West Yorkshire Combined Authority

Cross Hills Station

Project Inception Report

Volume 1 of 2

February 2017

Executive summary

WYCA is keen to improve access to the rail network in the journey to work area in Leeds City Region and West Yorkshire by investigating the feasibility and financial viability of constructing new rail stations. This report builds on previous work and investigates the viability and Business Case for a new Station at Cross Hills. The report's development has been managed by WYCA and sponsored by North Yorkshire County Council and Craven District Council.

The engineering study demonstrates that the proposal is viable. It should be noted however that provision of the station will increase road closure times at Kildwick Level Crossing unless alterations are made to the signalling arrangements. The road network surrounding the proposed station is currently very congested and it is unlikely that this proposal would proceed without this issue being resolved.

Immediate road access to the station appears achievable within applicable standards but further study is required to confirm sighting distances, etc.

The operational study has demonstrated that the stop of a train at the proposed Cross Hills Station appears to be possible without compromising the December 2019 SX timetable.

An outline cost has been developed for the preferred option identified for Cross Hills station from this work. The estimate is **£14,390,494**. This figure does not include Optimism Bias which is included within the Business Case analysis.

The Demand forecasting work has shown that based on the trip rates used **569,618** passengers per annum would use Cross Hills at 2015/16 demand levels. Application of the predicted growth would increase this to **985,439** per annum in 2024. At this level of demand the station would generate a revenue increase of **£2.4 million** (at 2015/16 prices) in 2024.

The appraisal has resulted in an illustrative BCR of 1.33, which suggests that the scheme should be taken forward for more detailed consideration. However it is noted that this is based on relatively optimistic demand forecasts to which the BCR appears most sensitive including the number of abstracted trips, the journey time benefits and trip purpose. Therefore, as the scheme is taken forward, priority should be given to refining the demand forecasting methodology and assumptions. This is particularly important, as the pessimistic scenario based on the trip rates used in the original feasibility study would reduce the BCR making the proposal less viable. Even if the variations in assumptions considered through the sensitivity testing, are adopted the BCR would not be sufficient unless the scheme costs can be significantly reduced. This could occur as the definition of the scheme develops and the level of optimism bias used reduces.

A review of the BCRs from this study and the previous work against the trip numbers implies that annual patronage from 2024 onwards would need to be around 900,000 passengers in order to justify the expenditure.

The following work is recommended to confirm this conclusion and prove the case for the proposed station.

1. More detailed consideration of the planning and land ownership issues
2. Further option development to confirm engineering and operational study conclusions and increase the accuracy of the cost estimates.
3. Further scheme development of the signalling proposals and the configuration of the stopping/non-stopping controls associated with Kildwick Level Crossing

4. Survey of the road closure times at Kildwick Level Crossing over an extended survey period.
5. Micro-simulation modelling of the road network to understand the access requirements in more detail
6. Further work to the demand study and business case including:
   i) surveys of users at other stations, household surveys,
   ii) More detailed analysis of forecast destination and ticket type
   iii) further refine growth in early 2017 when CP6 HLOS Capacity Study completed
   iv) repeating MOIRA work with lower elasticities
   v) repeat crowding when modelling complete and/or with final numbers
   vi) Inclusion of wider economic benefits.

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1. Introduction

1.1 Background

WYCA is keen to improve access to the rail network in the journey to work area in Leeds City Region and West Yorkshire by investigating the feasibility and financial viability of constructing new rail stations. New rail stations have played a key role and contributed to the growing number of passengers using the West Yorkshire rail network.

A new station has been the subject of a number of previous studies dating back to 2002 when a Project Inception Report was produced to investigate the feasibility of a new station albeit in a different location to that proposed in this study.

In addition, extensive correspondence has been exchanged with Railtrack and Network Rail regarding the impact of the level crossing at Kildwick on the road network and the congestion caused by the road closure time.

WYCA commissioned a “new rail stations study” review in October 2014 that covered 62 potential new rail station sites. The study resulted in the emergence of four stations having the potential to demonstrate a good business case. Two of these stations are:

- Elland (in Calderdale, West Yorkshire)
- Cross Hills (in Craven, North Yorkshire)

This report, commissioned by North Yorskhire County Council in conjunction with Craven District Council through WYCA, assesses the feasibility of a new station at Cross Hills.

1.2 Study objectives

The study is a pre-feasibility study intended principally to confirm the feasibility of the station but also to identify any constraints and key issues that must be resolved for the station to operate correctly. Key objectives of the study are:

- To build on the new rail station study conclusions and documents in section 6 and firmly establish if Cross Hills station proposals are technically feasible to construct and operate, are economically affordable and represent value for money.
- To identify in more detail any constraints or pre-requisites that would need to be addressed and how they might be addressed.
- To identify any land use planning implications in support of / as a result of the creation of the new stations to help inform / influence discussion with the local planning authorities.

The study provides:

- An illustrative appraisal to inform the decision to take the scheme to the next stage
- Identification of key issues to be resolved
- Definition of a concept
- Evaluation of feasibility and viability

It does not intend to form:

- A specification of requirements
- A firm design solution; or
- An operational solution

1.3 Structure of report

This report covers the viability of a potential station at Cross Hills. The work outlined in this report has been conducted in parallel with a further study into the viability of a similar station at Elland. Each report has been developed independently so each can be used with relevant stakeholders which are not the same in each case.

The report is structured to outline the scope of the work undertaken and then address the Engineering challenges and viability of providing a station at Cross Hills including the development of an indicative cost. The operational viability of the proposal is also addressed and finally an outline business case for the proposal is provided giving the currently perceived benefit of providing a station at the site.

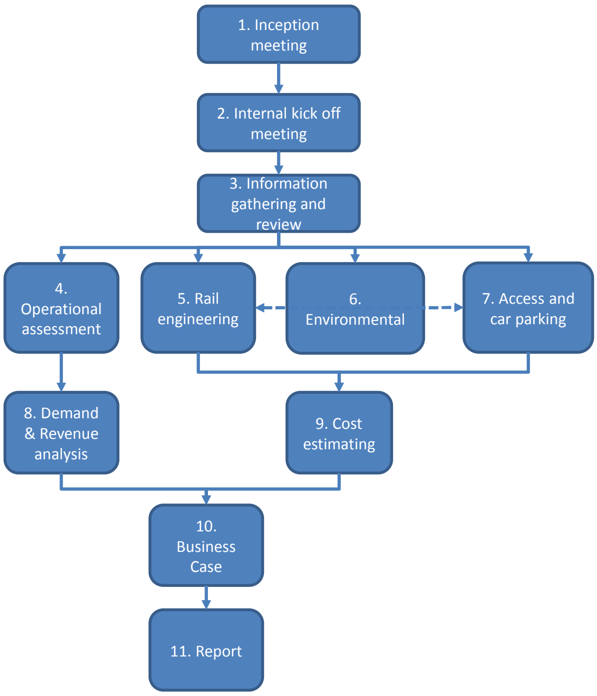
The report is structured in two volumes;

Volume 1 contains the main report with supporting information included in appendices.

Volume 2 contains supporting environmental details sourced as part of the work.

1.4 Scope and Methodology

An overview of the methodology used in our approach to this study is depicted below. Further details about specific elements of the approach can be found within the relevant section of the report.



1. An inception meeting was held at which the scope of work was confirmed, information requirements were identified and pre start assumptions were agreed. These are captured in Section 1.5 of this report.
2. An internal kick off meeting was held to confirm the scope, programme and budgets with task leaders.
3. Data was collated and reviewed in an information gathering exercise that incorporated
4. Client supplied information, e.g. previous work, OS digital mapping, traffic counts, etc.

5. Information available to the project team such as Northern Franchise 2019 timetable, source asset records in the Network Rail National Records Group.
6. A detailed list of data reviewed is provided in Section 1.6
7. Operational assessment was undertaken utilising the predicted 2019 franchise timetable, 2017 Timetable Planning Rules and current pathing allowances as a base. Run time modelling, using the GHD Run Time Model, was undertaken to quantify the extended journey time and inform timetable assessment. Generalised journey time was provided to inform the demand and revenue modelling.
8. A site visit was undertaken to inform understanding of the site constraints and development of a conceptual layout to test the feasibility of providing a station with sufficient platform length to accommodate the rolling stock anticipated to operate on the route. Concept layouts were developed taking account of track, signalling, possible electrification and the opportunities and constraints imposed by the level differences and existing civil features at the site.
9. A desk top environmental appraisal in the form of a Phase 1 environmental assessment, ecological assessment and utilities search has been undertaken to inform the engineering analysis and identify potential environmental issues
10. Access and car parking provision was assessed taking account of projected demand and modes of travel to and from the station. The impact on the immediate road network has been evaluated through the assessment of traffic count data and potential change to this arising from the introduction of the station. Modifications to the road network to enable access have been developed.
11. Base year demand and revenue forecasting has been undertaken using a trip rate methodology further informed by National Rail Travel Survey data and updated MOIRA calculations. Future year projections have been informed by the work we are undertaking on the HLOS CP6 Capacity Planning Study for WYCA, involving the preparation of forecasts through to 2024, taking account of up-to-date franchise commitments and exogenous growth data.
12. High level cost estimating has been undertaken to determine an understanding of potential construction costs. This is based on bills of quantities derived from the conceptual layouts and engineering analysis.
13. The benefit cost ratio has been calculated in line with WebTAG combining revenue and non-financial benefits and capital and operating costs. Sensitivity testing has been undertaken on key assumptions.
14. Finally, the analysis is captured and reported in individual inception reports for each station.

1.5 Assumptions

- Timetable basis
  - 2017 Timetable Planning Rules
  - Predicted 2019 working timetable and rolling stock allocations developed in consultation with WYCA, DfT, Rail North, Northern Rail, TransPennine Express and Grand Central
  - Current freight pathing allowances
  - Current infrastructure geography and constraints (i.e. junction margins, signalling headways, line speed restrictions, level crossings, etc)

  - Committed changes to infrastructure geography and resulting impact on constraints
- Background demand and growth
  - Access available to current and historical demand figures extracted from MOIRA
  - LENNON data for the work on CP6 HLOS Capacity Analysis at Leeds has not been forthcoming. We assume that the Moira data will suffice for this study.
- Train Loads
  - Average Passenger Count data for Winter 2015 from TOCs for work associated with CP6 HLOS Capacity Analysis used for these purposes.
- Changes in other rail infrastructure independent of the station schemes such as the Transpennine route upgrade are assumed to be programmed for delivery as currently scheduled in Network Rail's Enhancement Delivery Plan Update or published TOC schemes related to franchise commitments.
- Rolling-stock strategy as per Arriva Northern strategies for December 2019 and December 2024
- Future changes in exogenous factors driving rail demand.
  - Assumed Demand Driver Generator data provided by the DfT for July 2016, with any modifications resulting from discussions with DfT's NMF team and emerging trends from the work being undertaken for WYCA on CP6 HLOS Capacity Analysis at Leeds study.
- Revenues and fares policy.
  - Base revenues extracted from MOIRA.
  - Fare fluctuation of RPI + 0% assumed in line with DfT.

1.6 Data used in this study

- Five mile diagrams
- Signalling Plans Drg Nos: 0145M-A3-LNW/2 and 3
- OLE Layout Plan Drg No. L_LS_348.2-349.5
- Google maps
- BGS Bore hole records
- Envirocheck report
- Magic website
- Quail maps
- D19SX Timetable
- MOIRA data
- Working Timetable 2016
- Timetable Planning Rules 2017
- Sectional appendix
- Marlin maps
- Previous reports
  - West and North Yorkshire New Stations Feasibility Study 2014

  - Cross Hills Project Inception Report, 2002
  - Previous Cross Hills correspondence
- GHD traction library
- Omnicom data
- OS digital mapping
- Cross Hills local traffic data
- Craven District Local Plan

1.7 Consultation

Key stakeholders were consulted on the findings of this report including the current franchise operator, Northern and the local highways authority in Craven District Council. Consideration of their feedback has been incorporated.

2. Location

The proposal is to establish a new station at Cross Hills. The location outlined in the remit lies between Station Road and Skipton Road and utilises the Council Depot at this location for potential car parking. Brief consideration was given to alternatives options and these are described below and the reason for their rejection recorded.

The site for a new station at Cross Hills is bound by an industrial estate and private allotments to the North and a housing and residential area to the south; with Skipton Road to the East and Station Road (B6172) to the West. Connecting Station Road and Skipton Road is a lane or link road which has bollards part way along to prevent its use as a short cut. The Eastern side of the bollards is thought to be private property (following conversations with local residents) enabling access to the small businesses operated from this location. To the west of the bollards the lane may be under local authority control in association with access to the old shunting yard which is now used as a Council Depot for minor highways works.

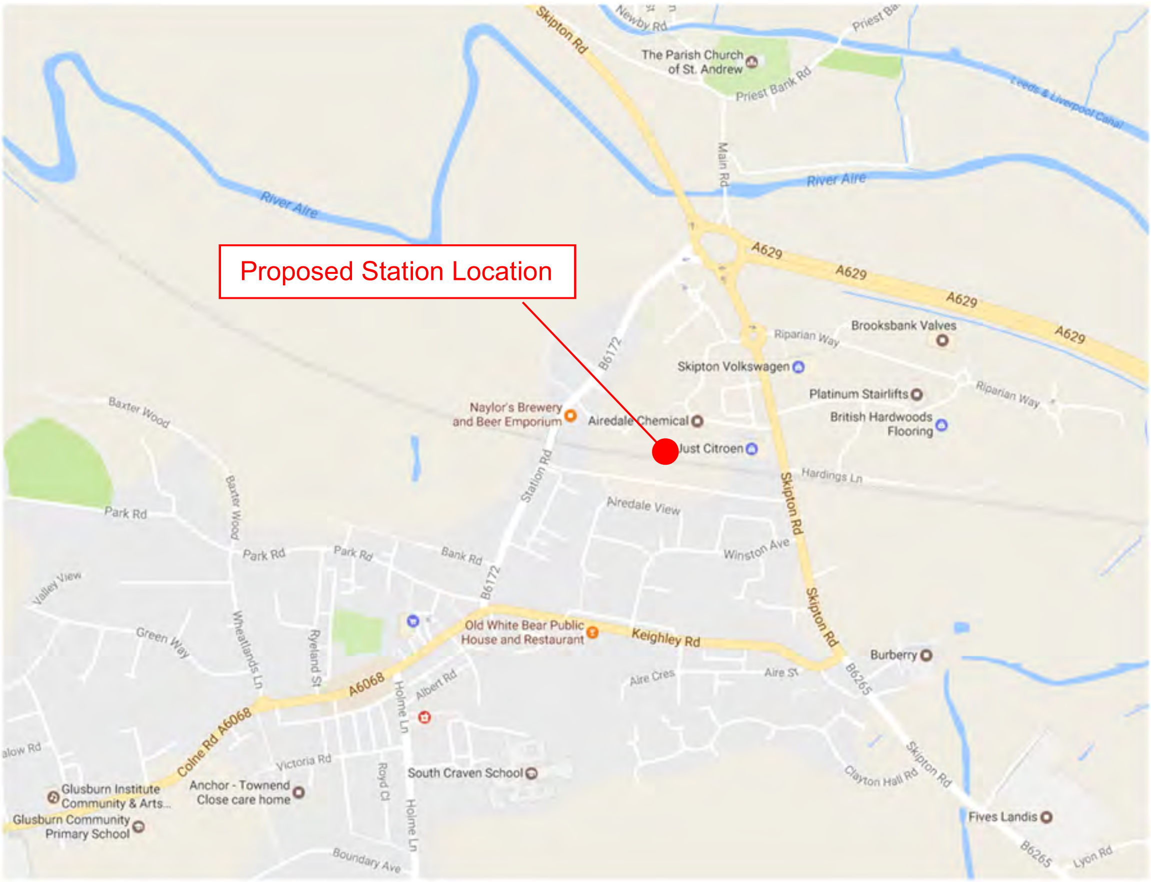


Figure 1 - Cross Hills Road Map

3. Rail Engineering

3.1 Existing Railway Infrastructure

The railway at the proposed station location is at Engineers Line Reference (ELR) TJC3 at 216 to 217 miles

From data in the Five Mile Diagrams the line is shown to be 90mph speed in both the up and the down direction and the line is at a 1:894 gradient rising to the west. The line is on straight track progressing into a transition approaching a 1167m radius curve. From this data it appears that platform construction within the required gauging and stepping standards can be achieved.

