Environmental Statement

Volume 2i: Scheme-wide Assessment

Chapter 3: Consideration of alternatives

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3. CONSIDERATION OF ALTERNATIVES

3.1 Introduction

3.1.1 The following chapter provides details regarding the alternatives considered in the development of the Huddersfield to Westtown (Dewsbury) Scheme (hereafter referred to as "the Scheme").

3.1.2 The Scheme is part of a wider programme of works known as the Transpennine Route Upgrade (TRU) which will improve the Transpennine railway between Manchester, Huddersfield, Leeds and York.

3.1.3 In 2015, the Secretary of State for Transport announced high level aspirations for the Transpennine Route. This announcement led to the creation of the TRU Programme.

3.1.4 The TRU Programme is divided into three geographical sections:

- West of Leeds: Manchester Victoria to Copley Hill East Junction;
- TRU Central: Leeds station capacity and diversionary routes; and
- East of Leeds: Leeds station departure (end of platforms) to York/Selby.

3.1.5 The Scheme lies within the West of Leeds section of the TRU Programme.

3.1.6 Rule 1 of and Schedule 1 to, the 2006 Application Rules indicates that the following information should be included in an ES:

"….An outline of the main alternatives studied by the applicant and an indication of the main reasons for his choice, taking into account the environmental effects…."

3.1.7 This chapter therefore describes the following:

- The 'do nothing' alternative – i.e. if the Scheme is not delivered;
- Strategic rail alternatives – summarises the options considered for alternative rail schemes; and
- Local design alternatives – summarises options for detailed aspects of Scheme.

3.2 Drivers for the Scheme

3.2.1 The purpose of the TRU is to deliver improvements to connectivity and capacity on the route between Manchester and York via Huddersfield and Leeds.

Existing constraints

3.2.2 The Scheme Route includes 14km of track and four stations at Huddersfield, Deighton, Mirfield and Ravensthorpe. Previously, the Scheme Route (around 40 years ago) was operated as a four track railway and the existing Deighton Station did not exist. Following the removal of the four track railway the remaining two track railway was re-modelled to accommodate new infrastructure such as Deighton Station and to accommodate the speed performance and signalling infrastructure applicable for a two-track railway. These changes to the infrastructure and operation of the Scheme Route have therefore constrained the ability for the Scheme Route to be returned to a four-track railway without significant interventions.

3.2.3 Currently the Scheme area is a key constraint on the capacity and reliability of the whole Transpennine Route. The key constraints are:

- Track capacity: The Scheme is almost entirely two tracks. Therefore fast (express) services routinely catch up the slow (stopper) services, which adversely affects service performance and resilience by causing delays to the fast (express) services and capacity issues. This means that currently there is not the capacity to increase the number of services able to use the Scheme and the Transpennine Route;
- Huddersfield Station: Currently has three through platforms which presents a significant capacity constraint to regulate services and manage the network efficiently;
- Line speeds: There are speed limits in place at various locations across the Scheme Route, with slower speed limits of 75mph in the Heaton Lodge area, and between the existing Ravensthorpe and Dewsbury stations. Previous works have increased track speeds as far as practicable, but they are still not of a sufficient speed to significantly contribute to improvements in journey times across the Transpennine Route;
- Conflicting train movements: In areas of the Scheme where train movement conflicts exist, the inclusion of more train services crossing and/or using the Transpennine Route will create more capacity problems. Due to the current track capacity of the Scheme, only a certain number of train 'paths' can be utilised at any one time. Therefore, any increase in train services without any interventions to improve its capacity will increase the existing pressure on maintaining the performance and reliability of train;
- Reliability: The Scheme area is typically where performance and reliability issues for the TRU programme services are encountered and is one of the most congested sections of the Transpennine rail network, with limited places for train performance to be managed. Therefore, should a train failure occur within the Scheme this will often mean a full blockage of the Scheme Route in either the up or down directions due to a limited number of places to manage rolling stock to ensure train movements can continue in both directions.

3.2.4 The Scheme is essential to the delivery of the TRU Programme and the full realisation of the aims of TRU, to better meet capacity requirements. Without it, the following overall TRU aims would not be achieved:

- An improved journey time for Leeds – Manchester Victoria of 43-44mins;
- An improved journey time for York to Manchester Victoria of 67-69mins;
- New four-tracking and a grade-separated junction between Huddersfield and Ravensthorpe for reliability and capacity, to help remove delays and prevent them from perpetuating from one side of the Pennines to the other;
- The ability to run eight passenger trains per hour;
- Full electrification; and
- A contribution to Network Rail's Decarbonisation Strategy and climate policy.

3.3 Options considered

<u>The 'do nothing' alternative</u>

3.3.1 Part of the process is to consider the 'do-nothing' scenario; that is to say what would occur if the Scheme does not go ahead. Under the 'do-nothing' scenario the environmental baseline would remain unchanged in that there would be no physical changes to the environment either positive or negative.

3.3.2 The descriptions of the existing baseline are included in the Scheme-wide Assessments (Chapters 6 to 21 in Volume 2i of the ES). Future baseline, i.e. changes in baseline conditions, that would be present without the Scheme but during the Scheme's construction and operational period are also set out within Chapters 7 (Air quality) and Chapter 14 (Traffic and transport). It should be noted that in the do minimum scenario, the TRU programme

constraints would continue and would result in continuing adverse effects on the socio-economics of the local and sub-regional area due to unreliable, crowded services.

