per cent of Bradford-Leeds roads are regularly congested, slightly more than London with 27 per cent and Birmingham with 21 per cent).

Given the high degree of national and longer distance travel compared to other lines (12% of travel is to/from London alone); these impacts are not just regional, but also national and international. The visitor and business attractiveness of York, Harrogate and Leeds, especially for events and conferences also promote significant movements to and from Manchester and Heathrow Airports as well.

Improvements are therefore essential to enhance and sustain national connectivity compared to surrounding areas (such as Manchester), and to ensure continued prosperity to leisure, tourism and conference trades and reduce congestion within historic towns in Harrogate and Knaresborough in particular.

Demand for the existing services has increased in recent years due to localised growth from the expansion of residential areas, and visitor attractions. The Leeds – Harrogate – York Rail Line is currently operating close to capacity in the morning and afternoon peak periods as demonstrated by data presented within the Leeds City Region Transport Strategy (November 2009) which is summarised in Table 3 and more recent Automatic Passenger Counting (APC) data from Northern Rail.

This is also backed up by reports and observations from stakeholders, and more recent studies, which forecast growth on the line of close to 3% a year (despite fare rises). This is as evidenced in the Yorkshire Rail Network Study (2011) for the line.

Table 2: Harrogate Rail Line Peak Period Patronage

Line	Total Passengers	Seated Capacity	Seated Load Capacity	DfT Load Factor
Harrogate	1,777	1,571	113%	102%

The lack of peak period connectivity by rail to key economic and employment centres, both on trains and because of limited station car park capacity, could result in any future developments which are located in the vicinity of the rail line being car dependant, as opposed to making use of existing rail services, and therefore contributing to congestion issues in the area.

The majority of stations on the line are small, unstaffed rail halts which have limited facilities provided for waiting passengers. There are also issues with regard to the accessibility of the majority of stations for mobility impaired passengers and limited parking is provided at all stations on the route except Harrogate, Hornbeam Park and Horsforth rail stations, placing further constraints on passenger growth.

Reduced reliability and performance is experienced on the Harrogate – York section due in part to crossing the ECML at Skelton Junction and from single line and token signalled sections east of Knaresborough.

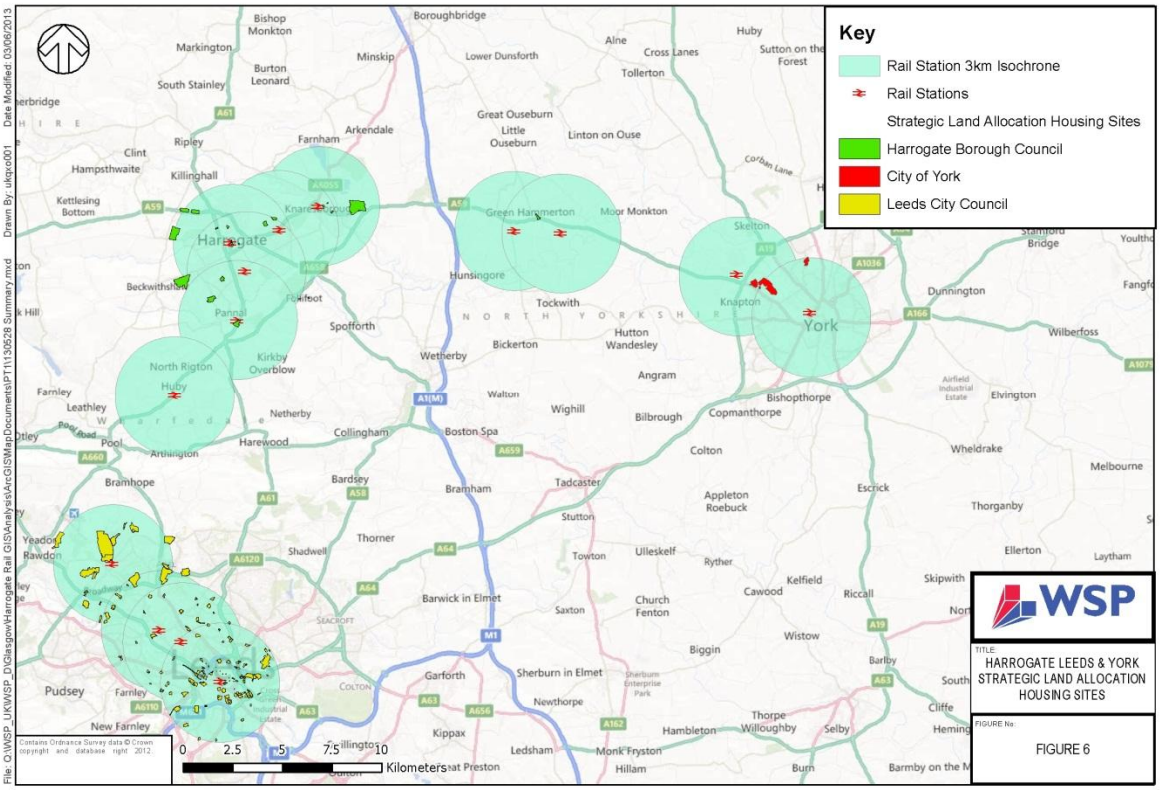
It is expected that train lengthening and the introduction of the Horsforth Shuttle services will provide sufficient capacity for short term requirements in terms of capacity, but these and any existing Network Rail plans do not impact upon the connectivity issue, and remain unresolved without the proposed electrification scheme.

This remains a key part of both Local and Leeds City Region Transport Strategies, with connectivity between Leeds, Harrogate and York also identified as important to both City Region and wider UK connectivity.

Impact of Not Changing

Earlier this report summarises the anticipated growth in terms of housing stock and employment. in the three local authority areas through which the Leeds - Harrogate - York Rail Line passes. These figures are currently being revised as part of the on-going review of the Local Land Use Plans.

Figure 6: GIS Mapping of Future Land Allocations across the Route



As can be seen from the above, the majority of growth in housing stock and jobs is anticipated to be focused in and around Leeds although there is also a significant annual growth forecast within the urban centres of York and Harrogate.

The Leeds - Harrogate - York Rail Line connects the three areas providing residents with access to employment opportunities using a sustainable mode of travel in preference to the private car, and the Harrogate Local Land Use Plan includes significant improvement to rail services between Harrogate, Knaresborough and York in its vision.

Electrification would enable the rail line capacity to be increased. The introduction of electric rolling stock which has greater power enables greater increased passenger capacity and a step change in customer experience. This would also enable greater flexibility in introducing timetable alterations, and directly support the overarching objectives of connectivity, economic growth and performance improvements.

The infrastructure along the line, although the subject of some improvement to date, presents a constraint and if changes are not made, an uplift in the level of service cannot be achieved. Supporting changes in infrastructure in the form of double tracking and signalling upgrades would also release some of the significant constraints on the line to allow a more flexible operation, with higher line speeds and greater resilience (improving performance and reliability). Synergies exist between the changes required, and implementing upgrades together can lead to significant cost savings, and reduced disruption.

The Impact of Not Changing:

Without the scheme, there will be lower connectivity, lower levels of economic growth and productivity, fewer developments and regeneration sites being brought forward, together with a poorer rail experience, higher road congestion and crowding levels. These will be combined with higher operating costs of the existing diesel units, and a constrained ability to take advantage of the UK marketplace for regional commerce and trade.

The Government are encouraging Local Authorities to exploit the benefits of HS2, the line connects with HS2 at York and Leeds and the full economic benefits of HS2 would not be realised if there was no change.

The scheme also works in parallel with the Harrogate Borough Council Station Parade Development proposals, creating enhanced interchange between bus services and an improved rail service to further enhance the amenity and passenger interchange benefits in term of access and egress to the upgraded line.

This is also the same at the Leeds station with regards to the committed Leeds Southern Station Access, Cross Pennine Electrification, and East Coast Main Line enhancements, along with medium-term plans for additional platform capacity at Leeds, and development-led proposals for additional capacity at York station.

Each of these factors creates the optimal conditions and timeframe for improvements to the Harrogate line, and to drive further effectiveness and value for money of the proposals.

Objectives / Measures for Success

The Leeds - Harrogate - York Rail Line Officers Group sets out the following as a priority for the route, and which are based on, and aligned with both LTP objectives for success, and national policy.

- **Connectivity –** increased service frequency, journey time, connectivity and extended hours of service operation- to enhance regional and national economic growth, enhanced local productivity and agglomeration, and local quality of life benefits in line with the LTP;
- **Capacity** – provide sufficient capacity to meet rising passenger demand, to support connectivity, and national carbon emissions targets; and
- **Performance** – target rail services operating within 5 minutes of timetable, to support an enhanced service, encourage mode shift and reduce congestion (both locally and for longer distance trips).

The following objectives have been developed to target the above priorities:

- Objective 1 – Increase service frequency between Leeds and York to enhance local and national connectivity;
- Objective 2 – Improve journey times between Leeds and York to promote local and national economic benefits, before and after HS2;
- Objective 3 – Extend service hours between Leeds and York to enhance business day-trips to London, and the weekend/ emerging night time economies;
- Objective 4 – Provide additional capacity to facilitate development growth on the Leeds - Harrogate - York Rail Line corridor, to meet local growth aspirations, and fulfil National Planning Policy Framework (NPPF) requirements;
- Objective 5 – Improve service reliability between Leeds and York, to support reduction in local road congestion, and each of the other inter-linked objectives below;
- Objective 6 – Encourage a mode shift from private car to rail, to support local road decongestion, and bring wider benefits to safety, carbon, and transport efficiency;
- Objective 7 – Reduce levels of congestion in Leeds, Harrogate and York;
- Objective 8 – Upgrades should be financially sustainable, to promote savings and value for money objectives to Government; and
- Objective 9 – Reduce carbon emissions- in line with local and National targets and commitments.

All of the above objectives can be aligned to the implementation of improvements to the Leeds - Harrogate - York Rail Line. The above objectives can be made Specific, Measurable, Achievable, Realistic and Time-bound (SMART) as part of the next stage of the study.

Importantly, each of these benefits is not specifically local, and represents a means of contributing to locally orientated objectives as well as national objectives and policy.

Options

Following the initial appraisal of a long list of scenarios, the following scenarios have been selected for further appraisal:

- Do Nothing – Retain current levels of service provision;
- Scenario 5 – Increased service frequency with the timetable enhancements introduced over a greater portion of the day with 4 trains per hour provided between Leeds and Harrogate.

In accordance with DfT guidance, the above scenarios have been appraised against the following key policy objectives in addition to the nine study objectives:

- Key Policy Objective 1 – Improve accessibility and increase the use of public transport[5]; and
- Key Policy Objective 2 – Improve connectivity and journey time reliability between towns[6].

The results of the appraisal is summarised in Table 3.

Table 3: Appraisal against objectives

Scenario	Key Policy Objectives		Study Objectives								
	1 - Improve Accessibility & Increase PT Use	2 – Improve Connectivity and Journey Time Reliability	1	2	3	4	5	6	7	8	9
Do Nothing	x	x	x	x	x	x	x	x	x	x	x
Scenario 5	√	√	√	√	√	√	√	√	√	√	√

As can be seen from the above, the 'Do Nothing' scenario does not contribute towards the policy objectives as no action would be taken, and little change could be achieved, whereas Scenario 5 generates positive scores against all.

There are however, risks associated with the delivery of the preferred scenario in addition to the 'Do Nothing' scenario and these are summarised below:

- Do Nothing:
  - Could have an impact on the level of development which is planned to be located in the vicinity of the corridor and as part of Local Land Use Plans;

[5] The Yorkshire and Humber Plan (including RTS)

[6] Local Transport Plans which are in place across the region

- Could encourage greater use of the private car and therefore increase levels of congestion on the local road network; and
- Has increasing costs of operation over-time, based on continued use of DMUs.

- Scenario 5:
  - Risk that service improvements do not generate the forecast number of additional passengers;
  - Timescales over which the area becomes developed would have an impact on how quickly the improved service becomes self-financing; and
  - Whilst an outline desktop cost and feasibility study has been completed, a detailed engineering study including onsite lineside and engineering inspections has yet to be undertaken to confirm the feasibility of electrifying the rail line.

Inter-dependencies

The implementation of improvements on the Leeds - Harrogate - York Rail Line is dependent on a number of factors which are outside the scope of this study. These include the following:

- It has been assumed that the improvements will be operational by 2019 to take full advantage of other planned rail projects and provide value for money solutions, although it is not possible to confirm at this stage;
- There may be a requirement to introduce a new platform at Leeds rail station that would benefit a range of services, and this requirement has yet to be investigated;
- Additional analysis will be required to confirm that the proposed timetable alterations can be implemented;
- ECML connectivity and signalling renewals between Harrogate to York;
- Suitable rolling stock becoming available; and
- Access: it is assumed that modelled patronage is not constrained by access at stations.

Our assumptions are that the high-powered EMUs will be cascaded, and we also recognise the need to consider seating to standing ratio on the basis of the travel times for the majority of users, and local demand forecast to maximise this opportunity.

Stakeholders

The following groups are key stakeholders supporting the delivery of improvements to the Leeds - Harrogate - York Rail Line:

- North Yorkshire County Council;
- METRO (West Yorkshire PTE);
- Harrogate Borough Council; and
- City of York Council.