There is a crossover and level crossing adjacent to the proposed site with significant signalling works required to facilitate the station. The works are required to prevent the Level Crossing being closed to road traffic for extended periods of time. These details are in the signalling/level crossing section however from a civil engineering perspective there are a number of new signal bases required. Further work will be required at a later design stage to refine this scope of work.

It is not known what the asset condition is however the Station Road bridge, number TJC3/B79, is a con arch structure reconstructed for electrification 20 years ago and shows no obvious signs of distress. The ramps down to the track from the bridge showed no signs of geomorphic characteristics.

There will need to be a thorough site investigation, asset condition survey and topographical survey at a later design stage when access to the infrastructure can be arranged with Network Rail.

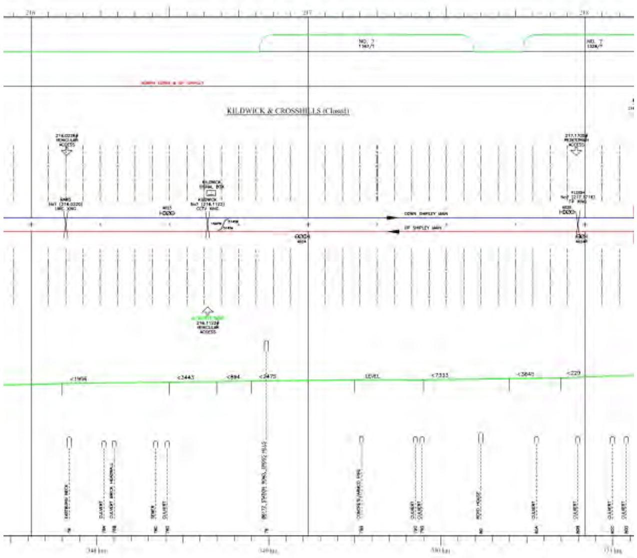


Figure 2 - -Five Mile diagram extract

3.2 New Station Proposal

As stated above the site for the new station at Cross Hills has been identified as lying between Station Road, carried over the railway by Overbridge 79 and Skipton Road which crosses the railway by way of Kildwick Level Crossing. During the site visit and generally within the study, consideration was given to the reuse of the previous two sites (discussed below as option 1 and option 2) used for a station in this location. These were adjacent to the Level Crossing and to the West of Station Road.

A facility close to the Level Crossing was rejected primarily due to the viability of creating any access in the area close to the crossing. The crossing is currently blocking the highway to allow the passage of trains for at least half of each hour. Creating any access that would require vehicles turning into an access close to the crossing is therefore likely to be unacceptable and would potentially create a considerable safety risk. A station located to the West of Station Road would have issues with access due to the height differences between road level and the proposed platforms, in addition the railway is on a curve at this location and the positioning of platforms here would be undesirable.

The chosen location and preferred option, would provide sufficient length for the required platforms and sufficient room for parking and taxi/kiss and ride access within the existing council Depot site. The station would have a footbridge with lifts and some signalling alterations would be required to mitigate the effects on Kildwick Level Crossing. This option has been used within the report for the proposed Cross Hills Station.

3.2.1 Option 1

Option 1 is where the first or Old Station was sited and some of the buildings are still in place however, as outlined above, this location is no longer viable for a modern station. The site has operational constraints to the east where there is a level crossing. If alterations to the signalling are not made this would require the barriers to be down when an east bound train stops at the platform and traffic waiting times would be extended. The amount of time the barriers close the road to traffic here is already a major concern. This impact could be mitigated with the platforms being split either side of the crossing however this is undesirable from an operational point of view and the automated level crossing control equipment is sited at the alternative platform location and would need to be relocated at considerable expense.

Due to high road traffic flows, the difficulty of providing access, the proximity of the existing properties and relative remoteness of the car parking opportunities this option is not considered viable and has not been progressed.

3.2.2 Option 2

The second Station location, formally known as Kildwick and Cross Hills Station, was closed in 1965. The access to this is via ramps (approx. 1:10 gradients) from the western side of the bridge on Station Road (TJC3/79) to the trackside area. Here the track is on a curve and canted to suit the 90mph line speed, making compliance with stepping and gauge clearance requirements challenging.

There are Signals and Overhead Line Electrification structures, which obstruct the likely platform footprint. The footpath on the bridge is only 1.0m wide at its narrowest, which would not be sufficient for modern accessibility requirements. There is no alternative access below the road as the structure provides constraint having lateral clearances for trains only. To comply with person of reduced mobility standards there would need to be a new access point and the existing bridge extended or replaced or alternatively a new footbridge with lifts established. As with the other options, land acquisition would be required.

The combination of these issues and complexities restricted investigation of this option, which was rejected.

3.2.3 Option 3

The site considered most appropriate is in the old Goods Yard currently used by the Council as a depot for highways maintenance. This site avoids disrupting the privately owned properties at the Skipton Road end of the site and has access from Station Road. The access is adjacent to the ‘humped back’ bridge but the highways work suggests the sight lines, etc. would be acceptable subject to topographical survey to establish that the vertical profile does not restrict visibility.

3.3 Preferred Option

As outlined above the preferred option is Option 3.

3.3.1 Platforms and car park (see Drg No. 66-10823-C002)

As shown below there is sufficient space to position the required platform length between the bridge and level crossing with capacity to extend in future years. Analysis of industry plans has identified that trains using the station in the foreseeable future, i.e within the next 10 years, could have a maximum possible train length of 138 m. A platform length of 141m can be accommodated and has been used in the drawings and estimates for the station. Stepping and Gauging compliance requirements should be achievable without significant challenge.

Figure 3 - Photo to indicate the platform length potential between structures

The preferred option utilises the depot land for the station entrance and carpark. The chosen option is to construct a platform on the down and the up lines opposite each other with a connecting footbridge and Lifts to achieve person of reduced mobility step free access.

The access to the parking area is from Station Road and the existing lane would need to be upgraded. A turning head would be formed at the station entrance and rights of way would need to be further investigated and accommodated. Some allotment land may need to be bought to facilitate the platform and its construction on the up line (East Bound). Access by footpath to this platform from Station Road appears viable but this would be stepped preventing DDA compliant access by this route.

3.3.2 Railway infrastructure changes

The Track alignment will remain significantly unaltered as it is constrained by the level crossing and the bridge.

The existing overhead line electrification system will require alteration through the platforms as the current supports conflict with the proposed work. The work would include installation of portals or twin track cantilevers that could be installed and equipment transferred prior to platform works. Portals may allow increased flexibility as the portal legs can be designed to completely avoid platform equipment.

There are vertical OLE design restrictions at both ends of the proposed station. At one end a level crossing and crossover; and at the other an overbridge to pass under.

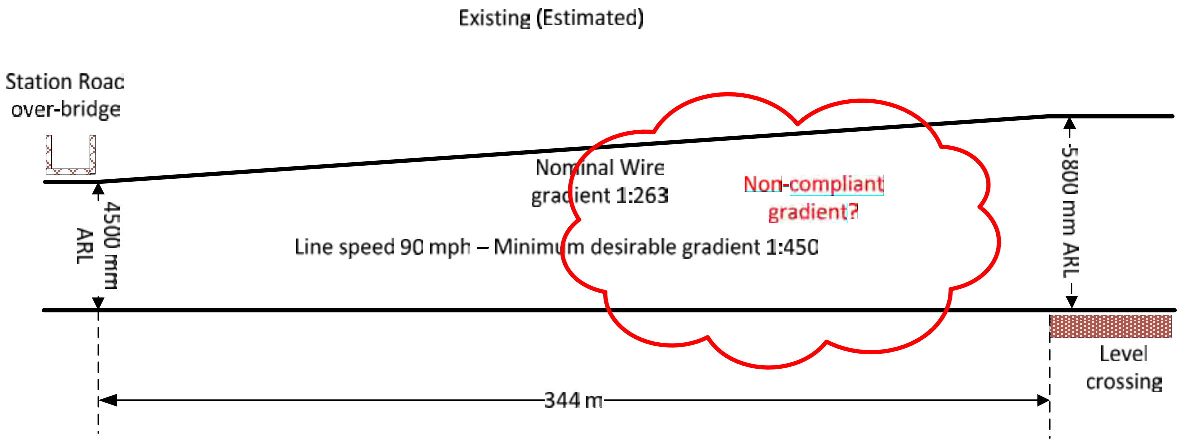


Figure 4 - Indicative vertical geometry of existing OLE

Data indicating the height of the contact wire and fixing arrangement to Station Road over-bridge has not been available for this study therefore to understand the potential implications of the vertical constraints an assessment of wire gradient and vertical clearance has been undertaken based on minimum clearances. Assuming a worst-case scenario of minimum wire height under the bridge and level crossing the existing gradient of the contact wire is potentially non-compliant with current standards. The clearance requirements of BS EN50122 would require the contact wire height at the platform to be ca 4.8 m. Provision of the station in its proposed location would nominally achieve this whilst retaining the existing wire gradient.

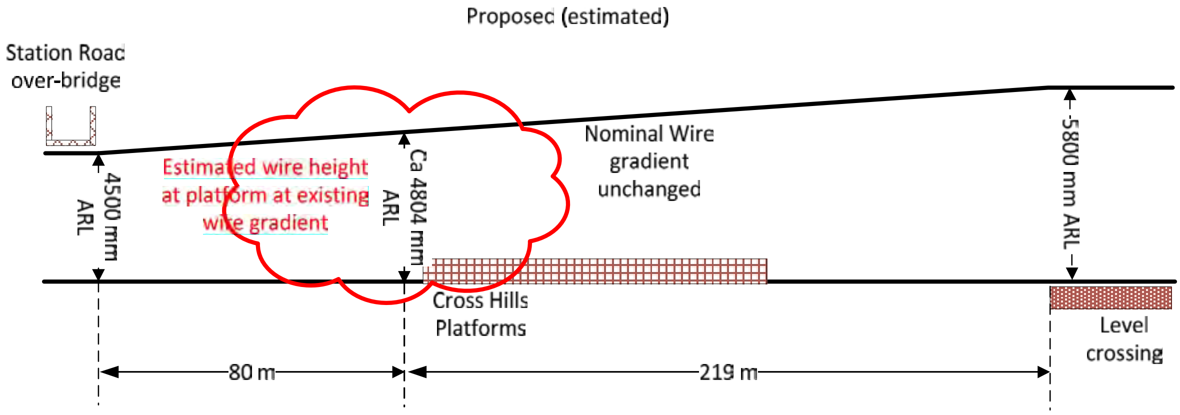


Figure 5 - Indicative vertical OLE geometry with proposed station

There is a risk that the introduction of the station may be perceived as significant work and the non-compliant wire gradient may not be acceptable. Further work should be undertaken in the next stage of development to ascertain through survey: the gradient of the existing wire, its compatibility with the proposed station site and the acceptability of the resultant wire gradient and clearances.

The wire height is likely to form a constraint on the footbridge soffit height.

These factors combined with BS EN50122 clearance requirements from platform edge to live equipment will heavily restrict where equipment can be positioned through the station and further detailed study and design is required.

3.3.3 Geotechnical

A brief review of records shows the site is situated within the River Aire basin and has surface material consistent with watercourses. This is as shown made up of clays, silts, sands and gravels and is overlain onto glacial deposits and then Sandstone / Grit bedrocks with coal measures.

The available data suggest that footings/raft foundations or friction piles may be founded on the boulder clay identified in the borehole records.

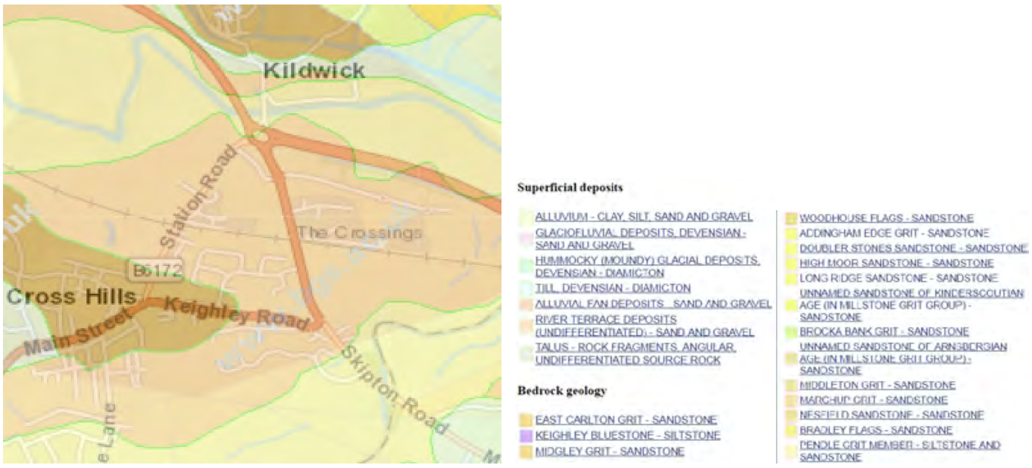


Figure 6 - Geological Information

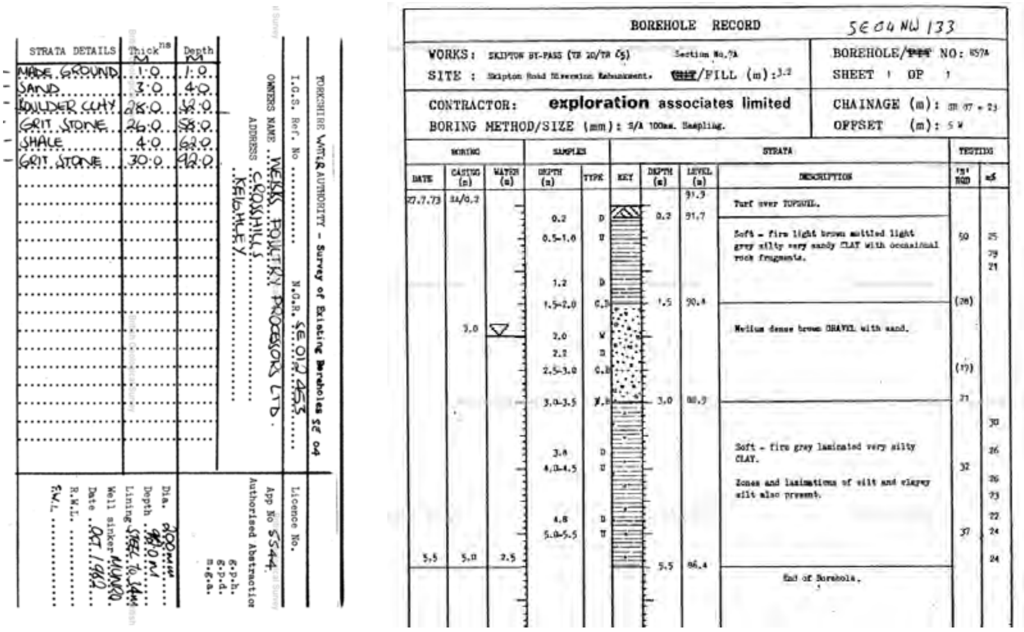


Figure 7 - Bore Hole Records

A full desk study followed up with intrusive investigation and analysis will be required at a later stage. This will ascertain, in detail, the materials at the site to allow design of foundations and any slope stability considerations.