3.3.3 The current infrastructure constraints of the Transpennine Route mean that it is not currently well-placed to deliver its key enabling role in joining the northern conurbations into a more productive economic entity. The route has not seen significant infrastructure investment for many years and in the last 25 years the TRU Programme has seen doubling of passenger journeys to 50 million per annum. Train services have increased in response, but the line is at capacity, with journeys unreliable, crowded and slow.

3.3.4 Reliability and punctuality of passenger trains along the route is very poor, with only 38% of trains On Time (making station calls within a minute of the scheduled time) to August 2019. This compares with a national average for the same period of 65%. This is primarily due to the constrained Transpennine Route infrastructure not currently allowing for fast trains to pass slower ones to make up time, meaning delays can be exacerbated, or at best, not improved.

3.3.5 Peak crowding on the Transpennine Route has been excessive and is exacerbated by the reliability problem. For example, late or cancelled trains lead to more passengers transferring to other services, making overcrowding worse. The introduction of new rolling stock and an improved timetable in December 2019 have increased the nominal seats per hour across the Pennines on fast or “semi fast” (limited stop) trains from 900 to around 1600, an improvement of 80%. Once these changes have bedded in, they will go a significant way towards relieving current overcrowding on the route, at least for the faster trains. However, challenges remain and this does not resolve the issue that there is no room for additional passenger or freight services to serve a growing economy, and journeys are relatively slow for the distances involved (less than 60mph on average for the fastest trains).

3.3.6 The Scheme is identified as being critical to addressing these constraints in capacity, reliability, and journey times for this section of the TRU Programme. The Scheme is also recognised in providing critical support for the wider TRU Programme to address these constraints and improving strategic connectivity through the Sub-regional and Regional level.

3.3.7 Decarbonisation means reducing, and ultimately eliminating, carbon dioxide emissions. It is essential in tackling climate change and a fundamental issue facing all industries. The rail industry intends to decarbonise through improved energy efficiency, new power sources and modal shift[1].

3.3.8 Given the government-wide target to achieve net-zero emissions by 2050 and the priority of decarbonising transport to improve air quality, health and take urgent action on climate change, TRU is seen by many stakeholders, including Transport for the North (TfN), as a key opportunity to decarbonise the Manchester-York route.

3.3.9 The Traction Decarbonisation Network Strategy produced by Network Rail (2020)[2] sets out that “Although rail contributes less than 1% of the total UK annual greenhouse gas emissions it is in the unique position of currently being the only transport mode capable of moving both people and heavy goods using a zero-carbon solution. As a result, rail has a huge potential role to play in decarbonisation of the UK economy by providing reliable, green transport for goods and people. The report also sets out that “Whilst a significant investment will be required in the long-term on a national scale there is both a strong strategic and economic rationale for investment in decarbonisation for rail traction".

[1] https://www.rssb.co.uk/sustainability/decarbonisation
[2] https://www.networkrail.co.uk/wp-content/uploads/2020/09/Traction-Decarbonisation-Network-Strategy-Interim-Programme-Business-Case.pdf

3.3.10 In summary, the do minimum option does not enable the Scheme to deliver on the required capacity or journey time improvement and the current operation of diesel trains does not significantly contribute towards Network Rail meeting the decarbonisation agenda. These challenges can only be resolved through significant infrastructure investment.

High level strategic alternatives

3.3.11 Given the TRU Programme is an upgrade to an existing railway project, this report has not considered an alternative location for the railway, as this is outside the scope of TRU. However strategic alternatives were considered during the early stages of the Programme. This included, use of an alternative route (across the Pennines) for fast passenger trains, construction of a new route (or partial re-opening of a closed route), it was concluded that these would not comply with the cost and programme constraints of the Programme and were therefore not taken forward as options.

Northern Power Rail

3.3.12 Northern Powerhouse Rail (NPR) is a programme to deliver a transformed rail network in the North of England featuring a mix of new and significantly upgraded railway lines, it will increase the capacity, speed and resilience of the North's rail network. In doing so, passengers will experience faster and far more reliable journeys between the North's economies and its largest international airport.

3.3.13 The TRU will form part of a wider transport strategy for the North of England as part of the NPR initiative. In particular, it should be noted that the March 2016 National Infrastructure Commission report 'High Speed North' calls for:

"a long-term programme with the objective of reducing (Manchester to Leeds) journey times to 30 minutes, alongside substantial capacity and frequency improvements. The first part of this should be a shorter-term plan, to be developed and implemented by TfN [and Rail North] and Network Rail by 2022, to cut the journey time between these cities and to onward destinations by roughly 20% from 49 to 40 minutes, enhance capacity and improve service regularity and frequency.

3.3.14 However, the strategic outputs required for the TRU and the conditional outputs required for NPR are different, the TRU will address the significant constraints on the existing network. NPR involves the delivery of a new railway. Therefore, synchronisation of development work, and the identification of synergies between TRU and NPR need to be recognised, and this will be facilitated by Network Rail.

3.3.15 Whilst TfN has its vision for a new NPR link across the Pennines, this will not enter service before 2035 at the earliest. Given the experience of growing demand and growing problems on the existing route over the last 20 years, the prospect of no further investment in it over the next 20 years is untenable. This option is therefore not considered feasible and so has been discounted.

North of England Programme

3.3.16 The North of England Programme (NoEP) has been progressively enhancing the existing system, dealing with challenges such as capacity bottlenecks, as well as electrification and some targeted connectivity improvements.