The rail line passes through the above local authority areas; all are keen to improve connectivity across the area, and in particular to improve access to the employment centres of Leeds, Harrogate and York

The improvement of the rail line is also anticipated to stimulate sustainable growth along its corridor, with critical importance of linking to London, via both Leeds and the sub-regional economic centres of York and Harrogate. The introduction of quicker journey times, and earlier departing trains is crucial in ensuring enhanced viability to 'day business trips', and which HS2 analysis has already proven to be critical in terms of driving sustained, economic growth.

All stakeholders have been heavily involved with the project to date and have attended workshops which have been held to discuss the findings of the study to date and develop the various scenario options. In addition to the local authorities, the following stakeholders have been consulted at various stages of this study:

- Network Rail;
- Department for Transport;
- Harrogate Chamber of Trade and Commerce;
- East Coast; and,
- Northern Rail.

Summary of the Strategic Case

Significant growth is planned for the area through which the Leeds – Harrogate - York Line passes, and which exacerbates existing issues on the line. These can be grouped into five main areas:

- **Connectivity** – increased service frequency, journey time, connectivity and extended hours of service operation- to enhance regional and national economic growth, enhanced local productivity, agglomeration, and quality of life benefits in line with the LTP and national priorities;
- **Capacity** – provide sufficient capacity to meet rising passenger demand, to support connectivity, and national carbon emissions targets;
- **Performance** – target rail services operating within 5 minutes of timetable, to support an enhanced service, encourage mode shift and reduce decongestion (both locally and for longer distance trips);
- **Passenger Amenity** - Significant potential exists, given an enhanced electric operation and with updated rolling stock to significantly enhance demand on the line, drive reduced congestion and attract current non-rail users. Electrification with updated rolling stock on the Wharfedale and Airedale line demonstrates the size of the benefits that can be achieved in the local context, once committed; and
- **Unlocking Development & Future Proofing** – Connectivity in terms of HS2 providing economic connections through to both Leeds and York by upgrade of the line.

SMART objectives have been set as part of this study. The 'Do Nothing' scenario is forecast to not meet the majority of objectives whereas the preferred scenario is shown to meet all of the objectives, prior to further and more detailed appraisal.

A high level financial sifting appraisal has been undertaken using MOIRA and this has shown that Scenario 5 is the best performing scenario and this has been modelled in detail with the appraisal results detailed in the following chapter.

In terms of the strategic fit of the project, improvements to the Harrogate Line will:

- Increase service frequency between Leeds and York to enhance local and national connectivity;
- Improve journey times between Leeds and York to maximise local and national economic benefits, before and after HS2;
- Extend service hours between Leeds and York to enhance business day-trips to London, and the weekend/ night time economies;
- Provide additional capacity to facilitate development growth on the Leeds - Harrogate - York Rail Line corridor, to meet local growth aspirations and NPPF fulfilment;
- Improve service reliability between Leeds and York, to support local road decongestion;
- Encourage a mode shift from private car to rail, to support local road decongestion, and bring wider benefits to safety, carbon emissions, and transport efficiency;
- Reduce levels of congestion in Leeds, Harrogate and York;
- Upgrades should be financially sustainable and provide value for money, to maximise savings to Government; and
- Reduce carbon emissions - in line with local and National targets and commitments, and drive improvements to existing AQMA areas in Knaresborough.

Modelling and Appraisal Results

Introduction

The assessment has been undertaken in accordance with WebTAG Unit 3.13.1 (Guidance on Rail Appraisal), and the use of MOIRA for assessing future passenger demand and revenue change.

Local evidence, to support, or overlay with existing national data has also been used - in particular around considerations of journey lengths, local demand and trip making patterns, levels of background growth, and the economic impacts of upgrading the line - and each of which are consistent with the Yorkshire Rail Network Study (2011).

The following sections set out the methodology and assumptions used in the modelling process in addition to summarising the results of the appraisal. The analysis has been undertaken for Scenario 5 which the high level financial sifting identified as being the best performing scenario.

Modelling Assumptions

In accordance with the guidance, the following has been undertaken for the preferred scenario:

- An Analysis of all Monetised Costs and Benefits, including a BCR with and without the addition of Wider (economic) Impacts.
- The BCR is calculated as the total sum of benefits, divided by the total levels of cost (operating costs and capital costs), and is presented in 2010 values and prices, using a 60-year period required by guidance.
- The BCR is presented with and without Wider (economic) Impacts, so that the impact of these is clear, and given that these are to be separated out in line with appraisal guidance.
- Incorporation of RPI+1% Staff cost inflation, use of Department of Energy & Climate Change (DECC) central electricity price inflation forecasts, and allowing for on-going renewal costs, given the 60 year appraisal period, and to ensure all sources of cost and benefit are taken into account.

The appraisal has, in accordance with WebTAG guidance, appraised the scheme against options which meet the same objectives, and background demand growth has been capped at 20 years from present (2013).

All monetary values (except the value of time for non-work purposes) have been up-rated in line with WebTAG values in the present version of WebTAG Unit 3.5.6.

Risk and Optimism Bias (OB) has been calculated based on the following formula as specified in conjunction with Network Rail consultation, and is specified at 66% OB in relation to all levels of capital cost. This is applied in the WebTAG manner, consistent with Network Rail appraisals, which excludes the impact of any Quantified Risk Assessment work within the optimism bias levels applied.

Risk and optimism bias adjusted cost = (Base cost) * (1+Optimism bias)

The appraisal has used standard assumptions with regard to the assessment period which has been taken to be 60 years, and the standard Government discount rates which specify 3.5% for the first 30 years and 3.0% for the remainder of the appraisal period. Additional renewal costs beyond year 30 are also incorporated within the appraisal for consistency.

The impact on Wider Society (Present Value Benefits) has been determined using guidance based on Table 3 of Unit 3.13.1 which summarises the source of values and assumptions for rail appraisals.

The cost of car use has been estimated using guidance provided in WebTAG Unit 3.13.2 'Guidance on Rail Appraisal: External Costs of Car Use'. Diversion Rates based on WebTAG values have been used to identify the reduction in vehicle kilometres travelled as a result of drivers switching to the rail scheme, with DfT values used to implement a marginal external cost approach, and which allows monetary pence/km saved values to be obtained in a consistent manner for each of the following areas of scheme benefit:

- Carbon;
- Air Quality;
- Noise; and
- Infrastructure/ Maintenance Savings.

The appraisal also analyses the additional accident savings, using DfT Cost Benefit Analysis (COBA) accident rates, set against local safety values and probabilities for the Yorkshire and Humber Region (as per decongestion benefits), and also calculates the additional Vehicle Operating Cost (VOC) savings (and indirect taxation loses) to car users and government as a result of modal shift to rail.

Travel distances are based on demand-weighted outputs from MOIRA, to be the most accurate possible in this part of the appraisal, and diversion factors (inclusive of the impact of car passengers also transferring to rail) have been used to ensure consistency and alignment with other appraisals.

VAT implications of additional rail fare spend are also incorporated to ensure consistency against other national scheme appraisals, and in line with Network Rail best practice.

The impacts of loss of revenue to competing bus operators are also noted and calculated within the appraisal, and which are based upon METRO figures of a £1.79 average bus yield in the area- again, and like rail, due to the higher than average distance travelled within the scheme area.

Ramp-up of demand is also incorporated for the first years of the scheme, and so as to be conservative with regards to the benefits and as 100% of forecast demand is not likely to be achieved in year 1. These have been derived from local evidence on other, similar schemes, and applied as follows:

Figure 7 – Illustration of dynamics of demand ramp up

Dynamics of Demand	0.6	Yr1
	0.9	Yr2
	1	Yr3

Operating Costs

The operating costs for the rolling stock are calculated using:

- Network Rail values for Variable Track Access Charges and electricity supply costs; and
- Information provided by Rolling Stock Companies (ROSCOs) and train operators regarding lease and maintenance costs.

This information is not included within this report due to commercial confidentiality reasons, but can be made available to DfT on request, and to confirm the suitability of operating cost inputs. Inflation (to staff wages at RPI+1%, and electricity inflation in line with DECC forecasts) have both been incorporated.

To be conservative for purposes of appraisal, and ensure a consistency with other Network Rail studies, significant increases in diesel fuel costs have not been incorporated, although we recognise there is potential for this to occur when set against WebTAG fuel price assumptions), and which would otherwise enhance the overall value for money results obtained in this report were these to rise more rapidly. Similar journey ambience benefits have not been calculated, but it is recognised that these would also enhance the value for money of the scheme, if monetised.

It has been assumed, that Driver Only Operation (DOO) equipment would not be provided as part of the route upgrade, and that a guard would be required on each train as at present.[7] This has been factored into the staff costs element of the operating costs of the new trains.

In terms of the rolling stock types used throughout the rail performance process, three kinds of four-car units have been considered:

- Refurbished Electric Multiple Unit : costs based on Class 319 units;
- Cascaded High-specification Electric Multiple Unit : costs based on Class 365 units; and
- Cascaded Diesel Multiple Unit: costs based on Class 172 units.

Given the age profile of rolling stock currently in use on the Leeds - Harrogate - York Rail Line, it was assumed the cascaded DMU vehicles would replace the existing rolling stock as it becomes life-expired in the Do Nothing scenario (and given the opening year of 2019). This also accords with the year for compliance with Rail Vehicle Accessibility Regulations (RVAR) 2010.

For Scenario 5, a train performance analysis performed by Tata in RailSys indicated that older lower powered EMU rolling stock (e.g. Class 319) would not be able to deliver the 15 minute journey time improvements assumed in these scenarios. The cost-benefit analysis was therefore performed with the assumption that higher specification EMU rolling stock (e.g. Class 333 or 365) would be operating on the line, which are able to achieve the 15 minute end-to-end journey time reduction.

Value for money is reduced if lower specification EMU's are run on the line; primarily due to the 6-7 minutes less journey time benefit that is achievable against the same cost of electrification. Due to lower levels of performance, additional lengths of double track may also be required.

Class 333 EMUs were selected as the preferred option for the purposes of appraisal, as these already operate on the suburban services between Leeds, Bradford Forster Square, Skipton, and Ilkley. Acquiring similar rolling stock for the Leeds – Harrogate – York Rail Line services would also provide significant economies of scale for the operator.

Appraisal

The appraisal identifies that Scenario 5 is the best performing scenario and this has been appraised in detail with the appraisal results summarised in the following sections.

Based on the methodology set out within the previous section, the Capital Costs included for electrification at Table 1 are taken from the assessment of electrification set out in the work undertaken by Tata. Full details of the cost assumptions are included at **Appendix D**.

- Base Construction Cost - £68,235,983
- Total Construction including Design, Commissioning, Testing, Possessions, etc - £93,347,629

The Optimism Bias in the appraisal is factored to 66% to ensure that it both meets guidance at the present stage of analysis, and also allows direct comparisons against other Network Rail schemes, although at higher cost estimates we consider there are objective reasons for applying a value nearer 40%. Risk is excluded at this stage in the appraisal, also in accordance with WebTAG guidance.

The patronage data which has been used included Monday to Friday data although no data was available for weekend patronage. A conversion to full week revenue applied a 21% uplift to capture the weekend revenue, which is based on the difference between MOIRA revue factors between Monday to Friday and all-week services. Costs have also been uplifted by 21%, so that the additional services are also incorporated within the calculation of operating costs as well.

[7] Driver Only Operation (DOO) requires the installation of equipment which would enable the driver to ensure that the train doors are released and closed only when it is safe to do so. This could include mirrors at the end of each platform, or CCTV equipment in monitors based either on the platform or on board the unit. DOO is generally used in the UK on urban train services on routes which have ticket barriers installed on most stations (since there is no guard or conductor on board to check tickets). This solution was not deemed appropriate given the nature of the Harrogate line and station facilities.

As MOIRA is known to miss certain existing movements, several other uplift factors were applied to the output MOIRA data. These are shown in Figure 7, and include:

- Uplift to Capture Missed Ticket Sales – (based on Northern Rail and CENTRO reports into the issue);
- Uplift to Capture Non-MOIRA PTE Ticket Sales- (based on METRO evidence); and
- Option to switch between 'Trend' and 'Trend Plus' Scenarios within the appraisal (as output and determined from the Rail Industry Forecasting Framework (RIFF), from the Yorkshire Rail Network Study, undertaken in 2011).