3.3.4 Utility Searches

The utility search has identified a number of service providers who have assets that may be affected by any works undertaken at the Site. These companies represent gas, rail and telecommunication services. Other utilities are present in close proximity to the Site boundary. The following utilities are shown to be present on-Site:

Medium pressure gas pipelines run across the eastern end of the Site from north to south, Telecommunications cables (Instalcom and Vodaphone) run alongside the northern edge of the railway line that crosses the Site from east to west.

It is recommended that the information provided by the utility companies in Volume 2 is read and understood and appropriate communications with them undertaken. For example, Northern Gas states that:

"If you or one of your contractors plans to work near gas pipes or other Northern Gas Networks equipment you must let us know."

Works requiring notification would include, but not limited to: seismic surveys, excavations within three metres of the pipeline, or piling within fifteen metres.

To date, 9th December 2016, no response has been received from the Environment Agency, KPN International and TATA Communications. These entities are legally obliged to respond to a utility request; however, the date of response is not known. The outstanding information will be sent to WYCA when received by GHD.

A response has not been received from North Yorkshire County Council; however, they are not legally obliged to respond. Should information be received from North Yorkshire County Council, GHD will provide it to WYCA.

4. Access

4.1 Current situation

The proposed Station site is located to the north of Cross Hills centre directly to the south of the railway line which passes under Station Road and crosses Skipton Road at Kildwick Level Crossing to the east.

Station Road runs south to north from Keighley Road to the south-west of the site, to the roundabout of A629/Skipton Road/ Station Road to the north and forms one of two routes into or out of Cross Hills. Access to the proposed Station will be from an improved existing access road located approximately half way along its length. The location map of the site and the junctions considered within this study together with supporting drawings referenced in Section 4 are provided in Appendix B

A site visit was undertaken on 10th November in order to observe traffic behaviour and conditions within the vicinity of the site and review pedestrian routes to the site.

During the visit it was noted that Station Road is heavily trafficked for the majority of the morning and evening peaks with queuing along its length occurring before and remaining for some time after the traditional peak period.

Skipton Road is located to the east of the site and runs south to north from Eastburn to the roundabout of A629/Skipton Road/ Station Road to the north. This road also experienced queuing for significant lengths of time during the peak hours, this is due to prolonged road closure times associated with Kildwick level crossing located to the east of the proposed site, it is considered that the crossing is closed for at least 30 mins in each hour.

North Yorkshire County Council Highways have been contacted as part of this study but have confirmed that there have been no previous studies looking to improve the traffic conditions associated with Station Road or Skipton Road.

4.2 Sustainable Access

There is potential for two main routes into the site for pedestrians. The primary route will be from Station Road via the site access road and the secondary access will be from the eastern end of the existing access road which can be reached from Skipton Road.

As the proposed station would be located very close to the residential area of Cross Hills there are footways on all approaches to the site. There is currently only footway provision on the western side of the bridge located to the north of the site. However, there is little opportunity to provide footways on both sides of the carriageway due to the width of the bridge itself and consideration would need to be given to improve crossing facilities on Station Road at the new Station entrance. There are no formal pedestrian crossing facilities in the vicinity of the site, however there are multiple drop kerbs along Station Road.

The walking accessibility catchment plan, Appendix B2 shows a 0.4km, 0.8km, 1.2km, 1.6km and 2.0km walking catchment area around the site, this demonstrates that the majority of Cross Hills is within the IHT preferred maximum walking distance of the proposed station for commuters.

Clearly, it is anticipated that the new Station will result in a number of new walking trips to the facility from the surrounding residential and employment areas. The bulk of the housing in Cross Hills lies to the south of the railway line, however, it is recognised that the new facility provides an opportunity for employees of the business park to the north east of the site, accessed off Skipton Road, to use the train to access their place of work.

These additional pedestrian movements will result in some increase in pedestrian activity on the Kildwick Level Crossing, however Skipton Road has footways on both sides of the carriageway along its extent, including at the level crossing. Site observations indicate these are lightly used providing adequate waiting space for pedestrians, away from the carriageway, when they are required to wait at the level crossing.

Cycling has potential to substitute for short car trips to the proposed station, particularly those within 5km. Appendix B3 shows that the whole of Cross Hills is within 5km of the site, as is Glusburn, Kildwick, Eastburn and Silsden. It is unlikely that there will be any trips by bicycle from Silsden as there is a train station at Steeton which is significantly closer.

Carriageways throughout Cross Hills are suitable for cyclists with speed limits of 30mph. However, the A629 from Silsden and Skipton is the exception to this as it is a high speed road and does not provide a particularly conducive route for cycling to the site.

The nearest bus stops are located 180m to the north of the site on either side of Station Road. The frequency of services at these locations is shown in Appendix B4 along with plans showing the areas from which a bus can be used to access the site within 30 minutes, Appendices B5 and 6. Guidance from the CIHT suggests that the desirable walking distance to a bus stop is 400m and therefore the provision of a bus stop within the station car park has not been considered further.

Demand analysis suggests that 79.1% of passengers using the station are likely to reside within 1500m of the site and will walk, cycle or use local buses to access the station. As a result, 20.9% of the passengers using the station are likely to arrive by car.

4.3 Traffic Impact

Traffic data for junctions in the surrounding area, collected in 2015, informs the as the base scenario for this assessment. Growth rates determined using the National Transport Model (NTM) adjusted Trip End Model Presentation Program (TEMpro) Version 7.0 suggest that growth has been experienced at a rate of 1.0055 and 1.0062 meaning that growth is less than 1%. The base traffic flows are contained in **Appendices B7 and B8.**

The junctions for which we have obtained traffic data are as follows;

- A629/Skipton Road/ Station Road
- A629/A6034 Keighley Road
- A6068 Skipton Road/Riparian Way/Industrial Access
- A6068 Skipton Road/B6265 Skipton Road/B6068 Keighley Road
- B6265 Main Road/Sutton Lane
- B6068 Keighley Road /A6068 Street/B6172 Station Road

Alternatively, there is scope for the creation of a pedestrian access from the north between Station Road and the light industrial estate. This would obviate the need for pedestrians from the North to cross Station Road Bridge. It is noted however that the majority of the pedestrian traffic will be from the residential area to the south of the proposed site.

The number of passengers arriving at the site by car is expected to be 242 per day, this is a future year prediction and represents the demand in the year 2023.

The daily profile of arrivals and departures has been derived from survey data obtained for six stations with similar characteristics to those included within this study. The peak for boarding trains is 20% of daily total between 0700 and 0800 hours, whilst the peak for alighting is 15% of daily total between 1800 and 1900 hours, the full daily profile is included in **Appendix B9**.

The daily profile has been used to inform a car park accumulation calculation and to determine the peak flow of vehicles entering the station car park in the morning and evening peaks. Based on 242 daily arrivals, the peak car park accumulation and therefore required number of spaces is 75, this occurs between 1200 and 1300 as after this time the number of vehicles arriving is less than the number of vehicles departing. A car park design has been produced showing 148 spaces and is attached in **Appendix B10.** As design is developed further the number of spaces provided can be more closely aligned to the expected demand.

The peak arrival times are 0700-0800 in the morning and 1800-1900 in the evening with 48 arrivals in the morning and 36 departures in the evening. The car park accumulation for the daily profile is contained within **Appendix B9.** It is acknowledged that the station peak and the network peak do not coincide but in order to provide a worst case scenario the station peaks and network peaks have been combined for the operation assessment of the site access.

In order to assess the likely impact of trips to the station on the local road network the likely distribution of trips has been considered. The distribution and associated flows contained in **Appendices B11-15** assume that;

- 12.5% of trips arrive from the north on Station Road from Kildwick,
- 88% arrive from the south via Station Road,
- 62.5% arrive from Glusburn, Sutton-in-Craven and New Road Side,
- 25% arrive via A6068 Keighley Road from Eastburn.

The morning and evening peak arrivals and departures to the site have been combined with the 2015 base traffic flows in order to calculate the impact of the increased flows on the local road network, the net increase and percentage difference for each movement at each junction on the network has been calculated in **Appendices B16 and 17.**

This analysis shows that the priority junction located at the southern extent of Station Road will need to accommodate 88% of the trips associated with the station. This would mean 42 arrivals and 15 departures in the morning peak, and 13 arrivals and 32 departures in the evening.

The overall impact at this junction equates to an increase of 3.4% in traffic movements through the junction in the morning peak and 3% in the evening peak. This does not represent a significant increase in flows, being less than the day to day variation in traffic flows, and is unlikely to have an impact on the operation of the junction as a whole.

Access to the proposed site will be from Station Road via a priority controlled junction as shown in **Appendix B18.** In order to form an access from Station Road into the existing access road we have proposed closing Back Station Road. This would allow the bell mouth of the new Station Access to be formed and avoid conflicting movements from Back Station Road across the new access. The proposed layout suggests that sightlines are compliant with the Manual for Streets but survey would need to be undertaken to obtain vertical profile data to verify this. Some easement of the current boundary to the Council depot would be required to create sufficient width in the access road.

The section of Back Station Road, which would be closed, runs parallel to the new Station Access Road, and access to the remainder of Back Station Road could be provided from the new access road. Land ownership data shows that Back Station Road is privately owned and therefore further assessment of viability is required.

In order to demonstrate that the proposed site access can accommodate the flows associated with the proposed station a capacity assessment has been undertaken using Junctions 8, the results of which are contained in **Appendix B19** and tabulated on the next page.

Table 1: Cross Hills Site Access Junctions 8 Assessment

	AM		PM	
	Queue	**RFC**	**Queue**	**RFC**
Site Access	0.04	0.03	0.08	0.07
Lowfields Way	0.13	0.09	0.03	0.03

The table above shows that there is a significant amount of spare capacity at the site access junction with very little queuing. The Ratio of Flow to Capacity (RFC) is a measure of spare capacity at a junction, and an RFC value up to 0.85 is normally considered to provide an acceptable level of operation at new junctions. It should be noted that this assessment does not reflect the existing queuing on Station Road, further micro-simulation would be required to understand this issue with greater clarity.

Due to the queues currently experienced on Station Road it is expected that some commuters who currently drive from Cross Hills will choose to travel by train in the future. This is likely to mean a reduction in car trips on Station Road as some opt to walk to the station or park and ride using the station car park.

It should be noted that none of the above considers the number of kiss and ride journeys to and from the site, however due to the significant spare capacity at the site access it is not envisaged that kiss and ride related trips will have a significant impact on the operation of the junction.

Although the above assessment demonstrates that a station in Cross Hills will have little to no impact on local traffic it is recognised that congestion is a significant existing issue in the area. In order to demonstrate that the station has very little impact on the local road network it is suggested that a microsimulation model be produced to replicate the existing highway conditions in Cross Hills. A future year scenario would then be produced with and without the proposed station. This is expected to show the minimal increase in travel times and queue lengths associated with additional trips to and from the proposed station.

In addition, the model could be used to assess highway improvement schemes allowing WYCA/NYCC to test improvement scheme options and demonstrate overall improvements to the network.

5. Kildwick Level Crossing

5.1 Introduction

Kildwick Level Crossing is a manually controlled barrier crossing monitored by CCTV (MCB-CCTV) from York Integrated Electronic Control Centre (IECC). It is located on the Shipley lines between Keighley and Skipton and protects the road traffic and pedestrian movements on the A6068 Skipton Road.

The crossing is reported to experience prolonged road closure times due to the configuration of the signalling system and protection arrangements for the crossing; with average road closure time in the order of 35 minutes in the hour. This is reported to cause significant queuing of road traffic, particularly in the peak hours. It is considered likely that a new station at the proposed Cross Hills site will exacerbate the road closure time creating increased road congestion.

The railway defines the direction of travel on the network in terms of up and down. This can become confusing to the lay-person. For the purpose of consistency the terms Up and Down have been used extensively in this section and are defined as follows:

Phrase	Direction of travel	Line name
Up Direction	Towards Leeds	Up Shipley
Down Direction	Towards Skipton	Down Shipley

5.2 Current operation

Kildwick Level Crossing is supervised and operated from York IECC by means of a CCTV monitor and desk mounted control panel adjacent to the signaller's workstation.

It is protected to the west by Signal No. 4024 located approximately 600 m from the crossing. To the east the crossing is protected by Signal No. 4023 located approximately 290 m from the crossing. These signals are interlocked with the road barriers such that when the road is open the signals will display a red aspect. In order for the signaller to set the route over the crossing and clear the signals to a proceed aspect for an approaching train the crossing barriers must be down and the signaller has to confirm the crossing is clear of vehicles and pedestrians by operation of a crossing clear button.

The crossing controls are configured to prioritise rail traffic over road traffic. This is achieved by completing the crossing closure sequence and clearing the protecting signals before the approaching train sees a restrictive aspect causing the driver to apply the brakes. The crossing initiation points therefore are situated on the approach to the green aspect as indicated in the sketch below.

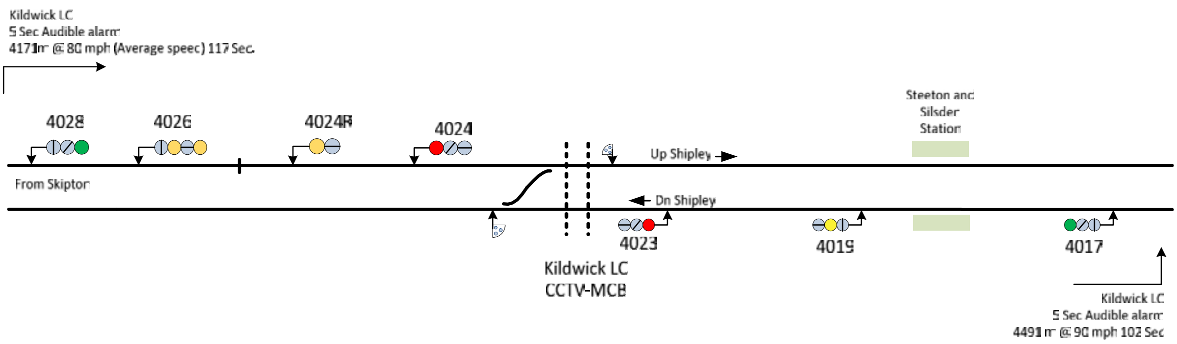


Figure 8 - Existing signalling arrangements at Kildwick LC

The four-aspect sequence to the west of the crossing causes the crossing initiation point to be located on the approach to Signal No. 4028; and to the east, the three aspect sequence causes the initiation point to be located on the approach to Signal No. 4017; east of Steeton and Silsden Stations. The approach times indicated in the sketch are those taken by a non-stopping train to reach the crossing and are the minimum times that the road will be closed for the passage of a single train in the relevant direction.