3.3.17 Work completed to date includes the majority of the North West Electrification Programme (NWEP) which is already delivering benefits to passengers by facilitating journey time improvements, reliability and capacity enhancement, improved connectivity through new services and improved rolling stock. Work is ongoing to improve the key rail hubs throughout

the region, at Liverpool, Manchester and Leeds. A number of smaller schemes across the region have dealt with (or are dealing with) pinch points in the network, such as on the corridor into Liverpool, and providing new connectivity (e.g. the Ordsall Chord in Manchester). However, this programme does not deal with cross-Pennine issues.

Scheme design alternatives

3.3.18 The existing railway corridor between Huddersfield and Ravensthorpe provides the greatest opportunity to implement improvement works on the Transpennine Route.

3.3.19 Significant work has been undertaken relating to the local design options in order to determine the preferred solution which would fulfil the requirements of the Scheme. Environmental and wider sustainability issues were material consideration in the design development and option selection process thereby achieving a continuous process of iterative design improvement with respect to the environment.

3.3.20 These design measures have been considered within the Environmental Impact Assessment (EIA) and the potential for effects and are termed embedded mitigation.

3.3.21 The following sections sets out firstly the overarching design process that has been followed and secondly details out the specific options considered for key interventions. Given the level of design work that has taken place on the Scheme, the following section is not intended to provide a full history of the design development but instead provides a summary to highlight the works that has been undertaken and the decision making process that has led to the preferred option that forms the basis of the TWAO application. It is also not intended that this section provides a full engineering design justification but focusses on those interventions where environmental factors were a key consideration in determining the preferred option.

Design process

3.3.22 Where several options were available, workshops were undertaken with a range of technical specialists and the options were considered against a range of criteria, which are set out in Table 3-1. An example output of these meetings is also provided in Table 3-1.

3.3.23 This approach was used in options ranging from determining the appropriate track layout, to more detailed consideration of specific interventions, such as bridge designs.

Table 3-1 Example output of design development workshop

			Contribution to Outputs				
Criteria	**Criteria definition**	**Notes – including key issues or impacts**	**Highly Unsupportive**	**Unsupportive**	**Neutral**	**Supportive**	**Highly Supportive**
			--	-	0	+	++
Performance							
Journey Time	Contribution to the system outputs for journey time						
Train Capacity	Provision for specified capacity						
Train Length	Provision for specified capacity						
Train Performance	Reliability of infrastructure						
	Number of incidents/response time						
	Resilience (ability to recover)						
	Capacity for further growth						
Operational Safety	Layout risk assessment, residual hazards CSM review						
Operability	Support vision of future railway state						
Maintainability	Supports vision for future railway state						
Engineering	Compliance to engineering and operational specifications						
Sustainability and Environmental							
Landscape/Townscape – Visual	National Park; Areas of Outstanding Natural Beauty						
	Visual impact, landscape and townscape impacts						
Ecology – Biodiversity	International (designated, proposed and compensatory) - SAC, SPA and Ramsar						
	National – National Nature Reserve, SSSI, Ancient Woodland and 'Veteran Trees', limestone pavement orders						
	Local – Local Nature Reserve, Tree Preservation Orders, Sites of Importance for Nature Conservation (SINCs)						

Cultural Heritage	International – UNESCO World Heritage Site						
	National – Grade I and II* listed buildings; Grade I and II* registered parks and gardens; Scheduled Monuments						
	Local – Conservation Areas						
	National Trust Property						
Air Quality	Air Quality Management Areas						
Noise and Vibration	Sensitivity of potential receptor						
Soils and Geology	Geological SSSI; Regionally Important Geological and Geomorphological Sites (RIGS)						
	Best and most versatile land						
Water Environment	Flood Risk Areas, Water quality (Ground water source protection zones/major aquifers)						
Carbon Footprint	Rail Carbon Tool						
Resilience	Route Weather Resilience & Climate Change Adaptation (WRCCA) Plan high and medium priority impact areas.						
Local wellbeing	Network Rail Social Performance themes						
Transport	Transport impacts on the local community through the transport of materials, waste and employees.						
	Impacts on connectivity for local community.						
Resource Management	Waste, material use and reuse, water use						
Land use/Amenity	Allotments; Village Greens, Common Land						
	National Cycle Network, long distance walking trails						
	Public open space (parks) and Public Rights of Way;						
	Recreational waterways						
	Other sensitive receptors (community & education facilities, residential etc.)						
	Assets of Community Value (ACV)						
Stakeholders							
Network Rail Route Asset Management	Level of support from Route Asset Management for option						
Stakeholders external to Network Rail	stakeholders impacted by works by type and influence; considering previous relationship with network rail; potential conflict with stakeholders; impact on community/businesses						

Deliverability							
Availability of sufficient land	For example, some land uses might prevent development - hazardous facilities, important community facilities (hospitals); contaminated land; Crown Land						
Timescale							
Technical Complexity							
Consent Risk							
Implementation Risks							
Safety							
Constructability	Consider staging viability, ease of access, disruptive possession requirements, impact on ops and maintenance during construction, construction and environment and safety in construction						
Value							
Capital Cost							
Life Cycle Cost	Evaluation of differences between options and key issues. No monetary value defined.						
Cost : Benefit Ratio	Considering journey time in particular note the cost per second of providing the journey time benefit. This does not include for capacity or performance benefits as measured above but allows a comparison between similar options						

Track layout

3.3.24 The track layout heavily influences the design of other elements of infrastructure within the Scheme. For example, the vertical alignment will determine whether the railway is accommodated at ground level, in a cutting or on an embankment.