Figure 8: Breakdown of patronage uplift calculations

Additional Sources of Passengers/ Revenue						
Conversion to Full Week Revenue	21%					
Exogeneous Growth						
Uplift To RiFF Trend Plus Scenario	11.16%	Apply	YES			
Uplift to Capture Missed Ticket Sales	5.50%	(London Midland- 3.3%- Birmingham/ Gated Stations, Northern Rail- Up to 13% at selected stations)				
Uplift to Capture Non-Moira PTE Ticket Sales (excluding above)	27.00%	(SDG- 29%- Centro Area Research; WSP- 25% SYPTE)				
2012- Annual Change	Value of Time Benefits	£10,353,098	Revenue	£4,045,595	Passengers	1,712,744

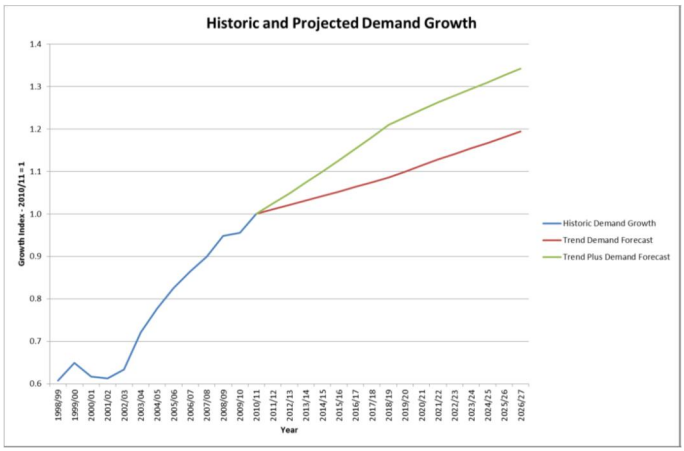
Both the 'Trend' and 'Trend Plus' scenarios have come from the above Yorkshire Rail Network Study, with the 'Trend' Scenario being capped at the National Trip End Model (NTEM) v6.2 levels, in line with DfT guidance.

The 'Trend Plus' scenario is in line with Northern RUS and High Level Output Statement 2 (HLOS2) demand forecasts, whilst also incorporating expected increases in car costs and parking charges. Trend Plus included adjustments to the Passenger Demand Forecasting Handbook (PDFH) parameters consider structural changes in the employment market and the cost of city centre car parking, consistent with the forecast in the Northern RUS.

In all analysis that follows we have presented alongside the 'Trend' scenario to ensure that differences between the scenarios are clear and visible, but in line with the RUS and HLOS demand forecasts consider that these latter scenario forecasts should be used as the more realistic forecasts of rail demand when considered in terms of local context, background trend, and alignment with other scheme development and plans.

This is also shown in the context of growth over the past decade in Figure 8.

Figure 9: Illustration of 'Trend' and 'Trend Plus' Scenarios in Context



The difference between these scenarios as applied to the Leeds – Harrogate - York line is shown in Figure 10 over the period from 2012 through to the opening year of 2019, and for each of the Leeds- Harrogate and Harrogate - York sections of the line.

For consistency purposes both of these scenarios are presented side by side within the results that follow, and so that appropriate sensitivity analyses on the Value for Money case is presented. Background growth has been capped at 20 years from today, irrespective of the rate of growth, and is applied consistently between the scenarios.

Figure 10: Illustration of 'Trend' and 'Trend Plus' Scenarios: Leeds-Harrogate-York

	Passengers	1,712,744				
	Harrogate- Leeds	80%				
	Harrogate York	20%				
	Background Growth	**TREND**	RIFF LITE- SDG (Yorkshire Rail Study)	**Background Growth**	**TREND PLUS**	
	Leeds-Harrogate	Harrogate-York Section	**PASSENGERS**	Leeds-Harrogate	Harrogate-York Section	**PASSENGERS**
2013	1.167%	1.122%	**1728730**	3.09%	2.01%	**1755068**
2014	1.167%	1.122%	**1744866**	3.09%	2.01%	**1798439**
2015	1.167%	1.122%	**1761152**	3.09%	2.01%	**1842881**
2016	1.167%	1.122%	**1777591**	3.09%	2.01%	**1888422**
2017	1.167%	1.122%	**1794183**	3.09%	2.01%	**1935088**
2018	1.167%	1.122%	**1810929**	3.09%	2.01%	**1982907**
Opening Year- 2019	1.167%	1.122%	**1827832**	3.09%	2.01%	**2031908**

Table 4 summarise the results of the analysis based on the test undertaken for Scenario 5.

Table 4: Scenario 5 - Test Results

BCR Calculation		**2010 prices and values**
Carbon	£	669,431
Time - Non users	£	156,475,391
Time - Existing users		
Time - New users	£	355,242,367
VOC Benefits - New users	£	56,141,234
Bus Operator Revenue	-£	10,972,189
Accident Benefits	£	11,076,657
Indirect Tax Cost	-£	21,995,007
Maintenance Savings- Road	£	133,886
Noise Benefits- Road	£	133,886
Total Benefits	**£**	**546,905,655**
Additional Benefits		
Wider Impacts	£	99,273,245
Total Benefits	**£**	**646,178,900**
Local funding	£	-
National Govt funding	£	151,155,833
Operating costs	£	126,244,092
Maintenance Savings- Rail TOC	£	-
Total Costs	£	277,399,926
Additional Revenue	£	126,067,019
Total Costs minus additional revenue	**£**	**151,332,907**
Core BCR		**3.61**
BCR with Wider Benefits		**4.27**

Observations and Comparisons

Summary

Table 5 summarises the results of the analysis in terms of the returned BCR values for the preferred scenario. As a result of the high value for money, and strong financial case, the scheme is strongly commended to DfT.

Table 6 also details the positive financial case for the scheme, which, whilst part of the BCR above has also been separated out within the analysis to demonstrate the financial case in addition to the overall value for money results shown in Table 11.

Table 5: Scheme Appraisal Results

Scenario	BCR	BCR (With Wider Benefits)
Trend Plus	**3.61**	**4.27**
Trend	**3.0**	**3.54**

When analysing comparable tests based on Capital Costs the test which has the Trend Uplift applied has a higher BCR ratio due to the increased patronage.

However, the above BCRs also exclude other significant benefits likely to be created by the scheme, and include:

- future provision and connectivity to link to HS2 and other network investments in Cross Pennine electrification and East Coast Main Line;
- Gross Value Added (GVA) and local economic job creation impacts created by the scheme; both directly and to support Local Plan and growth aspirations;
- enhancements to the UK economy as providing direct connectivity to key centres of international travel, tourism, education and conference centres- areas DfT Wider Impacts guidance does not yet fully address;
- passenger amenity benefits due to better quality rolling stock, further strengthen the case for investment on the line; and
- benefits and options values to East Coast Main Line InterCity Express Programme (IEP) utilisation through having the line electrified.

Table 6: Financial Modelling Results- Trend Plus/ Local Growth Scenario

Analysis of Costs versus Revenues, per year			
Year	**Cost (2010 prices)**	**Additional Revenue (2010 prices)**	**Difference/ Subsidy Required (2010 prices)**
2019	£4,806,761	£2,888,411	-£1,918,350
2020	£4,838,279	£4,373,173	-£465,107
2021	£4,862,871	£4,904,564	£41,693
2022	£4,902,293	£4,950,474	£48,181
2023	£4,934,796	£4,996,813	£62,017
2024	£4,967,633	£5,043,586	£75,953
2025	£5,000,809	£5,090,796	£89,987
2026	£5,034,327	£5,138,449	£104,122
2027	£5,068,191	£5,186,547	£118,357
2028	£5,102,403	£5,235,096	£132,693
2029	£5,136,969	£5,284,099	£147,131
2030	£5,171,890	£5,333,561	£161,671
2031	£5,207,172	£5,383,486	£176,314
2032	£5,242,817	£5,433,878	£191,061
2033	£5,278,830	£5,484,742	£205,912
2034	£5,315,213	£5,536,082	£220,868
2035	£5,351,972	£5,587,902	£235,930
2036	£5,389,110	£5,640,207	£251,097
2037	£5,426,631	£5,693,002	£266,371
2038	£5,464,539	£5,746,292	£281,753
2039	£5,502,837	£5,800,080	£297,242
2040	£5,541,530	£5,854,371	£312,840
2041	£5,580,623	£5,909,171	£328,548
2042	£5,620,118	£5,964,483	£344,365
2043	£5,660,020	£5,964,483	£304,463
2044	£5,700,334	£5,964,483	£264,149
2045	£5,741,064	£5,964,483	£223,419
2046	£5,782,213	£5,964,483	£182,270
2047	£5,823,787	£5,964,483	£140,696
2048	£5,865,789	£5,964,483	£98,694
2049	£5,908,224	£5,964,483	**£2,924,341**

Summary & Conclusions

Summary

WSP UK limited have been commissioned by North Yorkshire County Council, METRO (West Yorkshire PTE), Harrogate Borough Council and City of York Council to support improvement of the Leeds – Harrogate – York Rail Line. The line provides an important regional transport link accommodating social, education, business and leisure users facilitating access to regional employment and labour markets in York, Harrogate and Leeds, as well as important national connectivity for business travellers, and international visitors and tourists to key conference and visitor attractions.

An Evidence Base Review has been undertaken in association with consultation with key stakeholders to identify key issues which require to be addressed as part of this study, and which focus around enhanced connectivity, economic growth, capacity and performance.

In terms of delay per mile, West Yorkshire, Leeds, Harrogate and York have some of the highest values in the country. Despite this the Leeds – Harrogate – York Rail Line still suffers from poor comparative journey times preventing further connectivity across the North.

These issues are confounded by low levels of service frequency, poor (or non-existent) early morning, evening and weekend services, rolling stock quality, reliability, and capacity issues - each of which undermine overall rail service attractiveness. This is despite significant forecast growth on the line; and the potential of the route to facilitate significantly enhanced journey times and connectivity, and the high relative levels of congestion on the road network, against which the rail service is primarily competing.

The business case for the electrification and upgrade of the Leeds – Harrogate – York Rail Line recommended in this report has been carried out using industry standard modelling tools, and has been developed in conjunction with discussion and support of all stakeholders.

MOIRA outputs have been linked to a WebTAG compliant appraisal model, covering the key components of transport user benefits and are in line with Network Rail protocol to ensure consistency of appraisal against other schemes.

RailSys modelling of rolling stock options has also been undertaken to ensure deliverable journey times, together with an independent estimate and verification of capital and operating costs.

The Core BCR for the scheme, based on capital cost of electrification of £93.34m is 3.61; rising to 4.27 with the addition of Wider Impacts, and with RUS based level of demand being achieved through to the proposed scheme opening year of 2019. This represents high value for money.

The business case adopts a conservative treatment of costs, with 66% OB incorporated into capital costs, and in terms of future inflationary components of operating cost, which are also incorporated.

Additional Benefits

In addition to the high value for money of the scheme, the financial case for the scheme is also robust; with revenue greater than additional operating costs when based on local levels of growth. Revenues are also forecast to be close to forecast operating costs when based on more conservative DfT forecasts from the National Trip End Model.

The scheme also promotes longer-term TOC savings compared to continued use of the existing, and more expensive diesel fleet. The scheme is therefore directly supportive of existing national policy, and its timing also coincides with Network Rail re-signalling and modernisation of the line; representing a value for money approach to the delivery of an effective scheme.

Synergies with committed electrification associated with Trans Pennine Express and the Northern Hub are clear, and help to enhance output, reduce cost and provide longer-term ability to complement electrification on other routes and stakeholder aspirations.

However, the above BCR's also exclude other significant benefits likely to be created by the scheme, including:

- future provision and connectivity to link to HS2;
- GVA and local economic job creation impacts created by the scheme; both directly and to support Local Plan and growth aspirations;
- enhancements to the UK economy as providing direct connectivity to key centres of international travel, tourism, education and conference centres- areas DfT Wider Impacts guidance does not yet fully address;
- passenger amenity benefits due to better quality rolling stock, further strengthen the case for investment on the line; and
- benefits and options value(s) to East Coast Main Line rolling stock through having the line electrified.

City Region & National Benefits

As a result of the scheme over 3 million kilometres annually are forecast to be removed from the national highway network. This results in benefits being provided in a number of other areas of the appraisal, particularly around road decongestion and safety, together with associated carbon benefits; each of which are key objectives of local and national policy.

The longer than average travel distances made on the line by most passengers, and the importance of flows to London (with over 10% of all trips to/from London), enhances the importance of these benefits compared to other competing alternatives and schemes. Consequent safety benefits are also particularly noted on the A59, between Knaresborough and York, which has an accident rate 3 times that of the national average.

The scheme also strengthens connectivity to both Leeds and Harrogate via York in relation to HS2 and national connectivity, providing significant journey time reductions in each direction compared to today.

This is enhanced through the facilitation of additional early morning and evening trains, as well as at weekends. These maximise the economic return and viability of daily business trips to/from London, assisting regional economic performance, agglomeration, and balance.

Robust Benefits & Synergy

Important to the benefits of the scheme is the fact that the line has the ability to provide a high-quality alternative to car and bus modes, over the next 60 years. There are significant benefits to existing rail users promoted by the end-to end journey time reductions of 15 minutes (around 19%) achieved; this is 65% of the total levels of forecast benefits.

Importantly, the average time saving per user is greater than 5 minutes, and is important to the economic value and productivity promoted by the scheme compared to alternatives. In short, there is a strong case, even without additional demand attracted to the railway, but which the additional modal shift to rail also supports.

The scheme has strong synergy with existing Yorkshire Rail proposals, and especially with the Leeds Southern Station Entrance scheme, and Local Plans in Harrogate, Leeds and York.

In the medium-term there is also synergy with Network Rail proposals plans for additional platform capacity on the lower numbered platforms at Leeds, and plans for enhanced access to the line - in terms of park and ride ability at both existing and future station proposals.