The crossing lower sequence is initiated by the signaller upon receipt of an audible alarm. The barriers are equipped with an auto raise feature that raises the barriers and opens the road to traffic once all trains have been proved to have left the crossing.

In the current timetable there are up to 11 trains per hour operating over the crossing. Trains are timed such that a train travelling towards Leeds generally coincides with a train travelling towards Skipton and therefore the crossing will remain closed until both trains have cleared it. The length of time the crossing is closed to road traffic is dependent upon when a train a train arrives at each initiation point. A worst case calculation for non-stopping trains would be:

Up direction approach time (Train travelling towards Leeds)	117 seconds +
Down direction approach time Train travelling towards Skipton)	102 seconds +
Time for train to leave the crossing	14 seconds[1] +
Minimum Road Open Time	20 seconds
Total road closure time	253 seconds

It should be noted that the location of Steeton and Silsden Station to the east of Kildwick Level Crossing means that stopping trains travelling towards Skipton cause extended road closure time at the level crossing compared to non-stopping trains travelling at line speed. This is as a result of the train decelerating to a stand in the station, waiting in the station for passengers to disembark and board (the dwell time[2]) and then accelerating back up to line speed. The road closure time for a stopping train travelling towards Skipton, including a 60 second dwell time at Steeton Station, was estimated in our run time analysis to be in the order of 6 minutes.

Observations taken on the 15 November 2016 between 12:00 Hrs and 13:00 hrs indicated a road closure time of ca 5 minutes when a train was approaching the crossing from both directions at the same time. The positions of each train relative to the crossing were not known however, the analysis above suggests that the road closure time is dominated by the train travelling towards Skipton.

[1] 7 second allowance for each train
[2] 60 seconds in 2016 Timetable Planning Rules

Whilst outside the scope of this study it is noted that the signal layout on the Down Shipley line lends itself to the application of stopping and non-stopping controls as a means of mitigating the road closure time at the crossing and contributing to the alleviation of congestion on the surrounding road network.

5.3 Impact of proposed Station

In the up direction, the proposed site for Cross Hills Station places the platform on the approach to the crossing between the protecting signal, 4024 and the level crossing. Run time analysis has demonstrated that the effect of the station dwell and associated deceleration and acceleration on the approach time to the crossing is extended by ca 95 seconds resulting in a potential road closure time for a stopping train of 219 seconds, an increase of 77% cf a non-stopping up direction train.

In the down direction, the proposed station is on the exit side of the crossing and the effect of the provision of Cross Hills Station on the approach times in the down direction are assumed to be negligible. In practice, there will be a small worsening of road closure times due to the train decelerating to a stand in the station rather than continuing to travel at line speed.

Comparison of a theoretical combination of trains based on the 2019 train service specification[3], whilst not being able to provide an absolute measure of increased road closure time, demonstrates that the provision of the station is likely to significantly increase the overall road closure time in any one hour. Current road closure time within any one hour is already perceived to be at the limit of acceptable margins (ca 30-35 minutes). An increase beyond this level will present serious risk to the viability of the proposed station site.

5.4 Potential mitigation to increased road closure times

Potential mitigations to increased road closure time include:

1. Closure of the crossing and replacement with a bridge.
2. Provision of stopping and non-stopping controls on the level crossing.

It is understood that the closure of Kildwick Level Crossing has been investigated in a previous study that identified bridge construction costs in the region of £6 million and struggled to make a positive business case. Consequently, this option has not been investigated further in this study.

A potential mitigation to the projected increase in road closure times associated with up direction stopping trains is to provide stopping and non-stopping controls on the crossing. The provision of stopping controls enables the protecting signal to be held at red and the crossing to remain open while the approaching train is undertaking its station stop. In order for this to be implemented, the protecting signal must be located between the station and the crossing.

At Cross Hills, the proposed station site is located between what would be the protecting signal, 4024 and the crossing. In order to implement a stopping control Signal No. 4024 would need to be relocated as indicated in the sketch on the next page.

[3] See Appendix A2.2 - Kildwick Level Crossing Timing Calculations

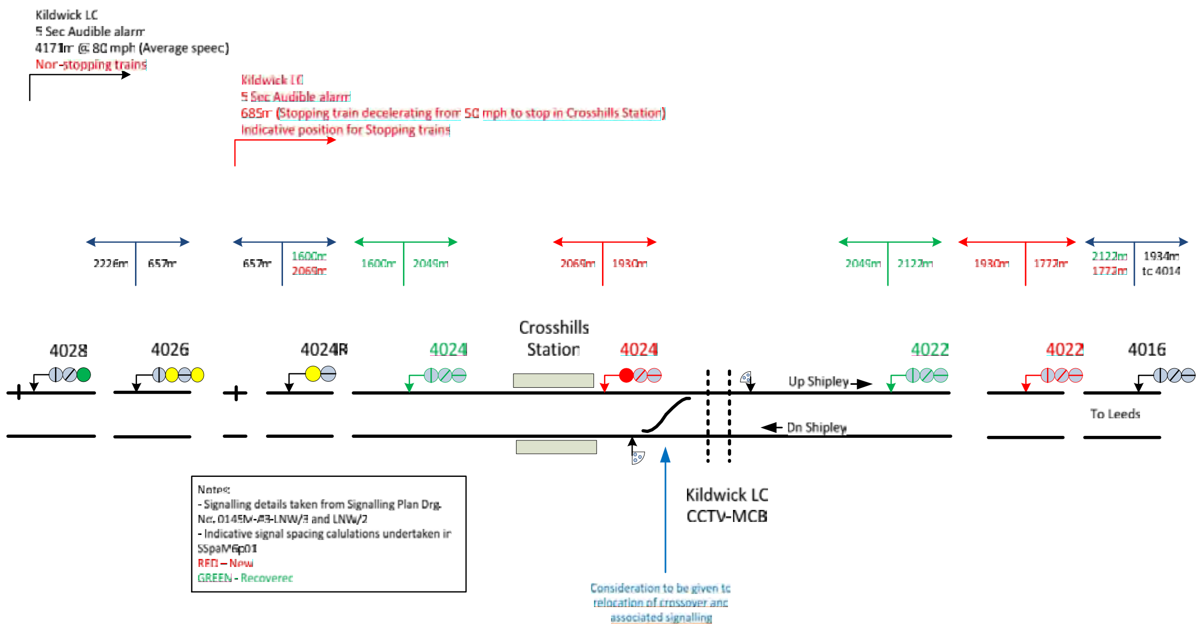


Figure 9 – Signal 4024 Relocation Sketch

In order to maintain satisfactory braking distances, the relocation of 4024 signal would require Signal No. 4022 to be relocated also. There are a number of constraints on signal positions on this route including electrification features and level crossings of various types. Further scheme development would be required to determine a robust solution but this preliminary analysis indicates the repositioning of signals is feasible.

Relocating Signal No. 4024 would place the trailing crossover at Kildwick in the overlap of Signal No. 4026. This would necessitate an interlocking alteration on the Solid State Interlocking to prevent the crossover being used in the reverse position when a train is approaching Signal No. 4024 at red. The trailing crossover is understood to be an emergency crossover for use in perturbation. If this assumption is correct, the presence of the crossover in the overlap would only impact operations when the service is already disrupted. However, Network Rail may want the crossover to be relocated to overcome any potential loss of recoverability or capacity on the network.

The indicative location for the revised position of Signal No. 4024 enables a stand-back of 25 m to the proposed stopping point on the platform. However, Kildwick Level Crossing would be within the overlap of the signal, ca 105 m from the indicative signal position. In exceptional circumstances, where a train over-runs the signal at red, the train detection controls at the crossing would need to be configured to initiate the red road lights without the amber sequence when the train occupies the overlap as part of an emergency response from the system.

Relocation of Signal No. 4024 would enable the crossing to remain open while the train approaches the new station and undertakes its station stop. The creation of a revised crossing initiation point for stopping trains would be necessary to activate the crossing closure sequence in sufficient time that the train can proceed at its booked time from the station, i.e. without service disruption. Preliminary assessment, informed by run time modelling, indicates this could be ca 685 m from the crossing. The effect of this revised approach indicates the road closure time for a stopping train in the up direction may be reduced to ca 104 seconds; a potential benefit of up to 20 seconds[4].

A comparison of the effect of stopping controls in the up direction on the theoretical train service specification used above indicates that stopping controls could be configured to maintain

[4] Calculations that support this are provided in Appendix A2.2 - Kildwick Level Crossing Timing Calculations.

current road closure times, if not better them, assuming a similar service frequency. Further scheme development and liaison with Network Rail is required to determine the absolute level of benefits.

Stopping and non-stopping controls would need to be provided for the signaller in the control centre to enable them to select the appropriate mode for each train approaching the crossing. This would necessitate alterations to the signallers crossing panel at the control centre.

The signalling plans indicate that this area is controlled from York IECC (Integrated Electronic Control Centre). Screen changes will be required to the signallers IECC workstation to depict the revised relationship between the position of Signal No. 4024, its overlap and the crossing and crossover. A programme of work is underway to transfer control to the new Route Operating Centre in York with the transfer of York IECC currently scheduled for December 2019. There is a risk that a cost associated with the transfer of control may be levied against the station scheme in addition to the cost of any screen changes.

In IECC areas it is common to have Automatic Route Setting (ARS). This system bears some of the signaller’s workload by automatically setting routes in the signalling system dependent upon train location and the timetable. It is assumed that ARS is provided at this location; the provision of stopping and non-stopping controls would require alterations to the ARS data.

6. Constructability

The scheme is at concept definition stage only but some consideration has been given to the constructability issues.

Construction Traffic and Access Points

The southern part of the site at Cross Hills is predominantly on the council depot land and this, once remediated as required, will form the transport access and car park area. This area is suited to accommodating the required site establishment and secure site compound. It will also be the main craneage area for the lifts, which being adjacent to and over OLE, will require pile mats and collapse zone consideration. Access can be achieved from the B6172 Station Road or with permission from the owners A6068 Skipton Road which will be better suited to larger vehicles. The Northern part of the site will require access agreements from Private Landowners.

Railway Infrastructure protection

The method of protecting the railway during construction of the platforms will depend on the system adopted and this is likely to be decided by the contractor; however all the NR standard designs can be deployed. There are varying constraints associated with the selection of foundation design. Piled foundations will need protection of the OLE and the track including critical rail temperature and track position monitoring. All NR protection processes will need to be deployed during the construction phase including Construction Phase Plan, Works Package Plan, Possessions and safe systems of work as laid out in NR standards and GRIP protocols.

Footbridge and lifts

The lift tower on the southern side may be lifted in from the carpark with protection to the railway corridor in place. The northern lift shaft will need to be lifted over the line and placed into position in a similar manner however; there is opportunity to reduce risks to the railway though lifting from the industrial estate where there are two options to site the crane if the road is protected and the landowners' permission obtained.

Platform Construction

Construction of the platforms on the southern side can be achieved from the site compound areas under NR controls. Construction of the platform on the northern side would be best achieved through access from the industrial estate and a satellite compound area may be required on this side, alternatively an access along NR property may be agreed from the Skipton road adjacent to the level crossing.

Carpark Construction

This will be undertaken in 2 stages. The initial fencing remediation, drainage, ducts, access roads, formation and sub base works would benefit the site operations if done early. The installation of the surfacing, lighting and white lines etc. need to be done once all heavy works is complete

7. Environmental

7.1 Flooding

The whole of the Aire Valley is subject to flooding and with limited warnings due to the catchment topography. The map below shows that the proposed station site is not adversely affected by flooding but is susceptible to access disruption as the surrounding areas are designated as Zone 2 & 3. A study of the hydrology, mitigation proposals will be required at a future design stage to determine the viability of the proposal against any required measures for attenuation.

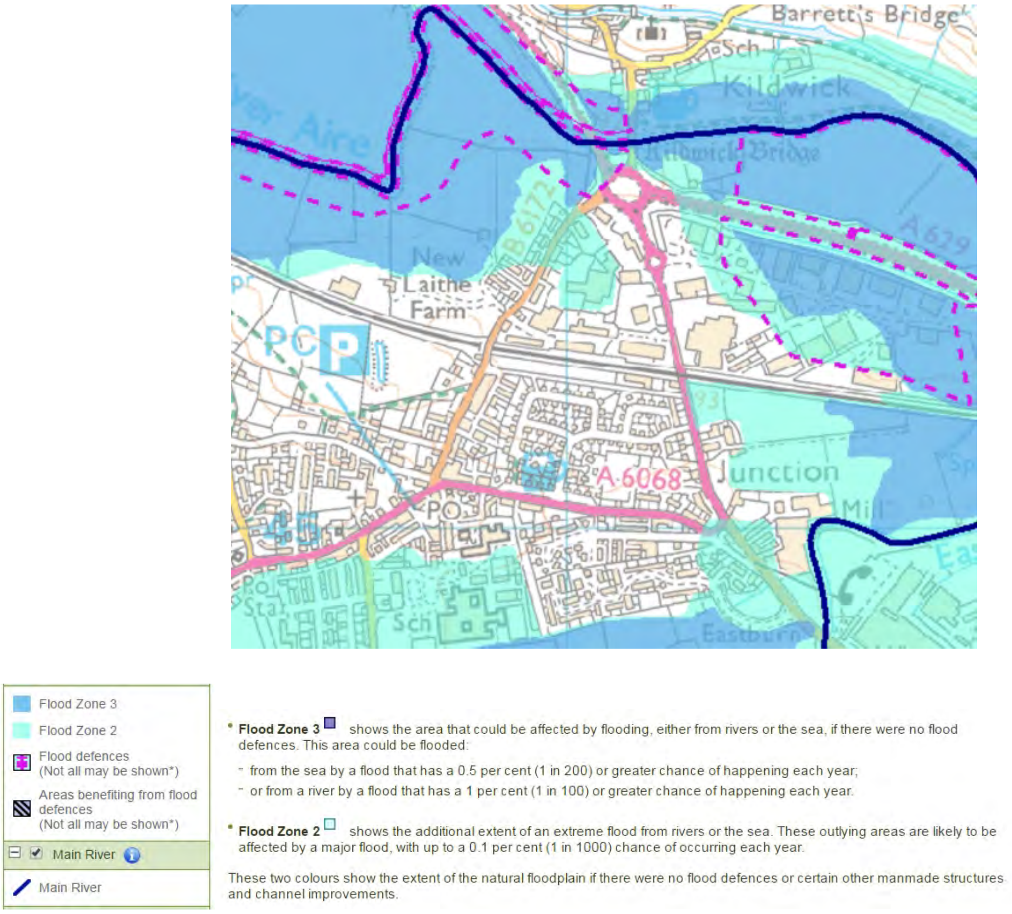


Figure 10 - Flood risk zones at proposed site

7.2 Flora and Fauna

From a desktop review, it is suggested that there is no SSSI status on the site or in the area. The site does fall within a designated area of a High Level of Stewardship and the impact of this should be evaluated at a later stage in the development. As indicated by the red Triangles there are a number of listed buildings nearby but none identified within the proposed site.