3.3.25 Vertical alignment also influences works that may be required to structures such as raising bridge decks or full demolition and rebuild of structures to allow overhead line equipment (OLE) infrastructure to pass underneath.

3.3.26 The base assumption, in order to meet the core objectives of the Scheme was that four-tracking would take place throughout the Scheme area and that line speed increase to circa 100mph should be achieved on the fast lines.

3.3.27 The following paragraphs outline the key areas considered through the options assessment process.

Grade separated junction

3.3.28 During design development, two options were considered for the location of the grade separated junction, either at Heaton Lodge or Ravensthorpe.

3.3.29 Ravensthorpe offered the opportunity to use a brown field site, gain wider railway operational benefits and had a lesser environmental impact. These benefits would not be realised with a grade separated junction at Heaton Lodge.

3.3.30 The preferred solution for the Scheme is therefore to implement a grade separated junction at Ravensthorpe. This will allow the fast lines to by-pass Thornhill LNW Junction removing conflict and thus delivering improved journey time and reliability.

Heaton Lodge Curve

3.3.31 The principal design driver at the Heaton Lodge curve was the opportunity to increase the line speed through the flattening of the alignment adjacent to the existing 70mph curve, one of the few locations between Leeds and Manchester where this is possible. The resultant alignment has been selected to deliver optimum benefit to the railway whilst minimising as far as possible the impact to railway neighbours and third party land. However, selection of this alignment does result in the need to demolish three residential properties in the area.

3.3.32 A range of options from 80mph to 110mph were considered particularly given the impacts to adjacent properties. Within the existing boundary, 80mph is the maximum fully compliant speed possible. This option would result in the least environmental effects however it would not achieve the base requirements of a minimum speed of 100mph.

3.3.33 The preferred solution, will deliver the two new lines to the south of the junction, thus allowing the direct services to by-pass the junction and therefore improve journey time and reliability of the Transpennine Route. The proposed alignment sits within a 12m deep cutting, minimising visual impact and noise impacts on local residents.

3.3.34 The solution does have biodiversity impacts as the work at Heaton Lodge will result in the loss of a main badger sett, however this sett would be impacted by any construction works to the lines in this area as well as works to Cooper Bridge Intersection (MVL4/2) so is not directly attributable to the preferred solution for the track alignment. Mitigation measures will be implemented prior to and during construction to minimise impacts on badgers. The requirements of which are well understood and will be carried out in compliance with a badger development licence will be obtained from Natural England.

Ravensthorpe Junction

3.3.35 The principal design approach to the grade separated junction was to locate the required structures in an area which is both beneficial to the operation of the railway and minimises impact to railway neighbours. As such the grade separated junction has been located on a brown field site (Thornhill Quarry) within the triangle of land bounded by the existing operational railways (referred to as the Ravensthorpe Triangle).

3.3.36 Two forms of grade separated junction were considered at this location; a fly-over or dive under. The key design drivers in the decision-making process were;

- Maximise offline construction and avoid/minimise impacts on the Wakefield lines thereby reducing impacts on the operation of the railway;
- Avoid temporary realignment for Wakefield lines;
- Minimising earthworks;
- Minimise environmental impacts, particularly in relation to noise, visual impact, water environment and contaminated land;
- Minimising third-party land take and impacts on local businesses;
- Minimising works to/diversion route of Calder Road;
- Consideration of the Dewsbury Riverside development to ensure that the Scheme (where possible) does not stifle future development;
- Achieve 110mph and 75mph on Fast and Slow lines; and
- Consideration of risks associated with works in an actively permitted landfill.

3.3.37 The same speed is achieved through the junction on slow lines in both options (70mph). Both layouts achieve 110mph on the fast lines.

3.3.38 The grade separated junction at this point necessitates the re-location of Ravensthorpe Station and the re-alignment of Calder Road. In both options, a new station is constructed to the west of Thornhill Junction allowing both the Leeds and Wakefield lines to be platformed.

3.3.39 There is approximately 28 weeks difference between the two options set out below in terms of the main civil engineering completion date and impacts on the operation of the railway. The overall difference in completion date is approximately 9 months longer for the diveunder.

3.3.40 Insert 3-1 shows the layout of the flyover, as presented during Phase 1 of the public consultation, with the diveunder shown in Insert 3-2. Feedback from the consultation did not indicate there was any significant difference in preference by the public between the two options presented.

Insert 3-1 Indicative layout of the flyover (during design development)

Insert 3-2 Indicative layout of the diveunder (during design development)

Flyover

3.3.41 The flyover option would have impacts on the landowners to the north of Scheme, particularly the Newlay concrete site, due to the necessary realignment of Calder Road. However, design development has refined the design such that it is less intrusive and requires less permanent land take into the Newlay concrete site.

3.3.42 Driven piles will avoid generating contaminated pile arisings from the landfill, mitigation measures are proposed within the Environmental Statement (ES) to manage this risk.

3.3.43 The River Calder has a large flood plain extending through the footprint of the works. Construction of a flyover reduces the land take requirements and the construction of the piers will not significantly impact the flood plain.

3.3.44 The flyover structure requires less than half the concrete works compared to the diveunder option, whilst the earthwork volumes are only 10% higher.

3.3.45 The level difference between the slow and fast lines can be mitigated in the flyover option. This minimises the visual impact on the structure in elevation and hence its impact on the setting of Calder & Hebble Canal Underbridge (MDL1/6) and River Calder Underbridge (MDL1/8), both Grade II listed structures.