As a result the scheme is supported by each stakeholder party to the development of this business case, and fits well with the objectives of a new de-centralised rail network for the North.

Conclusions and Key Facts

Government approval is therefore sought to commit to electrification of the route at the earliest possible stage, and to provide a platform for future success and economic vitality of the region. The scheme is based on the objectives of significantly enhanced connectivity (rather than just capacity), and improved journey times and frequencies to promote economic growth and agglomeration to maximum effect. These are aims to which electrification is most suited.

The scheme is therefore recommended to the DfT on the basis of, the high level of value for money obtained, the positive net financial case, and the long-term cost reduction in terms of operating the line promoted by the scheme, as well as national economic benefits promoted to UK PLC.

KEY FACTS

- **The core BCR for improvements to the Harrogate line, based on capital cost of electrification of £93.34m is 3.61; this represents high value for money, and rises to 4.27 with the addition of Wider Impacts.**
- **The improvements are shown to achieve end to end journey time reductions of 15 minutes, and as a result of the additional demand, generate a positive financial return over the life of the scheme.**
- **The scheme also results in a long-term cost-reduction of operating the line, which is a key driver of national policy with lower cost electric multiple units delivering a Revenue : Cost ratio of 1.25.**
- **Over 3 million annual vehicle kilometres are removed from the highway network, with associated social and environmental benefits, along with significant time benefits for existing users of the rail line.**
- **The scheme significantly enhances connectivity and economic productivity between employment, labour and international visitor markets in Leeds, Harrogate and York; driving both local and international competitiveness.**
- **Fast connectivity to both the ECML at Leeds and York is secured, together with future HS2 networks. This is important given over 20% of all daily travel on the line is to or from other national economic centres.**
- **The journey time benefits are deliverable using cascaded high power electrical multiple units.**

Appendices

Appendix A – Scenario Details

Other scenarios, and variants appraised are as follows:

- **Scenario 1**
  - 4 trains per hour Leeds – Harrogate, of which 2 continue to York, all stations, current journey time, between 0600 and 2000.
  - 2 trains per hour Leeds – Harrogate to run from 2000 to 0030 of which 1 continues to York, all stations, current journey time.
  - In the morning and evening peaks, one of the trains is extended to and from Knaresborough.
  - Current service pattern on all other services.
- *Scenario 1a*
  - *Scenario 1 but half this level of service before 0700 and from 2000 with retention of the York train.*
- **Scenario 2**
  - 4 trains per hour Leeds – Harrogate, of which 2 continue to York, all stations, 10 minute journey time reduction, between the hours of 0600 and 2000 from each end. (5 minutes either side of Harrogate).
  - 2 trains per hour Leeds – Harrogate to run from 2000 to 0030 of which 1 continues to York, all stations.
  - In the morning and evening peaks, one of the trains is extended to and from Knaresborough.
  - Current service pattern on all other services.
- *Scenario 2b*
  - *Scenario 2 but ½ this level of service before 0700 and from 2000 – keep York train. [to test early morning and late evening].*
- **Scenario 3**
  - 4 trains per hour Leeds – Harrogate, of which 2 continue to York, all stations, 15 minute journey time reduction, between the hours of 0600 and 2000 from each end. (7/8 minutes either side of Harrogate).
  - 2 trains per hour Leeds – Harrogate to run from 2000 to 0030 of which 1 continues to York, all stations.
  - One of the trains to start at Knaresborough in the morning and one to start at Harrogate in the evening.
  - Current service pattern on all other services.
- *Scenario 3b*
  - *Scenario 3 but ½ this level of service before 0700 and from 2000 with retention of the York train.*
- **Scenario 4**
  - 2 trains per hour Leeds – Horsforth, all stations.
  - 2 trains per hour Leeds – Harrogate, calling at Horsforth and all stations.
  - 2 trains per hour Leeds – York, all stations.
  - Leeds – Harrogate trains speeded up by 7 minutes; Leeds – York also by 7 minutes (inclusion of stops at Burley Park and Headingley); 0600 – 2000. 2 trains per hour Leeds –York, all stations from 2000 – 0030.
  - One of the trains to start at Knaresborough in the morning and one to start at Harrogate in the evening.
  - Current service pattern on all other services.

- Scenario 4b
  - 2 trains per hour Leeds – Horsforth, all stations.
  - 2 trains per hour Leeds – Harrogate, all stations.
  - 2 trains per hour Leeds – York, calling at Horsforth and all stations.
  - Leeds – York trains speeded up by 11 minutes; Leeds – Harrogate 4 minutes; 0600 – 2000. 2 trains per hour Leeds – York, all stations from 2000 – 0030. One of the trains to start at Knaresborough in the morning and one to tart at Harrogate in the evening.
  - Current service pattern on all other services.
- **Scenario 5 (Preferred Scenario):**
  - 15 minute journey time reduction. The journey time reduction is 7/8 minutes either side of Harrogate, as per RailSys modelling.
  - 4 trains per hour Leeds – Harrogate, of which 2 continue to York, all stations between 0600 and 2000.
  - 2 trains per hour Leeds – Harrogate, of which 1 continues to York, all stations from 2000 to 0030 and at weekends to optimise service efficiency.
  - Departures at 0520 Harrogate – Leeds and 0515 Harrogate – York to connect with the London trains from Leeds and York.
  - In the morning and evening peaks, one of the Harrogate trains is extended to and from Knaresborough.
  - Current service pattern on all other services.
- Scenario 5a
  - As Scenario 5 but with 4 trains per hour Leeds – Knaresborough rather than Harrogate.
- Scenario 5b
  - End to end evening half hourly service after 20:00 (rather than just 1 to York).
- Scenario 5c
  - As Scenario 5 but with only a 10 min journey time saving (5 mins either side of Harrogate).

Financial Analysis

MOIRA has been used to estimate the impact of timetable changes on passenger revenue. This has been undertaken first and foremost, prior to any further work, to ensure that the financial case is robust, and does not require any significant increases in subsidy.

This is a key component of deliverability, and we have ensured that only options that are suitably close, and maximised in terms of financial performance are taken forward into latter stages of the business case.

It should be noted that the figures below represent uplifted revenue and cost increments to represent the full week, and also account for PTE tickets and missed sales within the table below. Within this analysis it is clear that Option 5 provides the highest revenue/ cost return, shaded red. Table A1 summarises the costs and anticipated revenue associated with each of the above scenarios.

However, it should also be noted that these results have been generated using a conservative assumption of leaked revenue (at 5%). Northern Rail studies show at some unmanned stations this can be as high as 13%, and which would further heighten the revenue: cost ratios for all options, if the additional present leaked revenue was incorporated within the results.

Table A1: Revenue and Cost Increments Summary-

Scenario	Higher-cost EMUs (k)	Low-cost EMUs (k)	DMU costs (k)	Revenue benefits (k)	Revenue/ cost higher-cost EMU	Revenue/ cost low-cost EMU	Revenue/ cost diesel
1	£6,084	£4,543	£10,836	£2,049	0.34	0.45	0.19
1a	£5,637	£4,140	£10,097	£1,756	0.31	0.42	0.17
2	£6,084	£4,543	£10,836	£3,465	0.57	0.76	0.32
2b	£5,637	£4,140	£10,097	£3,204	0.57	0.77	0.32
3	£5,130	£3,715	£9,655	£4,116	0.80	1.11	0.43
3b	£4,683	£3,312	£8,915	£3,614	0.77	1.09	0.41
4	£9,274	£7,323	£14,924	£4,638	0.50	0.63	0.31
4b	£8,268	£6,417	£13,261	£4,134	0.50	0.64	0.31
5	£4,700	£3,327	£8,989	£4,150	0.88	1.25	0.46
5a	£5,788	£4,235	£10,316	£4,444	0.77	1.05	0.43
5b	£5,805	£4,245	£10,335	£4,496	0.77	1.06	0.43
5c	£4,628	£3,285	£8,911	£3,499	0.76	1.07	0.39

As can be seen from the above summary, the operational costs significantly outweigh the revenue benefits for a number of options. although for several options, the revenue/ cost ratio is over 1, for lower cost EMU's, and approaching 1 for higher-cost EMU's The preferred option, Option 5, has a Revenue cost ratio of 0.88 for higher cost EMU's, and 1.25 for lower-cost EMU's.

In addition, the following observations can be made with regard to the initial analysis:

- Late evening enhancements are seen to generate around £200,000 of revenue;
- Horsforth shuttles perform best in peak periods only and lose money at other times;
- The York to Headingley and Burley Park link is important; and
- Each of these are maximised in terms of scenario 5, and the various sensitivity test noted between Scenario 3, and scenario 5a through to Scenario 5c.
- All stations along the line serve each other when revenue is analysed, there currently does not appear to be a case for providing a skip-stop service.

Appendix B – Conditional Output Specification

APPENDIX B

HIGH LEVEL - CONDITIONAL OUTPUTS FOR THE HARROGATE LINE

JANUARY 2013

1. **Connectivity**
    - Increased frequency with a target of 15 minute even-interval frequency Leeds – Knaresborough. 30 minute frequency between Knaresborough and York. Frequency includes Saturday and Sunday and evenings.
    - Improve journey times between Harrogate and Leeds and Harrogate and York with an in - train station to station journey time equivalent to 75% of off-peak car travel times.
    - Improved connectivity across the UK via Leeds and York especially to London, including direct services.
    - Extended hours of operation (mornings / evenings and particularly weekends).

2. **Capacity**
    - Sufficient capacity to meet continuing passenger demand growth.
    - To accommodate rising demand from local land use development / economic interventions planned along the line and how these plans are being phased.
    - Accommodate rising demand from other growth drivers, e.g. access to employment, education and health.

3. **Performance**
    - 92.5% of York – Harrogate services and 95% of Harrogate – Leeds should arrive within 5 minutes of planned time. Longer – term 95% to be the target for the whole route.

4. **Journey Quality**
    - National Rail Passenger Survey – customer satisfaction scores for the route should attain the best in class.
    - Provision of new or refurbished rolling stock offering a modern railway environment, comparable or better than the car.
    - Provision of rolling stock that offers a level of comfort and facilities that meets the expectations of passengers for the specific service that is being operated. Provision of First Class accommodation, toilets, on train refreshments, WiFi, cycle storage, electronic device charging points, reliable mobile communications.
    - Provision of stations that act as welcoming, modern gateways to the network which enable easy access by any mode and offer a consistent high quality facility.

5. Access to the Harrogate Line / Integration

MINIMUM SPECIFICATION FOR FUTURE STATION FACILITIES

ACCESS	Headingley	Horsforth	Weeton	Pannal	Hornbeam Park	Harrogate	Starbeck	Knaresborough	Cattal	Hammerton	Poppleton
Car Parking	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Disabled parking	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Cycle parking	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Step free access to all platforms	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Passenger lifts	O	O	O	O	O	✓	O	O	O	O	O
Accessible walking route to station	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Bus interchange	Bus stops close by	Bus stops close by	Bus stops close by	Bus stops close by	Bus stops close by	✓	Bus stops close by	Bus stops close by	Bus stops close by	Bus stops close by	Bus stops close by
Taxi rank / drop off	Drop off	Drop off	Drop off	Drop off	Drop off	✓	Drop off	Drop off	Drop off	Drop off	Drop off
Drop off/pick up point	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Automatic ticket gates	O	O	O	O		✓	O	O	O	O	O
Safe and Secure routes	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
INFORMATION											
Customer information screens	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Public address system	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Printed timetable information	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Help point	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Local bus information poster	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
FACILITIES											
Ticket machine	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Passenger waiting shelters	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Heated waiting rooms	O	O	O	O	O	✓	O	O	O	O	O
Platform canopies	O	O	O	O	O	✓	O	O	O	O	O
Seating (to DDA standard)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Retail /accessible ticket office	O	O	O	O	O	✓	O	O	O	O	O
Toilets	O	O	O	O	O	✓	O	O	O	O	O
ENVIRONMENT											
Full CCTV coverage	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Adequate lighting	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Sustainable station	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Safe and Secure Mark	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

✓ = Facilities Required :
O = Facilities Not Required

New stations where there is a business case and fits with the line's overall strategy.

6. **Provide high quality integration between rail and other modes**

   Interchange
   Provision of balanced improvements to stations access including provision of
   - Sufficient car parking capacity to facilitate growth in rail demand
   - More attractive walking and cycling routes to stations including improved lighting, CCTV coverage, and secure cycle storage facilities
   - Better integration between bus and rail networks
   - Improved frequency / accessibility of connecting services

   Consideration given to car park charges to encourage more sustainable access to the rail network and more optimal use of car parking capacity and on-going revenue support.

   Ticketing / Multi Modal Tickets
   Provision of improved ticketing including through tickets and travel cards, so that passengers only need to buy a single ticket for a multi modal journey, and can buy this on the day of travel, and the use of smart card / mobile / the latest technologies.

   Information
   Provision of information to enable passengers to easily plan a multi modal journey.

7. **Links to Leeds Bradford International Airport (LBIA)**
   - Provision of frequent, reliable and fast access to the airport from Leeds, Harrogate, Knaresborough and York.