Figure 11 – Listed Buildings Locations

From the site visit it was evident that there were no significant trees however it has been assumed that the upper levels of the site will be contaminated as a result of the industrial past associated with Railways property which will need treatment and/or removal as hazardous waste. A Phase 1 Environmental Site Assessment is included in Volume 2.

7.3 Site Contamination

A Phase I Environmental Site Assessment (ESA) consisting of a desk based study of the available environmental and historical records at the Site, and subsequent development of a preliminary Conceptual Site Model was undertaken. The assessment presented the following conclusions based on the findings of the ESA.

The train line crossing the Site is the primary on-Site potential source of contamination, with its presence there since at least 1853. A number of potential contaminants may be present in association with the railway. Various industries have operated in proximity to the Site, including a gas works that may have impacted the land at the Site.

A preliminary CSM was prepared to summarise potential source-pathway-receptor pollutant linkages at the Site, along with an assessment of risk to potential receptors during a redevelopment scenario in which ground works occur. The CSM covered the potential for currently unknown contamination to exist within the ground, as no previous intrusive investigations have been available for review.

The CSM identifies a number of potential contamination linkages at the Site as follows:

1. The potential for ground contaminants (if present) to cause harm to human health via inhalation, dermal contact and ingestion of soils and dusts – moderate risk.
2. The potential for groundwater contamination (if present) to cause harm to human health via dermal contact and ingestion – moderate risk

3. The potential for ground gas contamination (if present) to cause harm to human health via upwards migration in to buildings and other enclosed spaces – moderate risk.
4. The potential for ground contamination (if present) to migrate through the underlying ground and groundwater – moderate risk
5. The potential for groundwater contamination (if present) to migrate through the underlying ground and groundwater to off-Site controlled waters receptors – moderate risk
6. The potential for asbestos fibres in the ground (if any) to migrate due to soil movements – low risk
7. The potential for ground and groundwater contaminants (if present) to damage underground structures through direct contact (chemical attack) – moderate risk

No prior investigations of the condition of the ground and groundwater beneath the Site have been available to this study. Given the potential for contamination to be present from both on- and off-Site sources of contamination, it is recommended that further investigations be undertaken at the Site to determine the full extent of any contamination present at the site. Undertaking an appropriate intrusive investigation would allow the risks to human health and the environment to be more accurately assessed and the CSM to be revised, and a suitable remedial strategy to be subsequently developed (if required).

A full report is contained in Volume 2.

8. Planning Consent

The site is not wholly on railway land as shown in the Marlin Map below but the land required for the permanent works is predominantly owned by Network Rail or is not registered with the Land Registry. The area of unregistered land is that portion currently used as a Highways Depot. North Yorkshire County Council have subsequently confirmed the Council owns this parcel of land. The land immediately to the North of the proposed station is designated as allotments and is privately owned. Temporary access to this land will be required to construct the works and a small portion may require to be purchased if a footpath access to the up platform from Station Road is to be provided. A drawing showing the land ownership that has been established to date is included in Appendix XX.

The site has not been used for a railway station in the past but it has been a depot and so may fall within the limits of deviation for Railway infrastructure. Clarification therefore will be needed on its status however; there is a risk that a full planning application process would be required through the Local Authorities with the powers to grant permission for the proposed new Cross Hills Station. Note: the Station Road Bridge is owned by North Yorkshire County Council and there are no plans for alteration or replacement for the foreseeable future.

Planning issues to establish acceptable access to the station are outlined in the access section of this report. Further investigation is required to fully confirm land ownership and requirements.

Figure 12 - Marlin map showing Network Rail land ownership

9. Operational analysis

Our operational analysis was undertaken in three parts:

1. Assessment of timetable performance impact with stop at Cross Hills
2. Optimisation of rolling stock and assessment of the sectional running times between Shipley and Skipton to assess potential improvements to the timetable without a stop at Cross Hills
3. Optimisation of rolling stock and assessment of the sectional running times between Shipley and Skipton to assess the impact of stopping at Cross Hills using the timetable improvements identified in (2)

The proposed 2019 timetable has been used in this work to take account of likely future service development, this is still subject to change.

Three typical service patterns operate hourly through Cross Hills on Arriva Northern's December 2019 weekday timetable:

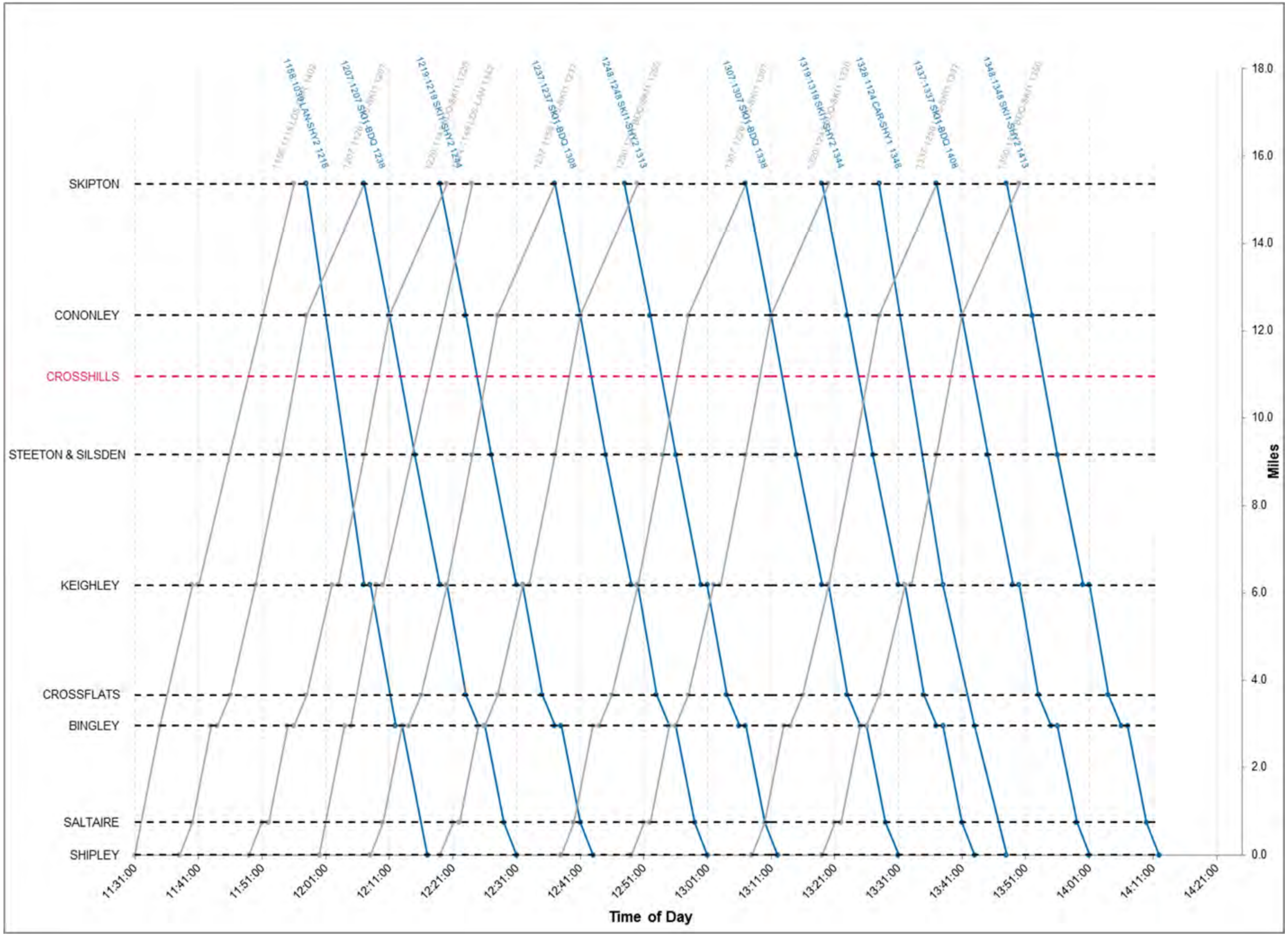
- 2tph Leeds<>Skipton (LDS<>SKI) operated with EMU stock
- 2tph Bradford Forster Square<>Skipton (BDQ<>SKI) operated with EMU stock
- 1tph Leeds<>Lancaster/Carlisle (LDS<>LAN/CAR) (alternating hours) operated with DMU stock

One train per day also operates between London Kings Cross<>Skipton (KGX<>SKI) (one in each direction) with Intercity EMU stock.

Each of these services operates between Skipton (SKI) and Shipley (SHY) (see Figure 13).

The working timetable shows 8 freight trains per day in operation with a number of Q paths in addition to the passenger services outlined above. We have assumed a maximum of 1 freight train in any one hour is accommodated in the D19SX timetable.

Figure 13: Arriva Northern December 2019 SX typical train pattern between Skipton and Shipley



9.1.2 Key timetable assumptions

Our timetable analysis will consider stopping at Cross Hills operationally viable if it is able to incorporate a stop at Cross Hills in the LDS<>SKI and BDQ<>SKI services and:

- it does not disrupt the LDS<>LAN/CAR services, that do not stop at Cross Hills and whose timings will not change
- arrival/departure timing points at SHY are maintained (and hence the complicated task of retiming services in LDS and BDQ is not required)
- it adheres to 2018 Timetable Planning Rules (TPR) (see Table 2 and Figure 15)

Figure 14 – Crosshills Location

Our analysis uses the December 2019 weekday (D19SX) timetable and rolling stock allocations submitted by Arriva in their winning Northern franchise bid.

Table 2: TPR for SHY<>SKI

Mileage	Location	Min Dwell (EMU) (min)	Junction margin (min)	Headway* (min)	Other adjustments (min)
0.00	Shipley [SHY]	-	-		½
0.10	Shipley west jn				
0.74	Saltaire [SAE]	1 (AM PK ARR @ LDS) / ½			
2.95	Bingley [BIY]	1			
3.36	Bingley FS OHNS				
3.66	Crossflats [CFL]	1 (AM PK ARR @ LDS) / ½			
6.18	Keighley [KEI]	1		6 (behind stopping service) 4 (behind non-stop service)	
7.29	Gotts LC (UWC)				
8.49	Thompsons LC (UWC)				
9.15	Steeton & Silsden [SON]	1 (AM PK ARR @ LDS)			
9.79	Eastbum LC (UWC)				
10.22	Raws LC (UWC)				
10.75	Kildwick LC (CCTV)				
10.95	**CROSSHILLS [XXX]**	½			
12.35	Cononley [CEY]	½			
12.38	Cononley LC (CCTV)				
12.75	Shadey Lane (UWC)				
12.85	Pettys No1 LC (UWC)				
15.10	Skipton south Jn				
15.36	Skipton[SKI] P2	2+5 (turnaround)	4		1

9.1.3 Sectional run time analysis

We have undertaken sectional run time (SRT) analysis using our bespoke Run Time Model (RTM). Our RTM is used to analyse the fastest speed that a train can achieve along a specified alignment taking into account any TPR restrictions (including speed restrictions), topography (gradients), track geometry and the properties of the rolling stock being used. The model also enables the assessment of the impact of differing stopping patterns on a timetable.

Two different types of rolling stock – class 333/4 (c.333/4) and a new rolling stock type to be procured by Arriva Northern during their franchise operations – will operate the EMU services that could include Cross Hills stops. We have undertaken our SRT analysis using the c.333/4 stock as it is the least operationally efficient of the two (based on our understanding of the characteristics of the new trains). This therefore provides a "worse-case scenario" assessment of the timetable.

Our SRT analysis incorporates the following assumptions that constrain the rolling stock to adhere to TPR and track conditions (see Table 3).

Table 3: c.333/4 rolling stock modelling parameter assumptions

Parameter	Value	Unit
Train Type	Class333-4car-GLW-limited	
Mass	223.65	tonne
Rotating Inertia	7.77	%
Train Length	93.78	m
Number of cars	4	No. (integer)
Number of Axles	16	No. (integer)
Number Motored Axles	8	No. (integer)
Max Speed	161	km/hr
MaxAcceleration	0.59	m/s^2
MacDeceleration	0.78	m/s^2
MaxJerk	0.60	m/s^3
Tractive Effort	0.95	*available TE
Adhesion	0.11	constant

The tractive effort (TE) of the rolling stock with respect to rolling resistance (RR) is modelled within the RTM to the TPR as shown in Figure 15

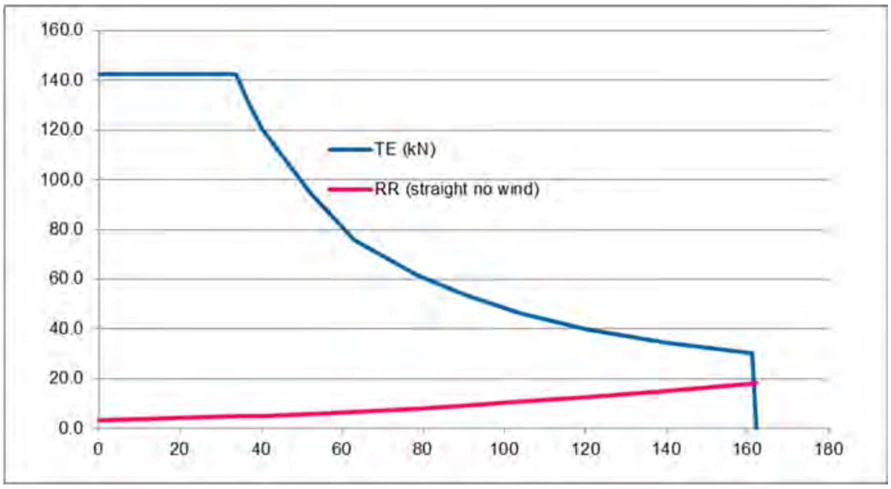


Figure 15 - Tractive Effort mapped against rolling resistance

Note that we have not considered specific train driving instructions, such as coasting, within this analysis.