Diveunder

3.3.46 The diveunder would involve a higher ground risk as the diveunder would involve digging into an area of landfill.

3.3.47 Less impact is anticipated on the Newlay concrete site but may impact on the industrial units to the north.

3.3.48 The Scheme in this area is also located within the floodplain and would need to consider the impact on surface water flows in the area.

3.3.49 There is also a long-term increased maintenance liability from pumping of any water from within the diveunder structure during the operational phase. In addition, there is a risk that overpumping will not be permitted into the adjacent watercourse, due to level of contaminants.

3.3.50 The TRU is committed to reducing carbon footprint where practical. The diveunder has greater embodied carbon due to the increased concrete requirements during construction. It also has higher operational carbon due to the need to pump out rainwater.

3.3.51 Design development has refined the new layout of Calder Road. The initial layout impacted on the Newlay concrete site to the extent that the operation of the site may no longer be viable and an alternative site would be required. Given the nature of the operations and the size of the site, finding an alternative location within the timeframes available was considered to be extremely challenging. The design therefore sought to reduce the land take required to the north of the railway. The layout of Calder Road has been kept as close as possible to the existing alignment whilst still maintaining required clearance from the railway lines and OLE. The provision of a roundabout to the south of the railway has facilitated this amended geometry and the refined design has reduced the impact on the Newlay concrete site such that whilst operations may be temporarily impacted it is not considered that the site could not continue to operate.

Stations

Huddersfield Station

3.3.52 Huddersfield is a Grade I listed station located within the Huddersfield Town Centre Conservation Area.

3.3.53 Historic England and Kirklees Council have been involved in ongoing stakeholder consultation with Network Rail through the development of the Scheme.

3.3.54 Regular meetings with both these historic environment stakeholders have been held to discuss structures of heritage significance on the alignment of the railway which are subject to impacts during the construction or operation of the Scheme. The first of these meetings was

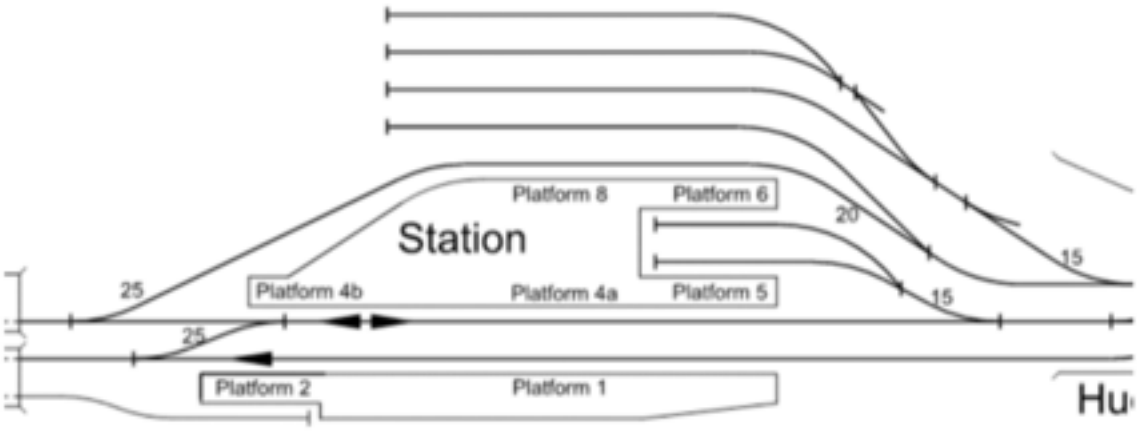
held in December 2018, with subsequent meetings held approximately every six to eight weeks, however not every structure/element was discussed at every meeting.

3.3.55 The station was originally constructed in 1850 and most recently modified in 2011 when lift access was installed as well as improvement works to the concourse and waiting areas. The original main trainshed roof structure is generally in a poor condition and known to have been strengthened on at least two occasions during its lifetime.

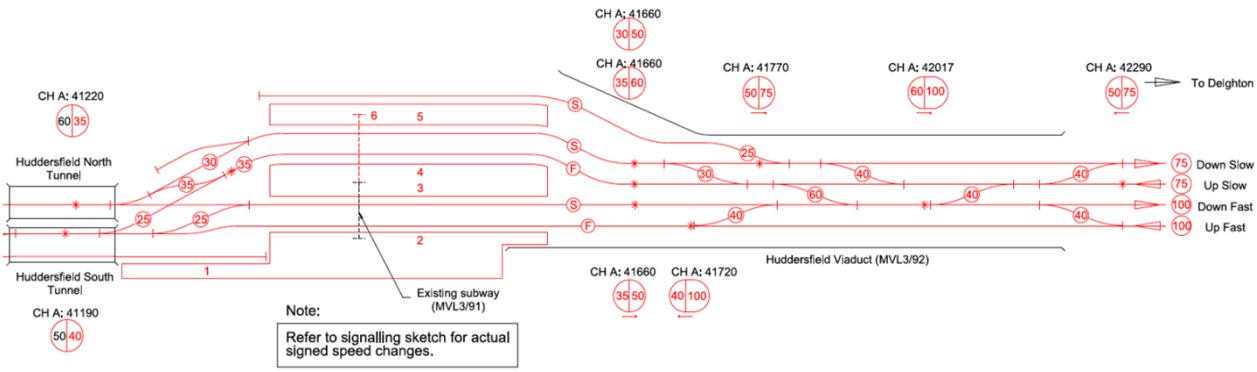
3.3.56 The current operational arrangement, as shown in Insert 3-3, includes three through platforms for the main Transpennine services and some local turnback services, a single west facing bay operating services on the Penistone branch as well as two east facings bays operating local services to Halifax, Bradford, Leeds and Wakefield. This platform arrangement and operational track layout is currently operating at capacity, and offers little, if no flexibility in operation or in perturbed working conditions.