8. **Carbon reduction**
   - Provision of a low carbon based transport system meeting Government national climate change targets.
   - Improvements to air quality along the corridor.

9. **Promotion**
   - Intiatives to encourage continued growth in usage of the line.
   - Stakeholder engagement.

These outputs are interlinked and will need to be delivered by a combination of Network Rail and stakeholders, for example access to the Network provides an opportunity for the PTE / Local Authorities etc. to contribute to the outputs in association with what the rail industry can deliver.

Harrogate Line Officers Group
January 2013

Appendix C – Stakeholder Group

The following stakeholders have been consulted to inform this study, with the Councils forming part of the overall client team:

- North Yorkshire County Council
- Metro (West Yorkshire PTE)
- Harrogate Borough Council
- City Of York Council
- Network Rail
- Department for Transport
- Harrogate Chamber of Trade and Commerce
- East Coast
- Northern Rail
- Leeds, York and North Yorkshire Chamber of Commerce
- Andrew Jones MP – Member of Parliament for Harrogate & Knaresborough

Appendix D –Tata Electrification and Rail Performance Study

WSP UK

Leeds – Harrogate – York Rail Line Outline Transport Business Case

Summary for inclusion in main Business Case

Harrogate Line Electrification Feasibility Study

B90412-REP-PEN0002
P01
For Approval
July 2013

TATA STEEL

Authorisation Sheet	
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Document History					
Version No.	Approved by Date	Description	Prepared By	Reviewed By	Approved By
P01	19/07/13	Initial issue	JO	RF	JC

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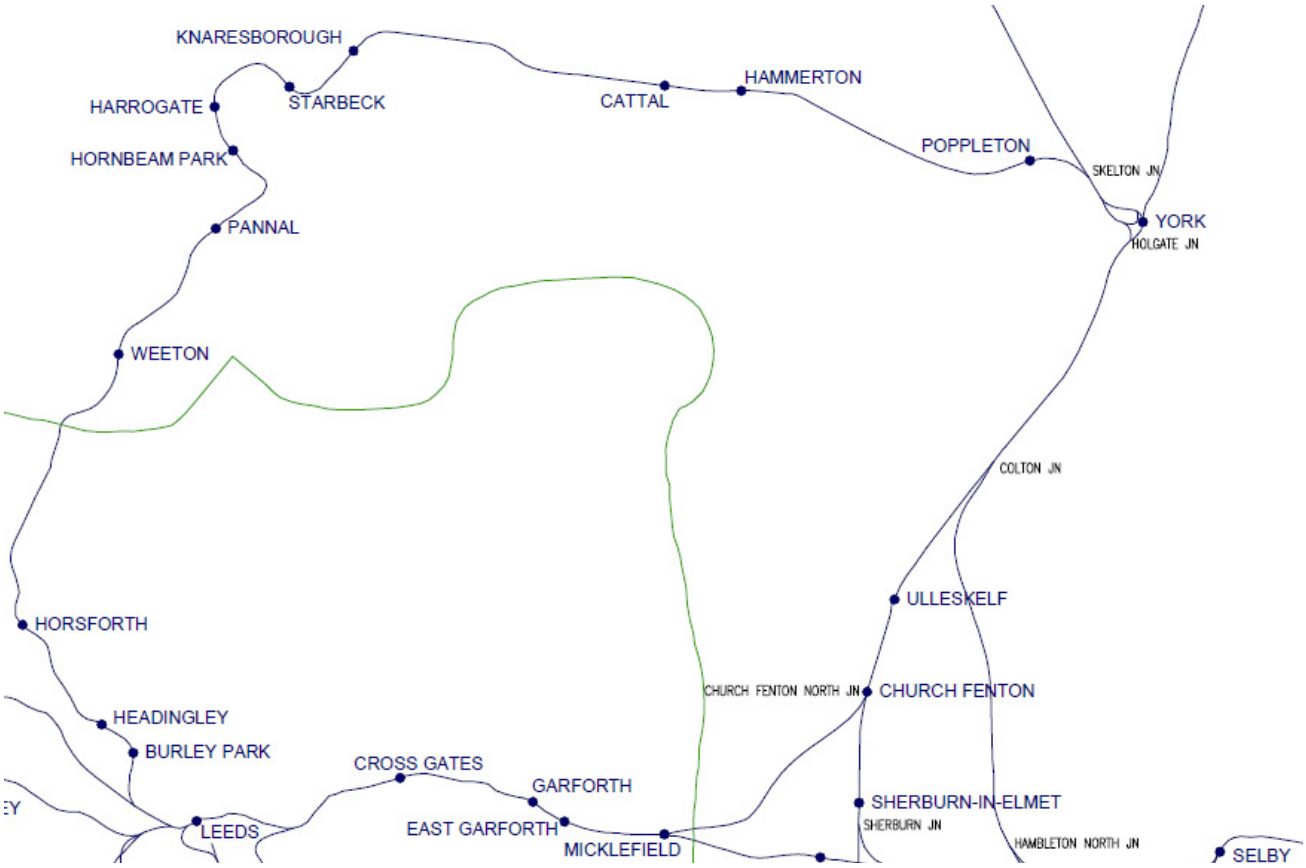
References:

Appendices:

1.0 Introduction

Tata Steel Projects were commissioned by WSP Ltd to undertake a feasibility study to define the requirements for the Electrification of the Harrogate Line between Armley Junction, Leeds and Skelton Junction near York. The purpose of the study is to identify the costs and challenges associated with delivering Electrification to inform the wider business case for the upgrade of the line.



This report has considered the over line structures, electrification and power requirements needed to deliver electrification. Works associated with signalling immunisation and infrastructure have not been included in the scope of this study. This is because part of the line has been recently resignalled and it has been assumed that the signalling infrastructure is current 25kV immune. The section of the line that has not been resignalled is a semaphore system and so it is not anticipated to have a significant impact on electrification, other than electrical clearance provision. This assumption needs to be validated with Network Rail.

In addition to this Tata Steel Projects have completed a Rail operations modelling report to consider the train capability for a proposed new timetable developed by WSP as part of the Leeds – Harrogate – York outline business case. The report[1] is contained within Appendix A.

2.0 Over Line Structures

Tata Steel Projects have applied the Network Rail National Gauging Database (NGD[2]) to analyse the impact of electrification to the bridges and structures passing over the railway, in order to understand the enhancement works required to achieve clearance for over-head line electrification.

2.1 Methodology

2.1.1 Track

ClearRoute™[3] was used to assess the electrical clearances at each structure. No electrification system has been decided for the route; therefore an electrical clearance gauge for use within ClearRoute™ has been based upon current standards and parameters and is consistent with the profile developed for the Trans-Pennine Electrification project. Appendix H contains the drawing showing the clearance profile used.

The electrification clearance gauge should be considered as a draft compound profile and should be applied only for the outline development of the options for achieving clearance at each structure. For detailed analysis of site specific clearances, the full clearance gauge of the chosen system type shall be defined to include any change in design parameters.

Clearances were assessed using 4 different scenarios as described below:

Description	**Requirement**
Electrical Clearance Gauge with 100mm Vertical Track Tolerance	Provided where there is **no** requirement to register the OLE from the structure and the full track maintenance requirements are provided.
Electrical Clearance Gauge with 100mm Vertical Track Tolerance and Construction Depth	Provided where there is a requirement to register the OLE from the structure and the full track maintenance requirements are provided.
Electrical Clearance Gauge with Standard Vertical Track	Provided where there is **no** requirement to register the OLE from the structure and reduced track maintenance requirements are

[1] B90412-REP-OPS0001 dated 2nd July 2013

[2] NGD contains structure profiles recorded across Network Rail's infrastructure. It is produced on a two monthly basis and contains the most-recently collated and validated data.

[3] ClearRoute™ is software used industry-wide for calculating the clearances between railway vehicles and the infrastructure. For the purposes of this study, this software has been used to calculate the clearances between a developed electrical clearance gauge and infrastructure.

Tolerance	provided
Electrical Clearance Gauge with Standard Vertical Track Tolerance and Construction Depth	Provided where there is a requirement to register the OLE from the structure and reduced track maintenance requirements are provided

On completion of the NGD assessment; clearances were formatted for upper sector[4] structures only, highlighting where the gauge infringed the structure. All results were manipulated and filtered to provide the structures on the route and the minimum clearances for each structure in the upper sector.

2.1.2 Civil Engineering

A register of all bridges along each option route has been produced using data from the Network Rail Civil's Asset Register and electronic Reporting System (CARRS) and Verification Route Availability (VeRA) databases. The register includes information on structure type, mileage, renewals, asset owner, overall length and listed status, see Appendix G.

A workshop was held with the design team to review the NDG output for each structure and review those structures that require work to clear them for electrification. The workshop used aerial mapping and the Network Rail structures record information to determine the solution at each structure. The notes from the workshop are contained within appendix B. A red, amber, green mechanism was used to highlight the significance of the solutions.

Each foul structure has been reviewed in turn and an individual option proposed based on its particular merits, however, an overall set of principles have been followed in selection options, these principles are described below:

- If the bridge no longer serves any purpose seek bridge removal with agreement of all necessary third parties. This is often the cheapest solution to meet the short term requirement of achieving OLE clearance and also removes any future maintenance liability.
- If the structure is a footbridge seek to reconstruct. This is generally more cost effective than a track lower providing limited works are required to approach ramps and stairs, and that the existing bridge parapets and decking are compliant for electrification. The replaced structure should consider options for DDA compliance however there needs to be a suitable business case for a DDA compliant structure due to the additional cost.
- If a track lower of less than 300mm can achieve normal clearance a track lower solution will be taken forward. Track lower solutions of less than 300mm are normally less expensive than a road bridge reconstruction (where track drainage will allow) and avoid complications of utility services, road closures, road alignment etc that are needed for jacking works. It is also considered to be the least complex method of work to deliver as it keeps works all within Network Rail land and therefore limits the impact on third parties.
- If a track lower of greater than 300mm but less than 500mm is required to achieve normal clearance consideration should be made for jacking or partial reconstruction the bridge deck. These options are considered the most costly and will have high impact on third parties, which is why they will only be undertaken where the above options are not feasible. Under

[4] Upper sector is greater than 1100mm above rail level

this condition considerations will also be given to a combined civil engineering and track solution.
- If a track lower of greater than 500mm is required to achieve normal clearance and/or a cost effective solution is not immediately evident from undertaking the above assessments then the structure will be classified as a project risk requiring a detailed assessment at the next GRIP Stage.

All overbridge and footbridge parapets have been reviewed to identify parapets that require further work to allow electrification of the route. Work is purely desktop based using satellite imaging and available visual/detailed examination reports.

2.2 Findings

The findings of the workshop and the solution at each structure are contained within Appendix B. In addition to this Appendix C contains a risk and opportunity register of items that are not included or that could have a significant impact on the cost. A red, amber, green mechanism was used to highlight the significance of the solutions at the structures. Those categorised as red are listed below.

Structure Name	**Engineering Solution[5]**
A1237 Outer Ring Road Bridge No.2B (Flat Deck Overbridge)	Bridge is not owned by Network Rail. Close proximity of Milfield Lane Level Crossing raises the wire height. The OLE will need to be registered from the bridge due to its width. Therefore an equivalent track lower of 1m is required. Based upon the site constrains the construction of a new bridge to replace Milforld Lane Level Crossing could be the most appropriate solution. Further development of the options is required.
Knaresborough Tunnel 16 miles 40 chains (Tunnel)	Significant works required, either a track lower, tunnel lining work, track slab or track slue or a combination of all 4. A more detailed study is required. Estimate is based upon completion of a major infrastructure solution. There could also be an impact to the level crossing and platform at Knaresborough.
Knaresborough Station Platform1 (Awning)	Consider new canopy or modification of existing. Structure may be listed.

[5] **based upon workshop held on 28/06/2013. Attendees: Harry Pascall, John Oldridge, Darren Smith, Helen Papadopoulou.**

Knaresborough Station Up Platform (Awning)	Consider new canopy or modification of existing. Structure may be listed. Include for relocating the existing canopy.
Harrogate Station Bridge Bridge No.44 & 44A (Overbridge)	Track lower including crossover to be relayed. Platform works required to suit the track lower. Reconstruction excluded because of the building on top of the bridge.
Victoria Road Bridge No.43 (Flat Deck Overbridge)	Either track lower with switches & crossings or reconstruction which will have a significant impact on road layout. Estimate includes for a reconstruction.
York Place Or Royal Bridge Bridge No.42 (Flat Deck Overbridge)	Either track lower or reconstruction which will have a significant impact on road layout. Estimate includes for a reconstruction. This solution would be considered in conjunction with bridge 43.
Pannal Station Bridge No.40 (Arched Overbridge)	Partial concrete arch deck reconstruction.
Nab Hill Bridge No.38 (Arched Overbridge)	Partial concrete arch deck reconstruction.
Wescoe Hill Tunnel 10 Miles 13 Chains (Tunnel)	Track slue and lower

3.0 Electrification & Power

3.1 Contact System Type

The contact system type will be either Mark 3D or Series 2 depending on route preference. Either of these equipment types will form an easy interface with the Mark 3B equipment at either end of the line. Series 2 is understood to be engineered to be easier to install and maintain than Mark 3D equipment, however Mark 3D equipment shares more of the same components with Mark 3B

equipment and provides the maintainer with consistent equipment in terms of spares and components. Whilst the requirements of NR/L1/ELP/27000 are most likely to be met with Series 2, the RAM must be engaged to ensure the most appropriate whole life solution is met.