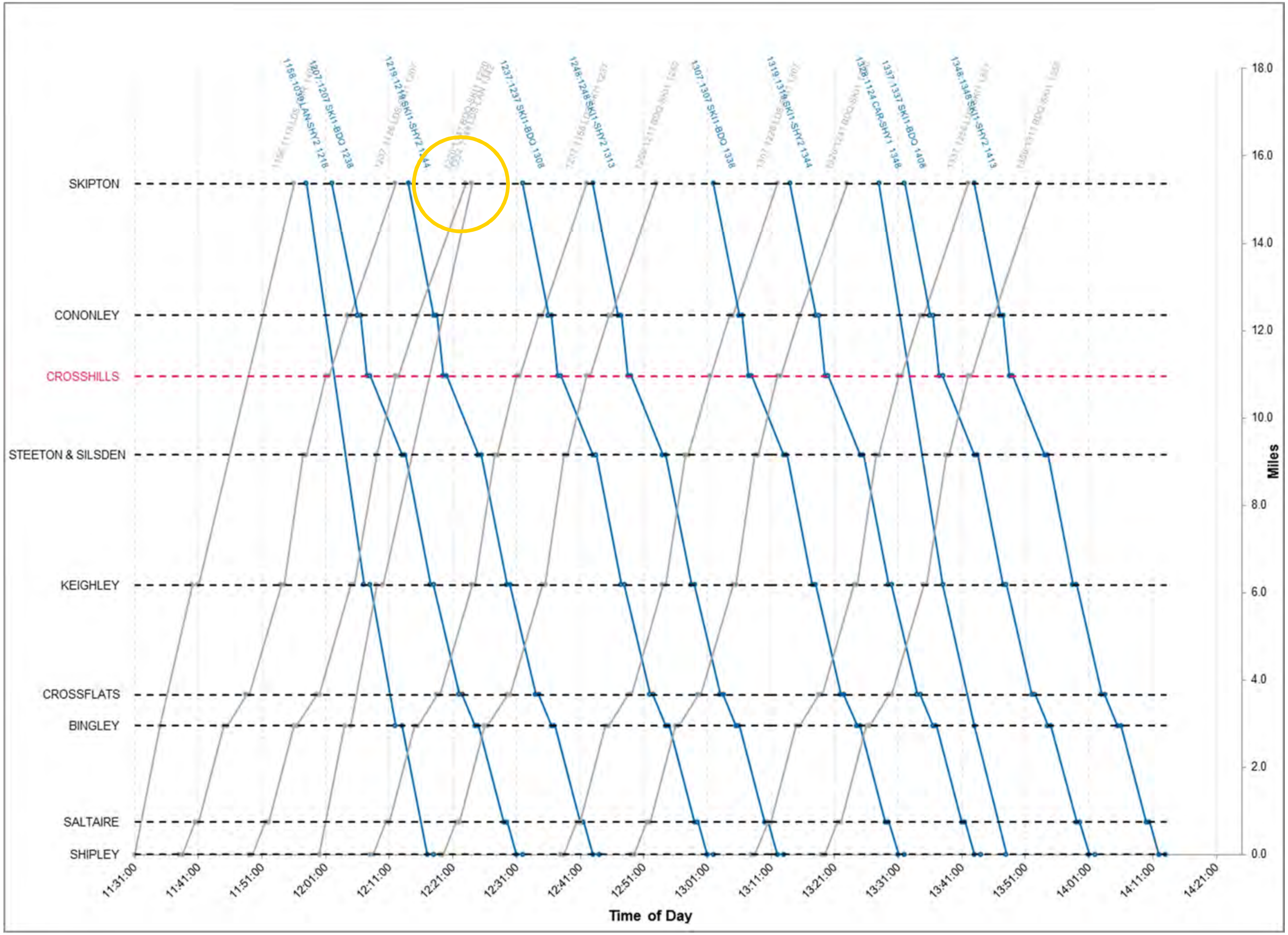
9.1.4 Base D19SX timetable – Stopping at Cross Hills

Our RTM analysis results in an additional minute and five seconds (00:01:05) of journey time resulting from deceleration and acceleration required to undertake a stop at Cross Hills in current conditions. We have also assumed a dwell time of 00:00:30, so overall increase in journey time is 00:01:35.

These changes result in minimal violation of the TPR in that some headways fall below the required six minutes, particularly in the case of the non-stopping LDS<>CAR/LAN services following a stopping service (see Figure 16 – violations highlighted in **yellow**). Most train paths were able to incorporate the stop at Cross Hills with no noticeable disruption to the timetable.

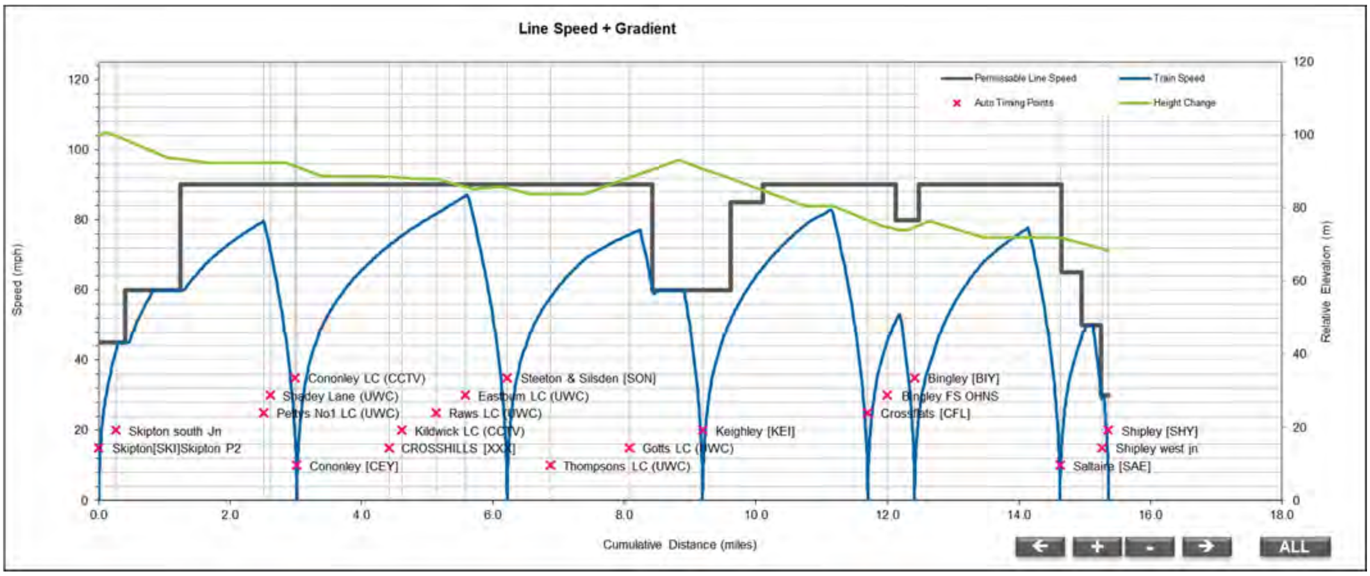
Retiming the conflicting services within the timetable is possible to remove the TPR violations, however this will likely result in small journey time dis-benefits on the LDS<>LAN/CAR services.

Figure 16: D19SX train pattern between Skipton and Shipley – Stopping at Cross Hills



9.1.5 Optimising rolling stock – no stop at Cross Hills

The stopping pattern along the section of route between SKI and SHY restricts the c.333/4 from reaching top speed. The line speed profile, however, is not overly restrictive, which enables the train to operate to its best potential along the majority of the route (see **Error! Reference**



source not found.) .

Figure 17: c.333/4 line speed profile between SKI and SHY

Our analysis, using these profiles, indicates that the proposed D19SX timetable has up to three (00:03:00) of available flex between SHY and SKI. Timings from SKI to SHY are an additional 00:00:30 faster.

Table 4 - Comparison of MOIRA timings and RTM outputs - no Cross Hills stop

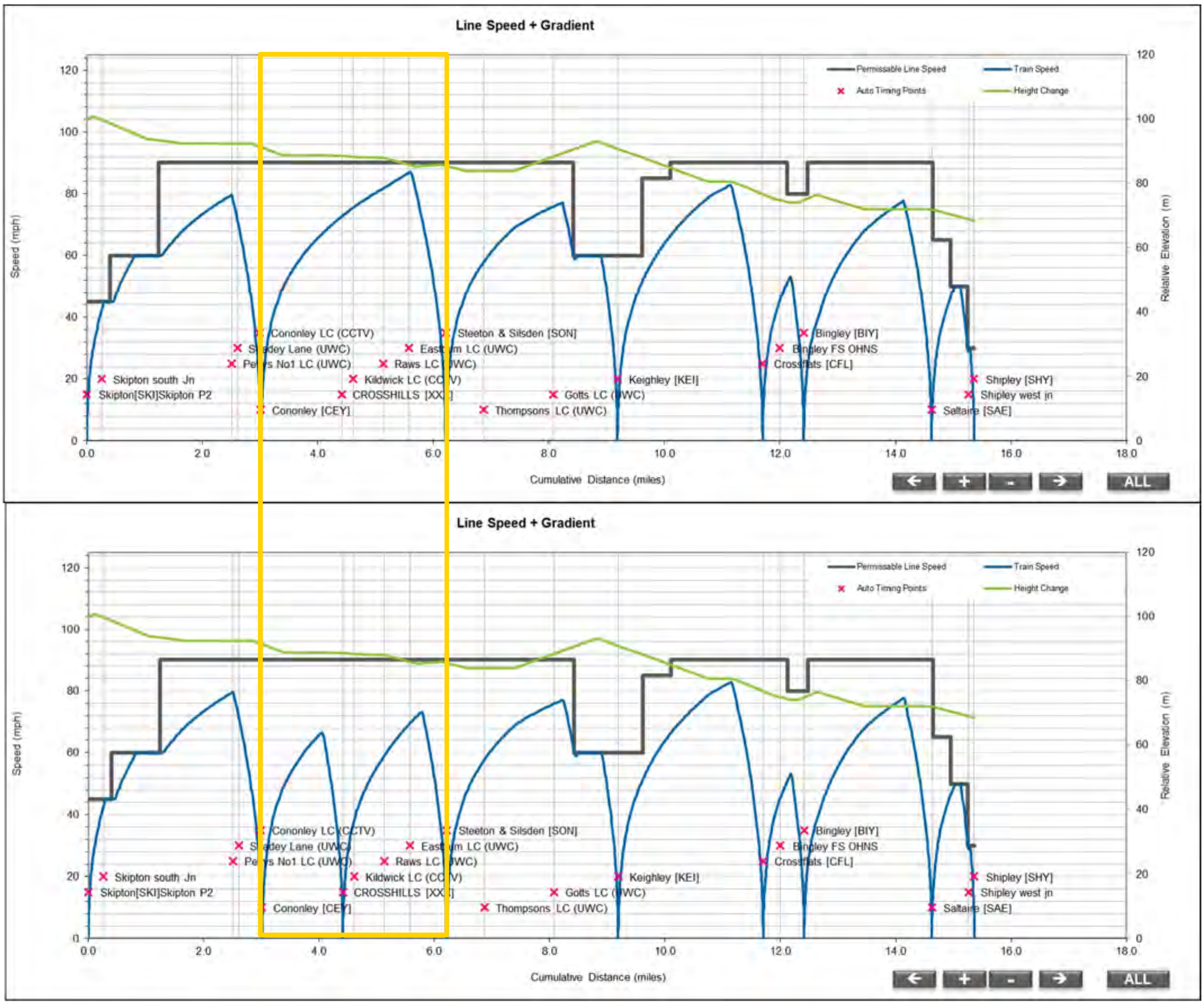
Timing Point	Stop (S) / Pass (P)	Dwell (min)	D19SX Time (min) (best^)	RTM Time (min)	Diff. (approx.)
Shipley [SHY]	S		00:00:00	00:00:00	
Shipley west jn	P			00:00:23	
Saltaire [SAE]	S	00:01:00	00:02:00	00:01:34	00:00:30
Bingley [BIY]	S	00:01:00	00:06:00	00:05:36	00:00:30
Bingley FS OHNS	P			00:07:35	
Crossflats [CFL]	S	00:01:00	00:09:00	00:08:13	00:01:00
Keighley [KEI]	S	00:01:00	00:14:00	00:12:26	00:01:30
Gotts LC (UWC)	P			00:15:05	
Thompsons LC (UWC)	P			00:16:01	
Steeton & Silsden [SON]	S	00:01:00	00:18:00	00:16:54	00:01:00
Eastbum LC (UWC)	P			00:19:07	
Raws LC (UWC)	P			00:19:33	
Kildwick LC (CCTV)	P			00:20:00	
CROSSHILLS [XXX]	P			00:20:10	
Cononley [CEY]	S	00:00:30	00:22:00	00:21:36	00:00:30
Cononley LC (CCTV)	P			00:22:27	
Shadey Lane (UWC)	P			00:23:06	
Pettys No1 LC (UWC)	P			00:23:13	
Skipton south Jn	P			00:25:33	
Skipton[SKI] P2	S		00:29:00	00:26:11	00:03:00

Timing Point	Stop (S) / Pass (P)	Dwell (min)	D19SX Time (min) (best^)	RTM Time (min)	Diff. (approx.)

^ Timings derived from MOIRA

This analysis indicates that optimising the rolling stock will enable a stop at Cross Hills within the current timetable without altering timings at either SHY or SKI.

Figure 18: c.333/4 line speed profile between SKI and SHY – No Stopping v Stopping at Cross Hills



9.1.6 Optimising rolling stock – stopping at Cross Hills

Stopping at Cross Hills restricts the train from achieving higher speeds previously achieved between Cononley (CEY) and Steeton & Silsden (SON).

This results in a slightly longer journey time along the route, however as shown in Table 5 - Comparison of MOIRA timings and RTM outputs - stopping at Cross Hills, the new timings with a stop at Cross Hills are still within the bounds of the D19SX timetable.