3.3.57 Operational modelling has shown that the proposed timetable can be supported with the greatest level of reliability with the following changes, as shown in Insert 3-4:

- Four through-platforms of 200m length;
- One west-facing bay platform of 200m length;
- Comprehensive junctions to allow train services to be sorted onto the correct platform and line at both ends of the station; and
- OLE introduced above all track.



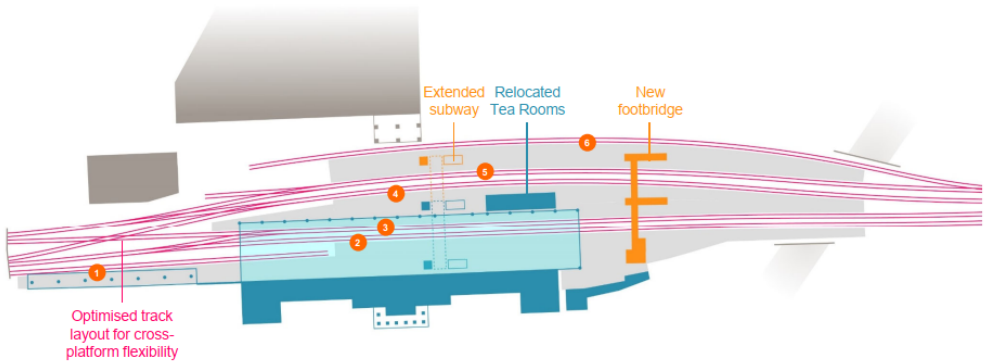
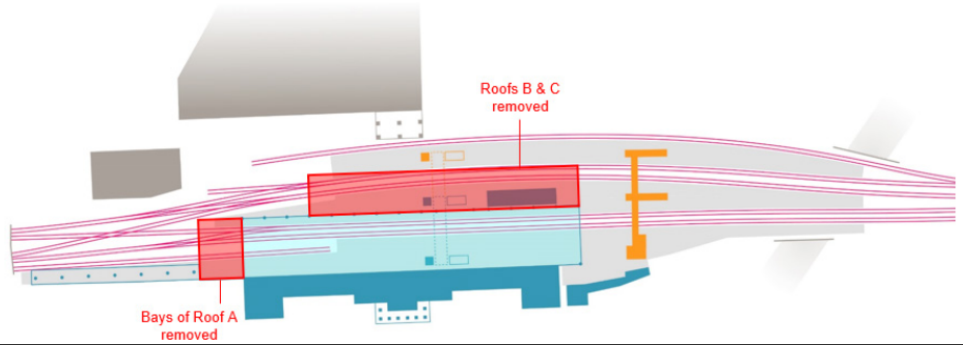
Insert 3-3 Current platform arrangement at Huddersfield Station

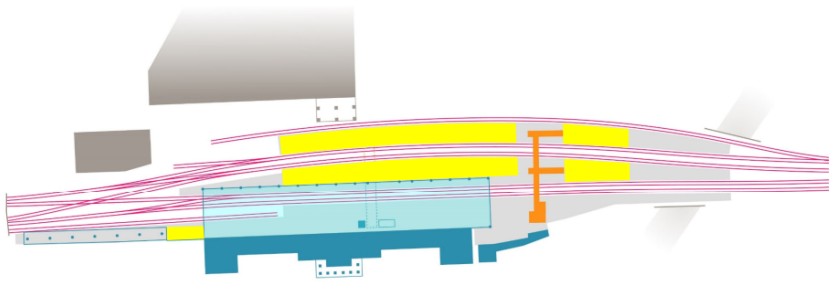
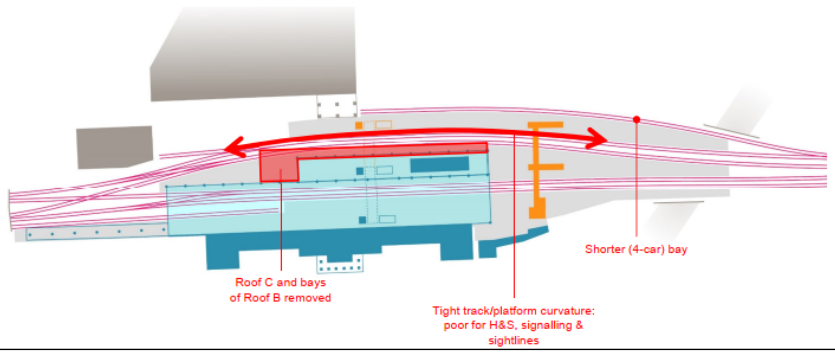