Series 1 equipment may be considered however as this has been primarily developed for the high speed Great Western Project it is considered unlikely to be suitable for this route.

There may be some benefit in certain situations to use a conductor beam in place of the overhead line through tunnels. This may provide opportunity to reduce the track works and amount of tunnel reconstruction required. The drawback of this system is that the interface with the tensioned overhead line is visually intrusive in sensitive areas. There are wider multidiscipline solutions to achieve compliant clearances and a holistic approach should be taken.

Early involvement of the relevant councils and stakeholders will be required for some of the sensitive areas such as Knaresborough and the other viaducts on the route where some bespoke engineering solutions may be required.

The majority of the route is single or two track railway and will be electrified using simple auto-tensioned equipment supported on standard UC or DC cantilever structures. The OLE in sidings and junctions will be supported from headspan or portal structures. Foundations will be either driven piles or concrete siding bearing depending on ground conditions and contractor installation strategy.

3.2 Traction Power

A full traction supply study must be carried out to assess the power requirements of the timetable in order to produce a performance specification for the planned electrification system.

The available system options are to use either an auto-transformer system, a classic system or a booster transformer classic system. The system to be used will depend on the results of the traction supply study and available power supply points.

With the current infrastructure, a new feeder station would be required; however due to the power requirements of the Transpennine electrification project a new feeder will be provided that will reduce the load on York and Kirkstall feeder stations. Therefore it is recommended that modelling is undertaken to determine whether the existing Kirskstall and York feeding arrangements will provide adequate capacity, and consider this in the context of future traction power strategy across this network.

There will be the requirement for enhancement of the distribution infrastructure at both these sites and the need for three Track Sectioning Locations on the route.

The most likely power supply arrangement would be a booster transformer classic system end fed from York feeder station and Kirkstall feeder station.

4.0 Estimates

4.1 Methodology

The estimate has been built up using priced Bill of Quantities with percentage mark-ups for preliminaries, design, T&C etc to arrive at a total construction cost. This feeds into Network Rails standard estimate summary sheet where further items (eg risk and escalation) are added as required.

Key items have been measured to produce an Order of Magnitude estimate with a level of confidence ±50%. With the exception of structures which are detailed below, items have been priced based on rates obtained for other electrification schemes, including the Trans-Pennine Electrification Project.

Costs for achieving OLE clearances at structures have been priced on a structure by structure basis, using information obtained from the Structures Workshop. These have been priced using elemest, which is an in house estimating tool where key variables are entered (eg bridge width and span) to provide a high-level realistic cost.

The estimate in Appendix D contains a full list of assumptions and exclusions, listed below are the key assumptions used in the preparation of the estimate:

- The estimate has been priced to 3Q2013
- The estimate includes a risk mark-up of 40%
- The estimate excludes Optimism Bias
- Whist it is recognised that WSP are the current client, It has been assumed that the works will be undertaken by Network Rail as part of the Trans-Pennine Electrification Project (TPE) project. As such addition costs for undertaking the works as a "3rd party" project have not been added into the estimate.
- It has been assumed that level crossings already conform to current standards. Allowance has only been made for additional signs warning of OLE.
- No allowance has been made for signalling immunisation costs (Assumes recently re-signalled sections are compliant and that the semaphore areas will not be significantly affected).
- No allowance has been made for double tracking the single sections of line (this is outside the scope of this study).

5.0 Conclusions and Recommendations (including the next steps)

This study has considered the requirements for the electrification of the Harrogate Line and produced a high level cost estimate. The study has focused on the bridges and over line structures, OLE system and power requirements to derive the costs. To move the project forward to the next stage the following recommendations are made:

- Undertake power modelling to determine Traction Power requirements;
- Investigate the signalling immunisation requirements;
- Complete a more detailed study of the Knaresborough station and tunnel area;
- Complete a more detailed study of Wescoe Hill Tunnel and A1237 Outer Ring Road Bridge; No.2B (Flat Deck Overbridge)
- Coordinate the solutions with potential future double tracking and timetable;
- Level Crossing review.

Appendix A: Train Journey Time Capability Assessment

TATA

WSP UK

Harrogate Line Feasibility Study

Final Report

B90412-REP-OPS0001
P02
For Approval
July 2013

TATA STEEL

Authorisation Sheet	
Client:	WSP UK
Project Title:	Harrogate Line Feasibility Study
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Date:	2nd July 2013

Document History					
Version No.	Approved by Date	Description	Prepared By	Reviewed By	Approved By
P01	10/05/13	Initial issue for comment	NS	JF	JH
P02	02/07/13	Final Report	NS	JF	JH

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1.0 Remit

A “high level” study to understand the effect of using electric multiple unit rolling stock on the Leeds – Harrogate – York route on journey times. The simulation will be conducted using RailSys (version 6) software.

Increasing the linespeed on the route between Skelton Junction (inclusive) and Armley Junction (exclusive) to 75 mph and 90 mph will be simulated also, and the effects of this will be reported.

A standard hour timetable will be produced from the journey time results.

2.0 Methodology

Traction data used for this study has been extracted from Tata Steel Projects files.

The traction types tested were:

- Class 319 (AC) 4 car formation – built 1987/88 and currently deployed on Thameslink route.
- Class 365 4 car formation – built 1994/5 and currently deployed on London Kings Cross – Cambridge/Kings Lynn/Peterborough route.
- Class 360 4 car formation – built 2002/3 and currently deployed on stopping services between London Paddington and Heathrow Airport.

A timetable in excel spreadsheet format was provided by the client. This was manually entered to RailSys timetable and Class 319 traction was allocated to all services in the timetable. All engineering and performance allowances, specified in the Timetable Planning Rules, were added to schedules in the RailSys timetable. Performance allowances can be removed from a train's schedule and the train advertised to arrive later. However, in this case the amount of time in performance allowance then must be consolidated when calculating turnround times or intermediate station dwell times. This is to ensure the robustness of the train timetable. No other services on this or other routes were entered into the RailSys timetable.

A Base Model infrastructure was created in RailSys which represents the current infrastructure (type and location of signals, stations, PSR changes and gradients). Data sources used to construct this model were:

- Sectional Appendix LN 838
- Supplementary Notice of Signalling and Permanent Way Alterations NR/LNE No 27 detailing Harrogate Area Signalling Renewals

Two further infrastructure models were created that raised the linespeed to 75 mph (option 1) and 90 mph (option 2). The locations of speed changes for all three models are detailed in Appendix A. The raised speeds have not involved any detailed study of the geometry of the line, signal sighting issues, or other possible restrictions to the enhancement in linespeed. Locations where the speed has been maintained at the current PSR or restricted PSR in both the option models were:

- **Crimple Curve** – 20 mph due to sharp curvature of the track.
- **Harrogate station** – 20 mph current, modelled at 30 mph in option 1 and 2. As all trains are scheduled to stop at Harrogate a high speed is not necessary through the station. A 40 mph PSR through Harrogate station would reduce the journey time of a York – Leeds service (operated by Class 319 unit) by only 9 seconds compared to 30 mph. In the opposite direction the reduction would be just 13 seconds.
- **Starbeck LC – Belmont LC** – 30 mph due to curvature of track with 50 mph across Belmont LC.

It is possible that if a more detailed study of the route is conducted the above PSRs may be able to be raised. An increase between Starbeck LC and Belmont LC is the most likely location for a change in line speed. However, the effects of this on the single line sections between Skelton Junction and Knaresborough also need to be understood.

3.0 Results and Observations

3.1 Client Timetable

The client timetable increases the frequency of trains between Leeds and Knaresborough from the current 2 per hour to 4 per hour, and Knaresborough to York from 1 per hour to 2 per hour. The journey times are also reduced from the current Leeds – York journey of 1 hour 15 minutes to 1 hour and York to Leeds journey of 1 hour 8½ minutes to 59 minutes. The client timetable assumes the use of electric multiple unit rolling stock.

3.1.1 Assumptions

It is assumed that times shown at intermediate stations are departure times and arrival times are 30 seconds (this is the minimum station dwell time for EMU operated services) prior to this.

Engineering and performance allowances are specified in the Timetable Planning Rules to be added to train schedules. It is assumed that the 2 minutes performance allowance approaching Skelton Junction for trains going to York will be added as an advertised differential. This is in effect showing the train arriving 2 minutes later in the public timetable than the working timetable. The consequence of removing this performance allowance from the trains working schedule is that the turnround allowance must be increased by 2 minutes, to 12 minutes.

It must be assumed that the signalling will be changed at Knaresborough to allow loaded trains to depart from the Up platform in the Down direction (towards Leeds).

3.1.2 Observations

The client timetable has trains scheduled to turnback at York with 7 minutes allowed between arrival and departure. The Timetable Planning Rules stipulate that a minimum allowance of 10 minutes should be scheduled between arrival and departure to/from Harrogate. The reduced allowance will affect the robustness of the timetable and increase the risk of secondary delay occurring due to the single line sections between Skelton Junction and Knaresborough. Any delay on this route has a strong likelihood of propagating delays to trains on the East Coast Main Line at the York end and the Leeds North West routes at the Leeds end.

The schedule has 2½ minutes between a train arriving at Hammerton from York and a train departing. The Timetable Planning Rules stipulate that a 3 minute minimum allowance should be

allowed on the current infrastructure. Future re-signalling of this section of route could reduce this margin potentially to 2 minutes.

The turnrounds at Knaresborough are scheduled to have a turnround allowance of 4½ minutes. The current method of working of a passenger train arriving from Leeds and terminating at Knaresborough is to arrive in the Up platform, and then shunt as an empty stock on to the viaduct and then reverse in to the Down Platform. The current allowance for this move in the Timetable Planning Rules is 12 minutes. A minimum allowance for a train to arrive with passengers on board from Leeds and departing empty back to Leeds is 5 minutes. If the signalling is altered to allow loaded passenger trains to depart from the Up platform towards Leeds, this minimum turnround allowance of 5 minutes is likely to be a reasonable assumption. However, further negotiation would be necessary on the acceptability of this turnround.

The continuous use of minimum turnrounds introduces a degree of risk to the timetable and should be avoided where possible.

The Timetable Planning Rules require trains passing at Starbeck to be scheduled within 1 minute of each other except on isolated occasions to avoid excessive closure of the level crossing to road traffic. The client timetable does not conform to this rule. It is possible that this rule could be relaxed, although this would result in increased road traffic congestion. The advice of Level Crossing engineers would be required in a full study.

The timetable requires two platforms to be used at Leeds to accommodate this service pattern. This is an increase on the current requirement. It will be necessary to undertake a detailed assessment of platform capacity for platforms 1 to 5 at Leeds station to understand if further enhancement is necessary to accommodate the projected increase in the number of services. The current platform capacity at Leeds station is already heavily utilised. It is projected that train lengths and frequencies on other routes as well as this one, will be increased in the future and this increase may only be able to be accommodated with additional platforms.

3.1.3 RailSys Results

Initially a Class 319 unit was simulated, using RailSys software, operating the timetabled services. This was compared to the theoretical end to end journey time achieved by the current DMU rolling stock (using Class 142 SRTs from the WTT). A class 319 unit could potentially achieve a 5 minute reduction in end to end journey time between Leeds and York via Harrogate. However, this does not take in to account the ability to path trains in the timetable or any additional pathing allowance that might occur from doing so. In the opposite direction a 6 minute reduction is possible if a class 319 unit operated the service between York and Leeds.

A class 360 unit was also simulated using RailSys. A class 360 unit could potentially offer an 8 minute reduction in journey time between Leeds and York and a 9 minute reduction between York and Leeds, when compared to the current DMU journey time.

Electrification of the route offers potential journey time reductions and as a result could reduce the numbers of units required to operate the service.

The end-to-end journey times calculated by RailSys have also been compared to the journey times specified in the client timetable. A comparison is demonstrated in the table below.

Difference in "End-to-end" Journey Time from the Scheduled Running Time

	Base Model - Current PSR			Option 1 - 75 mph PSR			Option 2 - 90 mph PSR		
	319	365	360	319	365	360	319	365	360
Leeds - Knaresborough	1:55	0:15	0:25	0:06	2:19	2:53	0:30	2:55	3:29
Leeds - York	5:07	2:48	1:57	1:06	2:02	2:50	0:11	3:40	4:31
York - Leeds	3:53	1:36	0:48	0:57	2:08	3:01	0:40	3:41	4:46
Knaresborough - Leeds	3:56	2:26	1:52	2:16	0:15	0:24	2:13	0:21	1:07

Red figures are end-to-end journey times calculated by RailSys in excess of 30 seconds longer than the scheduled journey time
Green figures are end-to-end journey times calculated by RailSys that are less than the scheduled journey time
Yellow figures are end-to-end journey times calculated by RailSys that are less than 30 seconds in excess of the scheduled journey time

The Class 319 unit does not meet the scheduled end-to-end journey times on the current infrastructure, with longer end-to-end journey times of between 1 minute 55 seconds and 5 minutes 7 seconds when compared to the client timetable. As a result two further traction types were tested (Class 365 and Class 360) using RailSys. These produced shorter end-to-end journey times although with the exception of 1 end-to-end journey time using a Class 360 unit, were still in excess of the client timetable end-to-end journey times.