Table 5 - Comparison of MOIRA timings and RTM outputs - stopping at Cross Hills

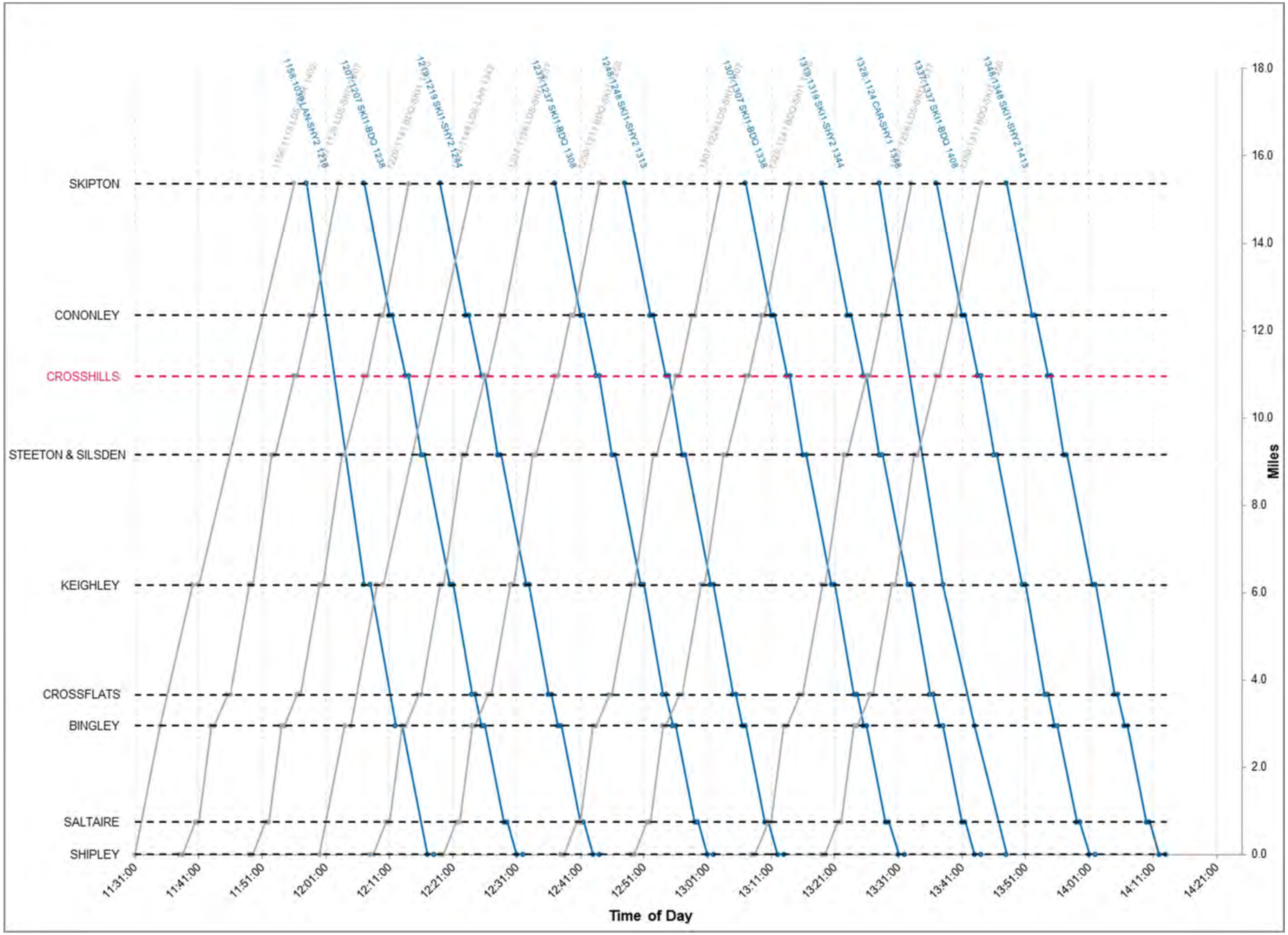
Timing Point	Stop (S) / Pass (P)	Dwell (min)	D19SX Time (min) (best^)	RTM Time (min)	Diff. (approx.)
Shipley [SHY]	S		00:00:00	00:00:00	
Shipley west jn	P			00:00:23	
Saltaire [SAE]	S	00:01:00	00:02:00	00:01:34	00:00:30
Bingley [BIY]	S	00:01:00	00:06:00	00:05:36	00:00:30
Bingley FS OHNS	P			00:07:35	
Crossflats [CFL]	S	00:01:00	00:09:00	00:08:13	00:01:00
Keighley [KEI]	S	00:01:00	00:14:00	00:12:26	00:01:30
Gotts LC (UWC)	P			00:15:05	
Thompsons LC (UWC)	P			00:16:01	
Steeton & Silsden [SON]	S	00:01:00	00:18:00	00:16:54	00:01:00
Eastbum LC (UWC)	P			00:19:07	
Raws LC (UWC)	P			00:19:33	
Kildwick LC (CCTV)	P			00:20:02	
CROSSHILLS [XXX]	S	00:00:30		00:20:31	00:00:30
Cononley [CEY]	S	00:00:30	00:22:00	00:23:11	00:01:00
Cononley LC (CCTV)	P			00:23:57	
Shadey Lane (UWC)	P			00:24:36	
Pettys No1 LC (UWC)	P			00:24:43	
Skipton south Jn	P			00:27:03	
Skipton[SKI] P2	S		00:29:00	00:27:41	00:01:30

^ Timings derived from MOIRA

Implementing a stop at Cross Hills using these timings within the timetable (keeping the arrival and departure time at SHY fixed), results in no violations of the TPR and no train conflicts.

We recommend further scrutiny of the timetable at all hours of the day prior to implementing this solution.

Figure 19: D19SX Optimised timetable – stopping at Cross Hills



9.1.7 Consultation

Northern Trains were consulted on the findings of the operational analysis above and made the following comments:

1. We would like to challenge the total journey time cost of this call of 1m30 seconds. With deceleration, acceleration and dwell on a 90mph piece of railway and think you should allow an extra 30 seconds for the dwell at Cross Hill to maintain the 60 seconds that all calls get along the route which would result in a total journey time impact of the call of 2 mins in total.
2. Current planned running time from Shipley to Skipton is 27 mins all station calls based on 1 min per dwell with an additional [1] <1> Rules allowances totalling 29 mins. Average actual journey time is 28m 16 seconds. Your data suggests 26m 11 seconds. We would challenge how much performance slack there actually is and would not want to absorb the call within the existing timings.
3. The additional running time to accommodate the call would reduce the turnround in Skipton. The effect of which would have to be assessed against the Dec 19 timetable to confirm the impact on the resource base.

Current modelling has made allowance for:

Network Rail limits on train performance in respect of acceleration and deceleration criteria

Attainable speed following the previous station stop and line speed profile. Station dwell utilised in the model was based on the ½ minute dwell stated in the 2018 Timetable Planning Rules.

Potential train performance benefits between Connonl;y and Skipton to mitigate the impact on turn around times at that location.

However, operational analysis in the next stage of development should take in to consideration the impact of the above comments.

In addition, consideration of the impact of a second freight path has been requested by TfN. This should be analysed in the next stage of development. Inspection of the December 2019 timetable suggests that a second freight path running at 75 mph may be accommodated but a second path operating at 60 mph may impact the passenger services.

9.1.8 Operational conclusions

The December 2019 SX timetable has sufficient flex to be able to incorporate a stop at Cross Hills without significant disruption. Minor timetable changes are required to the Base timetable should there be a desire to retain sufficient flex for operational performance reasons. We have assumed that the Base timetable caters for the requirements for 1 freight path. A second path may impact upon the passenger service and requires further analysis.

We have not assessed the wider reaching operational impacts of these minor changes and further study will be required in subsequent stages of development to confirm our initial findings. Our economic appraisal (see Section 12) therefore assumes:

- that the timetable is operationally viable with a stop at Cross Hills, and
- a journey time dis-benefit of 00:01:35 is experienced by passengers travelling across Cross Hills
- no additional crew or maintenance will be required

10. Demand and revenue

10.1 Demand forecasting methodology

The demand forecasting has used a trip rate methodology to show the potential of a new station, based on the demand levels at nearby stations.

It must be emphasised that the methodology is considered adequate for a feasibility study at this stage of scheme development, where the main purpose is to determine whether the proposal should be taken forward for more detailed assessment. However, a business case submitted to the Department for Transport to request public subsidy would clearly not be acceptable based on this level of analysis.

In the longer term, therefore, a much more detailed and robust demand forecasting exercise would be necessary, potentially incorporating some network modelling and/or local surveys.

Meanwhile, noting the risks associated with this level of demand forecasting, the economic evaluation (see Section 12) has been reinforced by sensitivity testing illustrating the impact of significant variations from the forecasts presented below.

10.2 Trip rates

In order to assess the impact of the new station, we have built upon the trip rate methodology set out in the *New Railway Stations in North and West Yorkshire Feasibility Study Final Report*. Initially, we considered the trip rates from the Feasibility Study, which are shown in Table 6 - Trip rates from New Railways Stations in North and West Yorkshire Feasibility Study.

Table 6 - Trip rates from New Railways Stations in North and West Yorkshire Feasibility Study

Annual trips per resident within 800 metres of station	33.483
Annual trips per resident between 800 metres and 1,500 metres from station	8.058
Uplift due to car park provision	26.5%

However, application of these trip rates to the population around a selection of local stations resulted in a significant underestimation of patronage compared with the usage statistics published by the Office of Rail and Road (ORR).

Therefore, we carried out a recalibration of the trip rates against the ORR station usage data. Noting that the proportion of passengers driving from outside the immediately surrounding area is effectively constrained by the car parking provision at the stations, our revised calibration also considered:

- A third band of residents between 1,500 metres and 2,500 metres from each station; and
- A further uplift for residents beyond this area in addition to those using parking facilities (for example, passengers using local bus or 'kiss-and-ride' to access the station).

At the time of the study, station usage data for the 2015/16 financial year were not readily available. Therefore, data for the 2014/15 financial year were used, and factored to 2015/16 based on extrapolation of the growth over the previous three years. The trip rates can therefore be considered appropriate for the 2015/16 financial year.

Table 7 - Recalibrated Trip Rates shows the trip rates derived from this recalibration.

Table 7 - Recalibrated Trip Rates

Annual trips per resident within 800 metres of station	18.000
Annual trips per resident between 800 metres and 1,500 metres from station	16.000
Annual trips per resident between 1,500 metres and 2,500 metres from station	10.000
Uplift due to car park provision	26.5%
Uplift due to access from beyond 2,500 metres by other modes	53.0%

10.3 Growth

We are currently undertaking a separate study for WYCA to assess the capacity requirements at the end of Control Period 6. Although final forecasts have not yet been produced, modelling work to date suggests that passenger demand on the Airedale Line will be 73% higher in the 2023/24 financial year compared with 2015/16. This has been calculated based on the expected changes in:

- Population;
- Employment;
- Car ownership;
- Gross Domestic Product;
- Car operating costs and journey times;
- Bus fares, headways and journey times;
- Rail timetable;
- Rail fares;
- Rolling stock; and
- Other improvements proposed as part of Arriva's bid for the Northern franchise.

10.4 Demand forecasts

Based on the trip rates set out in Table 7 - Recalibrated Trip Rates, **569,618** passengers per annum would use Cross Hills at 2015/16 demand levels. Application of the growth noted in Section 10.3 would increase this to **985,439** per annum in 2024. For the purpose of this study, it has been assumed that zero growth would occur beyond 2024.

Demand from the opening year of 2020 until 2024 has been based on linear interpolation between 2015/16 and 2023/24, although a 'ramp-up' factor has been applied to all benefits until the during the first three years of operation.

It is acknowledged that the demand forecast is high relative to some of the other local stations and low relative to others. For example, the ORR data report 185,566 passengers using Cononley and 862,046 using Steeton & Silsden in 2014/15. However, Cross Hills is has significant residential population close to the proposed station location, and is also well situated to attract passengers from East Lancashire. Nevertheless, in order to present a pessimistic scenario, we have also considered forecasts based on the trip rates used in the original feasibility study, which would suggest **372,359** passengers at 2015/16 demand levels and **644,181** passengers per annum from 2024 onwards.

10.5 Revenue

We initially reviewed National Rail Travel Survey (NRTS) data in an attempt to understand the distances currently travelled to other local stations in the area, and the relationship between the trip origins and the stations used. However, there are currently insufficient NRTS records at a station level to have a meaningful sample size for such analysis.

At this stage, we have therefore assumed that 30% of trips would be abstracted from other rail services in the area, which is similar to a study reported in the Passenger Demand Forecasting Handbook. In the longer term, more detailed local modelling and/or surveys should be carried out to refine this assumption.

Based on analysis of MOIRA data for Cononley (which is also outside the West Yorkshire fare zones), we have applied a yield of £3.50 to the remaining 70% of trips using Cross Hills. This yield compares with published fares of £9.70 return (£3.75 per direction) in peak periods and £8.20 return (£4.10 per direction) at other times. Noting that many passengers will use various discounted products, a yield of £3.50 is therefore considered appropriate for the current level analysis. However, a sensitivity test with a higher yield is included in Section 11.

We have assumed no change in real fares over the evaluation period. Accordingly, the station would generate a revenue increase of **£2.4 million** (at 2015/16 prices) in 2024. The pessimistic scenario based on the trip rates used in the original feasibility study has a corresponding revenue increase of **£1.6 million**.

10.6 Trip suppression

The opening of Cross Hills Station would extend journey times between Cononley and Steeton & Silsden by around two minutes. MOIRA has therefore been used to assess the impact of this extended journey time on passenger demand and revenue. Since the outputs from MOIRA relate to the demand and revenue in the 2015/16 financial year, the growth noted in Section 10.3 has been applied to calculate equivalent values for 2024.

Accordingly, it is forecast that passenger numbers would be reduced by **42,052** journeys per annum, whilst annual revenue would be reduced by **£119,561**. In reality, this could be an overestimate, as traffic conditions in the area are likely to discourage people from changing modes in response to the small increase in journey times. It may therefore be beneficial to prepare a revised forecast using lower elasticities to change in journey time compared with the standard values embedded in MOIRA, provided evidence for such elasticities can be obtained. Meanwhile, the potential impact has been examined through sensitivity testing (see Section 11.5).

11. Cost Estimates

11.1 Capital Costs

Cost estimates for the station at Cross Hills have been prepared based on the outline drawing of facilities included in this report. An outline Bill of Quantities was developed by the relevant engineering teams and this was passed to a Quantity surveyor experienced in developing railway scheme estimates. The estimated cost is as shown below.

Table 8 – Capital Costs

Discipline	Total
Civil	£6,801,093.33
Track	£86,015.00
Signalling & OPs Telecoms	£1,011,000.00
Retail Telecoms	£0.00
M&E	£1,030,000.00
E&P	£982,700.00
Design and Project Management	£1,189,297.00
Contractor's Prelims & OHP	£1,982,161.67
TOC costs	£1,308,226.70
Total	**£14,390,493.70**

The estimate is valid at Quarter 4 2016 prices as the date the station will come into use is currently uncertain and is based primarily on outturn costs which have then been checked against Network Rail's Unit Cost Model and Cost Analysis Feedback. Any Property and land acquisition costs have been excluded as has any third party compensation costs. Local Authority & Highways planning permits & road diversions and any antiquities investigation costs are also excluded.

No quantified risk assessment has been undertaken or risk allowance or contingency has been included in the figures above but optimism bias has been included within the business case as current DfT guidance requires.

11.2 Operating costs

An operating cost of £100k per annum has been used in the development of the Business Case. This cost was provided in the remit and represents a reasonable assessment of the annual cost of a facility of this type.

12. Appraisal

12.1 Economic appraisal design

Based on the demand and revenue forecasts discussed in Section 10, an illustrative economic appraisal has been carried out, broadly following the DfT's WebTAG guidance.

The appraisal uses a standard 60-year scheme appraisal period (2020 to 2079), and all benefits are subject to standard discounting treatment (3.5% per annum from 2010 until 2047, and 3.0% per annum thereafter). In addition, all relevant benefits have been factored by 25% in 2020, 50% in 2021 and 75% in 2022, representing the time taken for people to change travel behaviour and commence using the new station.

It should be noted, however, that development of a business case to justify public funding requires a much more detailed calculation of both costs and benefits than could be achieved in the timescale and with the information available for this feasibility study. Rather, the analysis set out in this section represents an outline business case to demonstrate the broad viability of the new station. As the scheme development is taken forward, the business case should be subjected to ongoing refinement

12.2 Financial components

12.2.1 Scheme capital costs

Capital costs associated with the new station are set out in Section 11.1. In common with other schemes at this level of development, and uplift of 60% for, 'Optimism Bias' has been applied.

At this stage, it has been assumed that 25% of costs would be incurred in 2018 and 75% of costs would be incurred in 2019. These costs have been discounted to 2010 values, giving a present value of costs (PVC) equivalent to **£17.0 million**.

12.2.2 Operating costs

An operating cost of £100k per annum has been used in the development of the Business Case. This cost was provided in the remit and represents a reasonable assessment of the annual cost of a facility of this type.

An uplift of 10% has been applied to accommodate potential 'Optimism Bias'.

These costs have been discounted to 2010 values, giving a present value of costs (PVC) equivalent to **£2.1 million**.

12.2.3 Revenue benefits

As noted in Section 7, revenue has been calculated on an annual basis from 2020 until 2024, beyond which zero growth is assumed. The revenue for each year has been discounted to 2010 values, giving a present value of benefits (PVB) equivalent to **£42.1 million**.

The impact of trips suppressed due to the extended journey times has also been taken into account, and reduces the PVB by **£3.6 million**.

Accordingly, the net PVB associated with the revenue is **£38.5 million**.