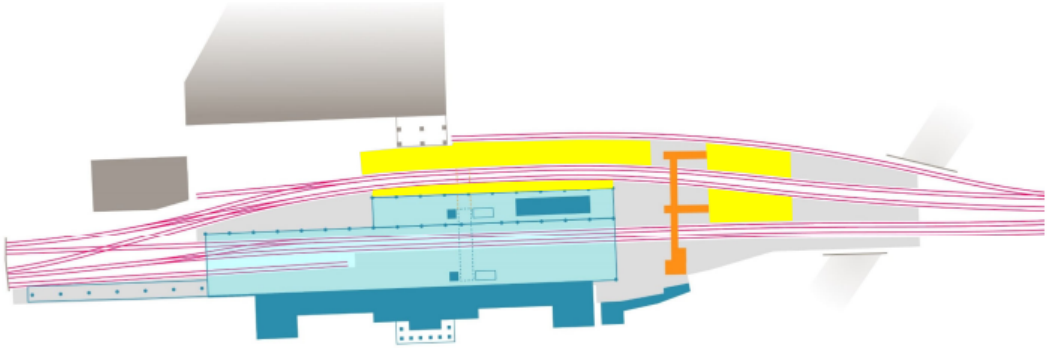
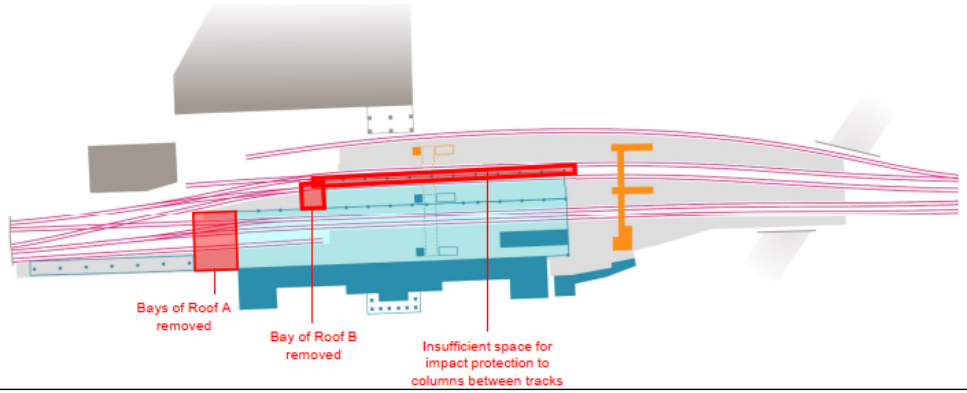
Insert 3-4 Proposed platform arrangement at Huddersfield Station

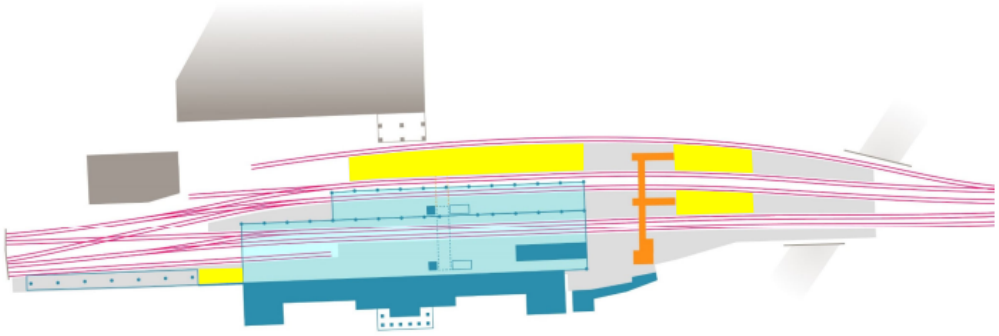
3.3.58 Three principal options were explored to achieve this arrangement, as described in Table 3-2. Each option has different implications for the structures within the station. None of the options would result in any changes to the principal station building, either in terms of the historic fabric of the building, or the experience of those using the station passing through it.

Table 3-2 Details of design options considered at Huddersfield Station

Design Option	Options considered
Option 0	• Island platform is wider and preserves more of the platform structures, including both historic spans of the trainshed roof. • Proposed Platforms 5 and 6 are positioned slightly closer to the western site boundary and so the new bay platform is limited in length by the physical constraint imposed by the warehouse goods lift. • Tea Rooms may be retained on the central platform but must be relocated slightly to the north-east. • Existing stair and lift on the central island platform will also require relocation.  • This option requires modification of the existing trainshed, removing two bays of Roof A from the Manchester end of the platform, and the removal of the smaller shed (Roof B) along with its cantilever span (Roof C). 

Design Option	Options considered
	• New coverage (canopies/roof structure) will be required to some of the extended platform areas. 
Option 1	• Island platform to be made wider and preserve more of the platform structures; • Owing to the width of proposed Platforms 3 and 4, the propose platforms 5 and 6 are positioned slightly closer to the western site boundary than in Option 0. As a result, the length of the new bay platform (proposed Platform 6) is limited to 150m by the physical constraint imposed by the warehouse goods lift; • The whole of Roof A is conserved. Two bays of Roof B will be removed, along with Roof C; • Safety concerns over layout of platform 4. This would introduce large distances between the platform edge and train doors, risking passengers' safety as they board or disembark trains, but the curvature would also reduce the signal sighting distances for train drivers through these platforms, providing a considerable safety issue in terms of visibility of both signals and also hazards, such as a person on the tracks; and • The Tea Rooms will remain in their original location. 

Design Option	Options considered
	• New coverage (canopies/roof structure) will be required to some of the extended platform areas. 
Option 2	• This option seeks to minimise the impact on the existing shed structures, while still narrowing the existing island platform, by incorporating the Roof B columns between two sets of tracks. This concept would require the installation of impact protection around the columns; even with this measure such a design approach would pose a considerable safety concern. • Roof A is retained, with the exception of two bays removed from the Manchester end. Roof B is retained with the removal of only one bay, the cantilever canopy (Roof C) is removed. The Relay Room and cable gantry will require removal. The Tea Rooms require relocation to the eastern platform, as the width of the narrowed existing island platform would be insufficient for it to be retained in its current position, or moved east or west on the platform. 