The RailSys infrastructure model was amended to create option 1 infrastructure. In this model most of the route had the PSR raised to 75 mph. The exact locations of the speed changes are detailed in Appendix A. The same rolling stock types were then re-run. This infrastructure enhancement delivered significant journey time reductions for all traction types modelled. However, with the exception of 1 end-to-end journey time the Class 319 unit is still unable to meet the scheduled end-to–end journey times in the client timetable. The class 360 was able to meet the specified end-to-end journey times for all journeys.

A further variant infrastructure model was created in RailSys with the linespeed raised to 90 mph for most of the route (option 2). The locations of the speed changes are detailed in Appendix A. The location of the speed changes is the same as in option 1. Further significant reductions in the end-to-end journey times result from the increased linespeed for all traction types. The Class 319 was still in excess of the scheduled end-to end journey time specified in the client timetable for 3 out of 4 end-to-end journey times.

A speed profile graph has been produced from RailSys assuming the PSR is raised to 90 mph. This is contained in Appendix B. The graph demonstrates the acceleration and deceleration of a Class 319 (slowest traction analysed) and a Class 360 (fastest traction analysed) over the route. It also demonstrates where the trains are able to achieve the PSR.

The graph demonstrates that a Class 319 unit is not able to achieve a 90 mph PSR, except on falling gradients between Horsforth and Weeton and Knaresborough and Cattal. However, a Class 360 unit would be able to achieve the 90 mph PSR between Poppleton and Hammerton, Cattal and Knaresborough, and Weeton and Horsforth, in both directions. It also achieves 90 mph for very short distances between Pannal and Weeton and Horsforth and Headingley in the Up direction.

A table demonstrating the reduction in sectional running times due to raising the PSR to 75 mph and 90 mph is contained in Appendix C. This demonstrates that if the PSR is raised to 75 mph it has an insignificant impact (less than 10 seconds reduction) on SRTs (compared to the current timetable) between:

- Hammerton and Cattal (both directions)
- Knaresborough and Starbeck (Up direction only)
- Harrogate and Hornbeam Park (Up direction only)
- Hornbeam Park and Pannal (both directions)
- Headingley and Armley Junction (both directions)

This is a result of the combination of distance between stations and gradient. The effect of the gradient is demonstrated by a greater reduction in the SRTs for the Down direction between Starbeck and Knaresborough, and Hornbeam Park and Harrogate.

Raising the PSR to 90 mph (option 2) only had a significant impact on SRTs (compared to option 1) for all traction types between:

- Horsforth and Weeton (both directions)
- Knaresborough and Cattal (both directions)
- Hammerton and Poppleton (both directions)

If the 90 mph PSR is to be considered further then only these three route sections should be studied as the traction will not be able to deliver this higher speed on any other part of the route. Further analysis is necessary involving Permanent Way, Level Crossing, Bridge, Tunnel, Signalling and Civil engineers to ascertain the maximum speed capability of the route, and the cost and works involved. Once this analysis has been conducted, the PSR will need to be re-modelled to give a definite journey time and impact on the timetable.

3.1.4 Interaction of RailSys Journey Time Analysis on Timetable

The client timetable has been constructed using the current infrastructure. The infrastructure is most constrained for the operation of trains between York and Knaresborough due to the single lead junction at Skelton Junction and the single line sections between Poppleton and Hammerton, and Cattal and Knaresborough. The client timetable has trains scheduled to pass on the current loop between Hammerton and Cattal with a turnround allowance at York of 7 minutes. As identified earlier in this report, the turnround allowance at York is sub-standard, posing a risk to the robustness of the timetable. To achieve the required 10 minute minimum turnround (12 minutes if 2 minutes performance allowance is incorporated) and maintain the same number of units diagrammed to operate the service specified in the client timetable, would require the trains to either arrive earlier at York or depart later, or a combination of both. However, this would cause the trains to meet on the single line section between Poppleton and Hammerton. To enable this to happen, the loop between Hammerton and Cattal would need to be extended further towards Poppleton so that the trains could pass without delay. If option 2 (90 mph) PSRs are achievable and a Class 360 unit is assumed, it is possible to achieve a 15½ minute turnround at York. The trains would pass

between Hessay LC and Cat Lane UWC. Given the short distance between Poppleton and Cat Lane UWC it is likely that the most cost effective option would be to re-double the whole route section between Poppleton and Hammerton to allow this method of train operation. The passing point will alter depending on the achievability of enhancements elsewhere on the route and the traction employed. However, this is just one version of a timetable. It is entirely possible to create a timetable with trains in both directions between York and Knaresborough running to a 30 minute interval, but with trains scheduled to pass to the west of Cattal.

If the current loop between Hammerton and Cattal was extended westwards towards Knaresborough trains could be scheduled to pass on this new loop. However, due to the run time between west of Cattal and Poppleton, it would require the eastbound train to pass the next westbound train between Skelton Junction and Poppleton.

If the current track layout is retained, this will determine the timetable that can be achieved and will drive the times at Leeds. As described above, with a half hourly service on the existing infrastructure, the trains must pass between Cattal and Hammerton. This then determines the times the trains pass between Skelton Jn and York. Due to the running times that can be achieved, the train will not arrive in York in time to form the next departure to Leeds

An alternative solution to allow the increase in the turnround allowance at York would be to use additional rolling stock resources. This would allow the arriving unit at York to form the departure 37 minutes after arrival (specified timetable times). However, this would require the redundant bay platform adjacent to platform 8 to be brought back in to operation to accommodate the additional platform occupation.

Further work is required by all relevant disciplines to define the technical feasibility and costs involved to understand the issues. This should be an iterative process to ensure the best results are achieved within the budget available. Any extension or provision of a new loop which reduces the length of single track that trains currently have to traverse between York and Knaresborough will provide additional capacity. This will result in greater flexibility in optimising timetables especially if service intervals are to be increased. It will also improve train performance both on this route and other routes that Leeds – Harrogate – York trains interact with.

There are other infrastructure improvements that would have a positive impact on capacity on the York to Knaresborough route, as follows:

- Creating a new platform at York that is adjacent to platform 11. Trains to and from Knaresborough would then be routed between York and Skelton Junction via York Yards and the currently freight only lines. This would avoid the interaction with ECML trains and the requirement for many of the Knaresborough to York trains to have pathing allowance approaching or additional dwell time at Skelton Junction. It would also improve performance of the ECML, by creating spare capacity between York and Skelton Junction and removing any primary delay caused in the Harrogate line.
- Skelton Junction is currently single lead for trains being routed to and from Harrogate. This requires all opposing moves on and off the Harrogate line to have a 3 minute margin. It would therefore introduce flexibility in developing a timetable for the route if trains were able to pass without conflict on this section of route.
- Trains towards York cannot depart from Hammerton until 3 minutes after a train has arrived from York. This is to allow the signalman to collect the single line token from the driver of the train arriving from York and then take it to the driver of the train departing to York. A similar margin exists for trains arriving and departing at Cattal. If the signalling was modernised to remove the requirement for being in possession of a manual token then the junction margin at either end of the loop could be reduced from the current 3 minutes to 1 minute.

- Trains terminating at Knaresborough from Leeds are currently required after arrival to shunt back on to the viaduct before returning in to the Down platform to collect passengers and departing for Leeds. If the signalling could be enhanced a new route could be provided to allow “loaded” trains to depart direct from the Up platform towards Leeds. This would allow the turnround allowance for terminating trains from Leeds to be reduced.
- Platform capacity at Leeds is already constrained. Without the provision of additional platforms the ability to run additional services on the Harrogate lines and the Leeds North West routes will be restricted.

Further work would be required to understand the likely costs and benefits from each of the above possible solutions.

4.0 Summary

- The client timetable has 7 minutes turnround allowance at York for most services. This is below the specified Timetable Planning Rules allowance of 10 minutes. It is also assumed that the 2 minutes performance allowance approaching Skelton Junction for trains arriving at York has been consolidated in to the turnround allowance, which in effect would give a minimum turnround allowance of 12 minutes. The 12 minute turnround can either be achieved by retiming of trains in both directions which would require the extension of the loop between Hammerton and Cattal, or the use of extra rolling stock resources which would also require the addition of an extra bay platform at York.
- The increase in the number of services from the Harrogate line into Leeds is likely to require additional platform capacity. This should be considered in a wider study together with other projected increases in train length and frequency at Leeds.
- A Class 319 is unable to match the journey times required in the client timetable, even if the PSR is raised on the route to 90 mph. If this unit was employed on this route without a change in traction power, the client timetable would need to be amended with longer journey times. However, the electrification of the route and use of Class 319 units could offer a theoretical reduction in end-to-end journey time in the region of 5 minutes for Leeds to York and 6 minutes for York to Leeds compared to the current DMU rolling stock and timetable.
- A Class 360 unit is able match or improve on the journey times specified in the client timetable if the PSR is enhanced to 75 mph (option 1). It does not meet the specified journey times if the linespeed is maintained at the current PSR. The electrification of the route and use of Class 360 units could offer a theoretical reduction in end-to-end journey time in the region of 8 minutes for Leeds to York and 9 minutes for York to Leeds compared to the current DMU rolling stock and timetable.
- A Class 365 unit is also able to match or improve on the journey times specified in the client timetable if the PSR is enhanced to 75 mph (option 1). Although some minor extension to journey time would be necessary as the Knaresborough – Leeds journeys require an additional ½ minute.
- A Class 319 unit cannot achieve a 90 mph PSR unless on a falling gradient and a reasonable distance between station stops. This only occurs between Horsforth to Weeton and Knaresborough to Cattal.
- A Class 360 is able to achieve a 90 mph PSR in both directions, between Poppleton and Hammerton, Cattal and Knaresborough, and Weeton and Horsforth, and only for very short distances in the Up direction between Pannal and Weeton and Horsforth and Headingley.
- Raising the PSR between Hammerton and Cattal (both directions), Knaresborough and Starbeck (Up direction), Harrogate and Hornbeam Park (Up direction), Hornbeam Park and Pannal (both directions) and Headingley and Armley Junction (both directions) has an insignificant impact on SRTs for any traction type.
- Raising the PSR to 90 mph will only have a significant impact between Horsforth and Weeton, Knaresborough and Cattal, and Hammerton and Poppleton for all traction types simulated in RailSys, compared to raising the PSR to 75 mph.
- The analysis undertaken in this study on the client timetable suggests that the loop between Hammerton and Cattal should be extended eastwards towards Poppleton to allow trains to pass and achieve more robust turnrounds at York. It is possible, however, that an alternative timetable would require trains to pass on the route further to the west i.e. between Cattal and Knaresborough. Further study is required by other disciplines to understand the technical feasibility and costs involved in providing any additional or new loop between Skelton Junction and Knaresborough.

5.0 Recommendations

- A study of the route involving other disciplines such as Permanent Way, Signalling, Civils, Bridge and Tunnel engineers is conducted to understand the capability of the route for linespeed enhancement or re-doubling. This will allow the linespeed profile and timetable to be refined. Any further study in to linespeed enhancement should concentrate on the sections of route that have been highlighted in this report as delivering significant journey time savings. If these can be delivered then real benefits for the route will be achieved.
- A further study of platform capacity at Leeds station to understand if there is a requirement for additional platforms. This should be considered together with other projected increases in train length and frequency.