The revenue increase in the pessimistic scenario based on the trip rates used in the original feasibility study has a PVB of **£27.5 million**. This is likewise reduced by **£3.6 million** as a result of trip suppression, giving a net PVB of **£23.9 million**.

As noted in Section 9.6, the impact of the extended journey times could be an overestimate because traffic conditions in the area are likely to discourage people from changing modes. A sensitivity test has therefore been carried out omitting this component of the revenue calculation (see Section 11.5).

12.3 Non-financial components

12.3.1 Background

The following non-financial components of the business case have been calculated based on the DfT's WebTAG guidance:

- Journey time savings;
- Journey time increases;
- Crowding impacts;
- Indirect taxes; and
- Highway decongestion.

Other marginal external costs are unlikely to influence the decision whether to take the scheme forward for more detailed assessment, and have therefore not been considered at this stage.

12.3.2 Journey time savings

A journey time benefit of 4.0 minutes per passenger has been assumed, based on the estimated drive time from the Cross Hills area to Steeton & Silsden Station, which is the nearest existing railhead. This has been multiplied by:

- The annual number of passengers abstracted from other stations (currently assumed as 30% of the total forecast demand), to calculate the journey time saving for existing users; and
- The annual number of new trips (currently assumed as 70% of the total forecast demand), to calculate the journey time savings for new users.

In accordance with the standard 'rule of half' used in all transport economic assessments, the latter has also been factored by 0.5.

A similar factoring process to the revenue (see Section 7) has been followed to reflect the growth profile between 2020 and 2024, with zero growth thereafter.

In addition, the overall breakdown by ticket type in MOIRA has been used to disaggregate the benefits by trip purpose, such that:

- The proportion of passengers using full-fare tickets is assumed to be representative of business travellers;
- The proportion of passengers using season tickets is assumed to be representative of commuters; and
- The proportion of passengers using reduced-fare tickets is assumed to be representative of leisure travellers.

However, when the scheme is progressed to more detailed evaluation, this process should be refined to consider:

- A breakdown by ticket type specific to stations in the local area; and
- A more accurate mapping between the ticket types and trip purposes.

The values of time for these three trip purposes set out in the WebTAG Databook have then been applied to the journey time savings for each year, discounted to 2010 and aggregated over the 60-year appraisal period to calculate a PVB of **£9.1 million** for existing users and **£10.6 million** for new users.

In the pessimistic scenario based on the trip rates used in the original feasibility study, the journey time savings have a PVB of **£6.0 million** for existing users and **£6.9 million** for new users.

12.3.3 Journey time increases

The opening of Cross Hills Station would extend journey times between Cononley and Steeton & Silsden by around two minutes, which is forecast to slightly result in the removal of some existing trips.

A similar process has therefore been used to estimate the journey time dis-benefits associated with the extended journey times, such that:

- The dis-benefit to passengers who would continue to travel has been calculated as 2.0 minutes multiplied by the number of passengers on trains at Cononley (which has been obtained from MOIRA); and
- The dis-benefit to passengers who would no longer travel has been obtained directly from the MOIRA assessment reported in Section 10.6.

In both cases, the MOIRA outputs related to the 2015/16 financial year, and the factoring processes described in Section 12.3.2 have been used to calculate the dis-benefit for each year and trip purpose. However, in the case of existing users, the 'ramp-up' factor has not been applied, as the journey time increase will apply to all passengers immediately upon opening of the new station.

The values of time for the three trip purposes set out in the WebTAG Databook have then been applied to the journey time disbenefits for each year, discounted to 2010 and aggregated over the 60-year appraisal period to calculate a PVB of **-£28.2 million** for passengers who would continue to travel and -**£0.5 million** for passengers who would no longer travel.

Since the journey time increases only impact the passengers passing through Cross Hills (rather than boarding or alighting), the numbers are unchanged in the pessimistic scenario.

12.3.4 Crowding impacts

The additional passengers generated by Cross Hills Station would increase crowding on some services. For the purpose of this study, we have undertaken a very simple calculation of the potential crowding disbenefit, which assumes that:

- Crowding is only significant in the weekday peak periods;
- The impact of the new station on crowding is only significant from 2024 onwards (noting that both underlying demand levels and the demand associated with the station will be lower prior to 2024);
- All passengers boarding trains at Cross Hills during the morning peak period travel to Leeds; and
- All passengers alighting at Cross Hills during the evening peak period travel from Leeds.

The first stage in calculating crowding was to convert the annual demand to an average weekday demand, using a typical annualisation factor of 300. The daily distribution of train boardings was then obtained for several nearby stations, and hence an average proportion of the daily demand calculated for each hour in the morning peak period (between 07:00 and

10:00 hours). These proportions were applied to the daily demand forecast for Cross Hills in 2024 (excluding abstraction from other stations), and hence the number of boardings in each of the three peak hours calculated.

We are currently undertaking a separate study for WYCA to assess the capacity requirements at the end of Control Period 6. This study involves the development of a crowding model, which calculates time penalties representing passengers' inconvenience of travelling in crowded conditions. The actual penalties associated with different levels of crowding are specified in the Passenger Demand Forecasting Handbook.

Whilst calibration of the model has not yet been finalised, it was considered sufficiently advanced for an initial assessment of the crowding increase attributable to the opening of Cross Hills Station. Accordingly, the additional demand for each of the three peak hours was assigned to the trains towards Leeds, over and above the demand levels already modelled for 2024. Consequently, the additional passenger minutes in crowded conditions resulting from the new station could be extracted from the model

The number of passenger minutes for a single morning peak period was then factored to an annual equivalent, assuming:

- A similar increase in crowding would occur in the reverse direction in the evening peak period; and
- An annualisation factor of 240 (representing the approximate number of working weekdays per year).

The process described for the journey time savings and increases (see Sections 12.3.2 and 12.3.3 was then used to:

- Disaggregate the annual increase in crowded passenger minutes by trip purpose;
- Apply appropriate values of time; and
- Discount the monetary values to 2010.

On this basis, the PVB associated with crowding was calculated as **–£33.6 million**. This is likely to be an overestimate of the dis-benefit as, in reality, some passengers will not travel to and from Leeds, and will therefore not cause or exacerbate crowding to the same extent.

The small number of passengers removed from the rail network as a result of the extended journey times (see Sections 10.6 and 12.3.3) have been ignored in the calculation of crowding impacts.

In view of the complexity of the crowding calculations, this process has not been repeated for the pessimistic scenario. Rather, the number of passenger minutes has been scaled down in proportion to the revised demand, giving a revised PVB of **-£22.0 million**.

12.3.5 Indirect Taxes

Some of the new rail demand at Cross Hills Station will undoubtedly be attributable to trips currently made by car. This will result in a small reduction in fuel tax revenue for the Government, which should therefore be incorporated within the appraisal.

We have followed the process set out in WebTAG, whereby:

- A proportion (specified in WebTAG) of the increase in rail passenger mileage is assumed to represent a reduction in car vehicle mileage;
- The fuel consumption resulting from this reduction in mileage is calculated, taking account of the different vehicle proportions and fuel consumptions associated with petrol, diesel and electric cars; and

- The tax loss associated with the reduced fuel consumption is calculated.

In order to estimate the change in rail passenger mileage, and hence vehicle mileage, an average distance per trip of 19.06 miles was assumed. This is based on analysis of MOIRA data for Cononley and Steeton & Silsden, and is also close to the distance between Cross Hills and Leeds.

Noting the change in vehicle efficiency and fuel prices over time set out in WebTAG, the indirect tax impacts have been calculated for each year, discounted to 2010 and aggregated over the 60-year appraisal period, resulting in a PVB of **-£2.7 million**.

In the pessimistic scenario based on the trip rates used in the original feasibility study, the indirect tax impacts result in a PVB of -**£1.8 million**.

12.3.6 Highway Decongestion

WebTAG also assigns monetary values to represent the benefits of reduced congestion when some trips are removed from the highway network. Accordingly, the process has been followed whereby:

- The reduction in car vehicle mileage (calculated as described in Section 12.3.5) is disaggregated by road type using factors appropriate to the Yorks and Humber region;
- Monetary values are attributed to the reduction in vehicle mileage for each road type.

The calculations have been carried out across the 60-year appraisal period and aggregated to give a PVB of **£32.2 million**.

The small number of rail passengers which could potentially return to the highway network as a result of the extended rail journey times (see Sections 10.6 and 12.3.3) have been ignored in the calculation of decongestion benefits.

In the pessimistic scenario based on the trip rates used in the original feasibility study, the highway decongestion results in a PVB of **£21.0 million**.

12.4 Benefit Cost Ratio

In the above sections, present values of costs and benefits have been calculated for the different components of the economic evaluation. These are combined in Table 9 - Calculation of BCR, together with calculation of an illustrative benefit cost ratio.

Table 9 - Calculation of BCR

	Standard Scenario (recalibrated trip rates)	Pessimistic Scenario (original trip rates)
PVC		
Capital cost (£ million)	17.0	17.0
Operating cost (£ million)	2.1	2.1
Total	19.1	19.1
PVB		
Revenue increase (new station)	42.1	27.5
Revenue reduction (trip suppression)	-3.6	-3.6
Journey time savings: existing users	9.1	6.0
Journey time savings: new users	10.6	6.9
Journey time increases	-28.7	-28.7
Crowding	-33.6	-22.0
Indirect taxes	-2.7	-1.8
Highway decongestion	32.2	21.0
Total	25.4	5.4
BCR	**1.33**	**0.28**

The analysis has resulted in an indicative BCR of 1.33, which suggests that the scheme should be taken forward for more detailed consideration. However, the pessimistic scenario based on the trip rates used in the original feasibility study results in a BCR of 0.28, which would clearly not be viable. A review of these BCRs against the trip numbers implies that annual patronage from 2024 onwards would need to be around 900,000 passengers in order to justify the expenditure.

12.5 Sensitivity Test

Noting the significant number of assumptions necessary at this stage of scheme evaluation, we have also carried out a number of sensitivity tests, which are shown in Table 10 - Sensitivity Tests.

Table 10 - Sensitivity Tests

Test	BCR	
	Standard Scenario (recalibrated trip rates)	Pessimistic Scenario (original trip rates)
Increase capital cost by 25%	1.09	0.23
Increase operating cost by 25%	1.29	0.28
Reduce demand forecasts by 15%	0.88	-0.01
Increase abstraction proportion to 45%	0.65	-0.16
Assume no trip suppression	1.52	0.47
Revise trip purpose breakdown to 50% business	0.66	-0.31
Reduce yield to £3.00	1.01	0.08
Increase yield to £5.00	2.28	0.90
Reduce assumed time saving from 4.0 minutes to 2.0 minutes	0.81	-0.05

The BCR appears most sensitive to the demand forecasts (including the proportion of abstracted trips), the journey time benefits and the breakdown by trip purpose (which affects the value of the benefits). Therefore, as the scheme is taken forward, priority should be given to refining the demand forecasting methodology and assumptions. This is particularly important as the pessimistic scenario based on the trip rates used in the original feasibility study would not be viable, even taking into account the variations in assumptions considered through the sensitivity testing, unless the scheme costs can be significantly reduced.

It should also be noted that an increase in yield would significantly increase the BCR, Future work should therefore include more detailed forecasting by destination and ticket type, in order to the confirm the yield which could be realistically expected. Similarly, the BCR is increased by ignoring trip suppression. However, evidence of experience elsewhere or detailed mode choice modelling would be required to justify omitting this element of the calculation or using alternative elasticities to those embedded within MOIRA.

12.6 Wider economic benefits

In addition to the benefits included in the conventional transport appraisal, WebTAG recognises the other benefits of transport schemes, namely:

- a shift to more productive jobs as employment is concentrated in key locations, where productivity is higher, resulting in greater output per worker;
- agglomeration benefits to existing jobs as the scheme supports higher employment densities;
- increased labour force participation, as more people work because of time savings from the scheme;
- imperfect competition where companies benefit from reduced transport costs and increase output; and
- potential regeneration opportunities.

Whilst the wider economic benefits associated with major transport schemes can be significant, these are less relevant for small-scale schemes such as new stations. Nevertheless, the BCR can be increased slightly through consideration of the wider economic benefits, thereby improving the overall business case.

Accordingly, if the scheme is taken forward for more detailed consideration, and the economic evaluation is refined through reviewing the various inputs and assumptions, calculation of the wider economic benefits should also be included.

12.7 Impact of car parking charges

The station revenue could potentially be increased through charging for car parking. If imposed, this would probably be on a similar scale to nearby Skipton Station, where a charge of £4 per day is levied, although an annual ticket at £250 effectively reduces this to around £1 per day.

As noted in Section 4.3, it is estimated that 242 passengers per day would arrive by car. Using the annualisation factor of 300 consistent with other components of the economic evaluation, the revenue uplift would therefore be between £60,500 and £290,400 per annum, depending on the breakdown between daily and annual (or other interim period) tickets. This would result in a maximum increase to the PVB of £5.1 million, which would increase the BCR to 1.60 in the standard scenario (recalibrated trip rates) or 0.55 in the pessimistic scenario (original trip rates).

However, the imposition of car parking charges could also reduce the demand for the station. Noting that a charge of £4 per day would effectively be the equivalent of increasing the fare by

£2 per trip for those passengers parking at the station (since a single parking space would be used for the outbound and return trip), this would represent an increase of 57% based on the yield of £3.50 assumed in the calculations.

In accordance with Department for Transport guidelines, the impact of fares is currently estimated using the elasticities specified in Version 4.0 of the Passenger Demand Forecasting Handbook, which range between -0.60 and -1.05 for passengers crossing the boundary into PTE areas. Thus, in a ‘worst case’ scenario (applying the elasticity of -1.05), the number of passengers using the car park could be reduced by 151 per day, reducing annual farebox revenue by £316,173, which is greater than the revenue gained from car parking charges.

Accordingly, it cannot be assumed that car parking charges would have a positive impact on the BCR. Rather, more detailed modelling would be required to determine the optimum balance between an increase in parking revenue and a reduction in farebox revenue, taking into account the different journey patterns and frequency of travel. The impact of reduced demand on the non-financial benefits would also need to be considered.

13. Conclusions and recommendations

13.1 Conclusions

4. The engineering study demonstrates that the proposal is viable.
5. Provision of the station will increase road closure times at Kildwick Level Crossing unless alterations are made to the signalling arrangements.
6. The operational study has demonstrated that the stop of a train at the proposed Cross Hills Station appears to be possible without compromising the D19SX timetable.
7. The analysis has resulted in an indicative BCR of 1.33, which suggests that the scheme should be taken forward for more detailed consideration.

13.2 Recommendations

Further work will be required in the following areas if the scheme is pursued:

1. More detailed consideration of the planning and land ownership issues
2. Further option development to confirm engineering and operational study conclusions and increase the accuracy of the cost estimates.
3. Further scheme development of the signalling proposals and the configuration of the stopping/non-stopping controls associated with Kildwick Level Crossing
4. Survey of the road closure times at Kildwick Level Crossing over an extended survey period.
5. Micro-simulation modelling of the road network to understand the access requirements in more detail
6. Further work to the demand study and business case including:

vii) surveys of users at other stations, household surveys,

viii) further refine growth in early 2017 when CP6 HLOS Capacity Study completed

ix) repeating MOIRA work with lower elasticities

x) repeat crowding when modelling complete and/or with final numbers

xi) Inclusion of wider economic benefits.