Appendix D: Estimates

Client:	**WSP UK Limited**
Project:	**Harrogate line Electrification**
Estimate Stage:	**GRIP 0** **Order Of Magnitude Estimate**

Level of Confidence: +/- 50% (GRIP 0), +/- 40% (GRIP 1)

B90412-EST-COM0001
Version P01
For Information
19 July 2013

Document History					
Version No	issued date	Description	Prepared By	Reviewed By	Approved By
P01	19/07/2013	Initial issue	Helen Morgan	Mark Davison	Steve Bunter

Project: Harrogate line Electrification
Client: WSP UK Limited
Estimate No. B90412-EST-COM0001 **Revision** P01 **Estimate Stage** GRIP 0
Estimate Date 19-Jul-13 **Price 'Base date'** 3Q2013 **Confidence** +/-30%
Anticipated Start Date 01-Jul-18 **Anticipated Finish Date** 01-Jul-19 **Mid point** 1Q2019

Estimate Breakdown			Leeds to York Via Harrogate	Site	Site	Site	Site	Site
Contractor's direct costs -								
1	Signalling		398,800					
2	Level Crossings		75,600					
3	E&P - OLE		29,689,114					
4	E&P - Power supplies		9,500,000					
5	Track		2,604,000					
6	Telecoms		2,614,517					
7	Op Property		2,475,000					
8	Structures		19,147,000					
9	Gen Civils		393,991					
10	Utilities		-					
Contractor's Base Construction Cost inc OH&P: Sub-Total A			66,898,022	-	-	-	-	-
Network Rail's direct costs / 3rd Party Charges								
	NDS - Materials			*Generally within the rates (direct costs) at Stages 0 - 2*				
	NDS - Fleet			*Generally within the rates (direct costs) at Stages 0 - 2*				
	- Engineering trains			*Generally within the rates (direct costs) at Stages 0 - 2*				
	- Tampers			*Generally within the rates (direct costs) at Stages 0 - 2*				
	NDS Possessions / isolations	2.0%	1,337,960	-	-	-	-	-
Sub - Total B			1,337,960	-	-	-	-	-
Total Base Construction Cost inc OH&P: Sub-Total C (A+B)			68,235,983	-	-	-	-	-
Contractor's indirect costs								
	Preliminaries	(Note 1)	9,737,862	-	-	-	-	-
	Design	(Note 1)	4,969,439	-	-	-	-	-
	Testing & Commissioning	(Note 1)	663,847	-	-	-	-	-
	Training			*Generally within the rates (direct costs) at Stages 0 - 2*				
	Spares			*Generally within the rates (direct costs) at Stages 0 - 2*				
Other	Possessions / isolations	1.5%	1,023,540	-	-	-	-	-
Sub - Total D			16,394,687	-	-	-	-	-
Total Construction Cost E (C+D)			**84,630,670**	**-**	**-**	**-**	**-**	**-**
Project Management & other costs								
Network Rail Project Management, (COWD)								
NR PM (forecasted remining costs)		(Note 1)	5,924,147	-	-	-	-	-
Sponsor		(Note 1)	846,307	-	-	-	-	-
Compensation charges (TOC & FOC)		2%	1,692,613	-	-	-	-	-
DCO Charges		0%	-	-	-	-	-	-
Land / Property Costs & compensation		0.3%	253,892	-	-	-	-	-
Escalation (Note 2)	No	0.00%	-	-	-	-	-	-
Other (State)								
Sub - Total F			8,716,959	-	-	-	-	-
Point Estimate - Sub - Total G (E+F)			**93,347,629**	**-**	**-**	**-**	**-**	**-**
Uplift for Risk and Contingency								
Contingencies	(Note 3)	40%	37,339,052	-	-	-	-	-
Other		0%	-	-	-	-	-	-
Project Anticipated Final Cost (AFC)			130,686,681	-	-	-	-	-
Other Costs to the Customer								
Escalation (Note 2)	Yes	21.19%	27,687,556	-	-	-	-	-
Allowance for Network Rail Fee Fund		0%	-	-	-	-	-	-
Allowance for Industry Risk Fund		0%	-	-	-	-	-	-
Allowance for Insurance Top-up		0%	-	-	-	-	-	-
Cost to Customer			**158,374,237**	**-**	**-**	**-**	**-**	**-**

Notes:-
Note 1: refer to assumptions and comments sheets for values used in the calculation of Contractors and Network Rail's Indirect Costs.
Note 2: Escalation to be included within the Project AFC if the AFC is in excess of £50m and the construction phase will be over two years in duration, otherwise included in Other costs to the Customer.
Note 3: In the absence of QRA values 40% has been used for risk.
Excludes Optimism Bias
Escalation has been added from 3Q2013 to 1Q2019, this is based on RPI at an average of 3.5% pa.

ASSUMPTIONS AND COMMENTS			
Project:	**Harrogate line Electrification**		
Tata Estimate No.	B90412-EST-COM0001	**Revision**	P01
Client ref:	WSP UK Limited		

CALCULATION OF INDIRECT COSTS

The following values have been used for calculation of Contractors and Network Rail's Indirect Costs:

Asset	Preliminaries	Design	Test & Commission	Network Rail Management	Sponsor
Signalling	18%	10%	5%	7%	1%
Lx	18%	10%	5%		
E&P - OLE	16%	7%	2%		
E&P - Power supplies	0%	7%	2%		
Track	18%	8%	0%		
Telecoms	18%	8%	2%		
Op Property	18%	8%	0%		
Structures	18%	8%	0%		
Gen Civils	18%	8%	0%		
Utilities	0%	0%	0%		

User note: Any values entered above will be carried to the estimate summary.

GENERAL

The estimates are based on information contained in:

Drawing / report ref.	Version	Title
B90412-REP-CIV00001	P01	Parapets Review
B90412-REP-PEN0001	P01	Eletrification Workshop Interventions
B90412-REG-PEN0002	P01	Harrogate Line Eletricifcation Feasibity Study Report

ASSUMPTIONS TO BE SPLIT INTO GENERIC COMMENTS AND STATION / OPTION SPECIFIC COSTS

A1 The estimate base date is 3Q2013.

A2 In the absence of QRA values 40% has been used for risk.

A3 The value of cost escalation has calculated using RPI and it is assumed that the mid point of construction will be 1Q2019. Excalation is based on an avergae of 3.5% increase per annun.

A4 ~~Escalation has been included within the Project AFC as the AFC is in excess of £50m and the construction phase will be over two years in duration.~~

~~*or*~~

Escalation is included in the Estimate Summary Report under "Other Costs to the Customer", and has been based on an expected opening date of 2019.

A5 Whist it is recognised that WSP are the client currently, it has been assumed that the works will be undertaken by Network Rail as part of the Trans-Pennine Electrification Project (TPE) project. As such additional costs for undertaking the works as a "3rd party" project have not been added into the estimate. Percentages used for prelims, design, T&C, NR PM, and Sponsor costs are based on values agreed with NR for use on the TPE estimates under taken by Tata for Routes A-D.

A6 It has been assumed that the power supply arrangement would be a boosterless classic system with feeds from York feeder station and Kirkstall feeder station. 3nr section cabins have been included within the estimate along with upgrading the York and Kirkstall feeder stations. Further costs would be incurred if an Auto Transformer system was used.

A7 Signalling immunisation costs, it has been assumed that the recent re-signalling scheme will have provided signals that are compatible with OLE. It has been assumed that no works will be required to semaphore signalling as a result of electrification.

ASSUMPTIONS AND COMMENTS

Project: **Harrogate line Electrification**
Tata Estimate No. B90412-EST-COM0001 **Revision** P01
Client ref: WSP UK Limited

A8 All structures have been gauge reviewed for OLE compliance and following an internal workshop the preferred option for archiving OLE clearance has been priced. In order to reduce the size of the BQ sheet, the structures requiring works have been priced on a separate sheet (OLE Clearance) and then costs for each section brought forward into the BQ.

A9 Track lowers assume reuse of track componentary (rails / sleepers / fittings etc) and reuse of 50% of existing ballast. In areas where the track lower is greater than 300mm it has been assumed that new track drainage will be required (including new sand blanket and geotextile).

A10 It has been assumed that level crossings already conform to current standards. Allowance has only been made for additional signs warning of OLE.

A11 Where overhead electrification is introduced over public vehicular crossing, it is assumed that any overhead wires are set at a height that do not require the introduction of bell gauges.

A12 Assumed track lowers for OB's will be at max lower for 20m then runout at 1:500

A13 Track condition suitable for tamping and re-use of material.

A14 Partial reconstruction allow for replacement of bridge deck, raising height of new deck and alterations to road levels. Full reconstruction includes the above, plus replacement of foundations and abutments

ASSUMPTIONS AND COMMENTS			
Project:	**Harrogate line Electrification**		
Tata Estimate No.	B90412-EST-COM0001	**Revision**	P01
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EXCLUSIONS

E1	Optimism Bias
E2	Double tracking of line in areas that are currently single track.
E3	Line-speed increase as a result of electrification.
E4	Costs for achieving freight W9, W10, W12, W6a gauge clearances.
E5	Signalling immunisation costs (See comment A12).
E6	Electrification of Hessay WD GF (5miles 946yrds).

OPTION SUMMARY

Project Title / Location	**Harrogate line Electrification**		
Site	**Leeds to York Via Harrogate**		
Tata Estimate No.	B70019-COM-EST0001	**Revision** P01	
Estimate Date	27-May-00	**Price 'Base date'** 3Q2013	

section	item		quant	unit	rate	total	Comments
1.0	**Signalling**						
1.01	Immunisation		-	SEU	70,000.00	-	See comment A7
1.02	Alterations to signal gantries		2.00	nr	N/A	112,000.00	See OLE Clearace Sheet
1.03	Alterations to existing signalling		1.00	sum	170,000.00	170,000.00	For tracklower / slew schemes
1.03	Adding cages to signals		32.00	nr	3,650.00	116,800.00	colour light signals only
					Signalling Total	**£398,800.00**	
2.0	**Level Crossings**						
2.01	Additional Signage (Warning OLE)		21.00	nr	3,600	75,600.00	(nr - per LX)
2.02	x		-	x		-	
					Level Crossings Total	**£75,600.00**	
3.0	**E&P - OLE**						
	Base items						
3.01	OLE stm to be electrified		96,730	stm	266.00	25,730,180.00	
3.02	AT Wire run (if required)	No	-	stm	11.50	-	
3.03	Cross overs		8.00	nr	141,000.00	1,128,000.00	(inc wire run / over runs & switching)
3.04	Turnouts		5.00	nr	68,000.00	340,000.00	(inc wire run / over runs & switching)
3.05	Over runs		-	nr		-	not required (adjoining lines have OLE)
	Extra over's for:						
3.06	Station runs		24.00	nr	10,000.00	240,000.00	Nr of Platforms
3.07	Viaduct connections		50.00	nr	19,200.00	960,000.00	Nr of pined connections
3.08	OB support arms		94.00	nr	4,500.00	423,000.00	Nr of fixings
3.09	Tunnels (cabling / fittings only)		7,514.00	m	31.00	232,934.00	length of both tracks
3.10	Embankments / cuttings	15%	290.00	nr	1,500.00	435,000.00	extra over for complex foundations
3.11	Alterations to existing OLE		2.00	sum	100,000.00	200,000.00	Allowance only (Skelton / Armley Jn's)
					E&P - OLE Total	**£29,689,114.00**	
4.0	**E&P - Power supplies**						
	Power supplies						
4.01	National Grid Connection		-	nr	17,857,143	-	£25m less risk markup
4.02	New Power supplies (DNO's)		-	nr	7,142,857	-	£10m less risk markup
4.03	Upgrade to existing feeder stations		2.00	nr	2,500,000	5,000,000.00	York and Kirkstall
	Distribution						
4.03	Track Sectioning Cabins		3.00	nr	1,500,000	4,500,000.00	
4.04	Additional 25kv for AT	No	-	sum	-	-	
4.05	x			x		-	
					E&P - Power supplies Total	**£9,500,000.00**	
5.0	**Track**						
5.01	Tracklowers / slews to achieve OLE clearances		8.00	nr	N/A	2,604,000.00	See OLE Clearance Sheet a breakdown of costs.
5.02	x			x		-	
					Track Total	**£2,604,000.00**	
6.0	**Telecoms**					-	
6.01	SCADA & Telecoms		96,730	stm	5.00	483,650.00	(based on £5k per km)
6.02	Screening cable		96,730	stm	11.50	1,112,395.00	150mm2 aluminium cable
6.03	De-lid and re-lid troughing		96,730	m	10.40	1,005,992.00	
6.04	Screening conductor linked ...		24	nr	520.00	12,480.00	... to return equipment every 4km
					Telecoms Total	**£2,614,517.00**	
7.0	**Op Property**						
7.01	Alterations at Stations to achieve OLE clearances		2.00	nr	N/A	2,475,000.00	See OLE Clearance Sheet a breakdown of costs per station.
7.02	x			x		-	
					Op Property Total	**£2,475,000.00**	
8.0	**Structures**						
8.01	Alterations / Reconstructions of Structures for OLE clearances		28.00	nr	N/A	18,672,000.00	See OLE Clearance Sheet a breakdonw of costs per structure.
8.02	Parapet works - Minor		5.00	nr	25,000.00	125,000.00	Nr of structures, Alts to existing
8.03	Parapet works - Major		7.00	nr	50,000.00	350,000.00	Nr of structures, New Parapets
					Structures Total	**£19,147,000.00**	
9.0	**Gen Civils**						
9.01	Veg clearance - Flail		115,470.00	m	2.91	336,256.49	route length x 2
9.02	Environmental		1.00	sum	57,735.00	57,735.00	relocation of protected species etc
9.03	x			x		-	
					Gen Civils Total	**£393,991.49**	

OPTION SUMMARY

Project Title / Location	**Harrogate line Electrification**		
Site	**Leeds to York Via Harrogate**		
Tata Estimate No.	B70019-COM-EST0001	**Revision**	P01
Estimate Date	27-May-00	**Price 'Base date'**	3Q2013

section	item	quant	unit	rate	total	Comments
10.0	**Utilities**					
10.01	x		x		-	inc in bridge / track estimates
10.02	x		x		-	
				Utilities Total		**£0.00**

Summary

Signalling	£398,800.00	
Level Crossings	£75,600.00	
E&P - OLE	£29,689,114.00	
E&P - Power supplies	£9,500,000.00	
Track	£2,604,000.00	
Telecoms	£2,614,517.00	
Op Property	£2,475,000.00	
Structures	£19,147,000.00	
Gen Civils	£393,991.49	
Utilities	£0.00	
Contractor's Base Construction Cost inc OH&P	**£66,898,022.49**	**Carried to estimate Summary**

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