Design Option	Options considered
	• New coverage (canopies/roof structure) will be required to some of the extended platform areas 

3.3.59 Option 0 was selected as the optimal arrangement for platforms and tracks, delivering the greatest range of upgrades to Huddersfield Station, operational safety for rail and station users, while also minimising where practicable impacts to the significance of the station. The operational constraints posed by either Option 1 or Option 2 were recognised as considerable barriers to either of these options delivering a safe and beneficial Scheme.

Secondary access means – subway or footbridge

3.3.60 The existing subway in the station is the sole means of passenger access to the existing and proposed island platforms. In order to accommodate the forecast increase in passenger flows through the station to the target date of 2033, and to comply with emergency access/egress requirements, a second means of access is required to the proposed island platforms.

3.3.61 A subway or a footbridge were explored as options. A detailed study was carried out, considering a number of factors. Based on the outcomes of the study, highlighting the challenges posed in constructing a subway in the wider context of the station and ground conditions, as well as the potential disruption caused to the operation of the station and the other works of the Scheme as a result of its complexity, the approach of constructing a subway was dismissed. A new footbridge was deemed to be the preferred option.

Footbridge design

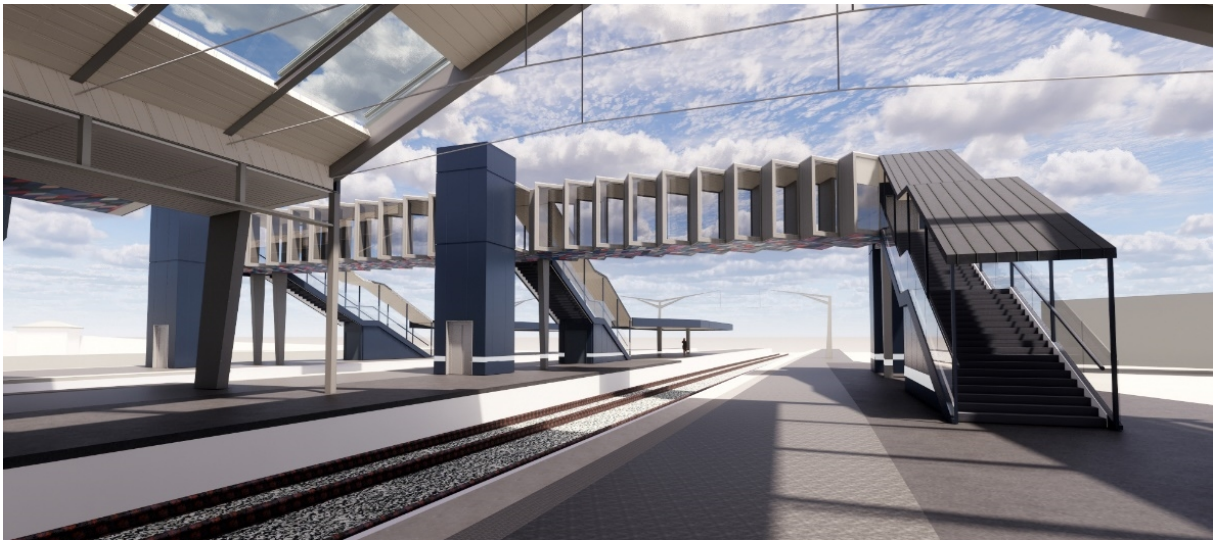
3.3.62 On determining a footbridge would be constructed, it was recognised that this structure would need to respond to the significance and setting of the Grade I listed station, whilst delivering a design approach which provided a modern iconic design. Being placed towards the northern end of the platforms, this would be a new element in views at that end of the station.

3.3.63 Due to the nature of the exposed environment at the Leeds end of the station and the prevailing westerly wind, it was identified early on that the bridge would need to be enclosed by glazing or a solid cladding. The latter was identified as not being acceptable from a heritage perspective due to the fact it would obscure the gable end of the main trainshed and limit views out from the station towards the viaduct.

3.3.64 In designing the footbridge to be as transparent as possible, issues relating to potential glare problems (for train drivers) and access and maintenance concerns were identified.

3.3.65 This fed into the proposed design of the footbridge, by shaping the elevations as ‘saw tooth’ designs, appropriately dealing with the glare issue while also maintaining visibility through the structure. This has created a distinctive form that is unique to Huddersfield, delivering a design which takes into account the surrounding context and the environment around the station.

[3] This is taken as 25 years from 2018 and is set by the Government as a target date for passenger forecasts when compiling need statements.



Insert 3-5 Proposed Huddersfield Station Footbridge – visualisation

Deighton Station

3.3.66 Due to the conflict with the new track alignment, Deighton Station is to be relocated. Two options were considered.

3.3.67 The locations of two options are shown in Insert 3-6 and the advantages and disadvantages of each option are set out in Table 3-3.

Insert 3-6 Location options for Deighton Station

Table 3-3 Advantages and disadvantages of Deighton Station options

Option	Advantages and sisadvantages
Option A – Retain existing location as far as possible with platforms shifted to the west	**Advantages:** • Located at current station location; and • Accessed from Whitacre Street as per existing. **Disadvantages:** • Extended station closure; • Poor intermodal connectivity; • Environmental impact (significant works to urban green space; residential area); • Less than optimum station forecourt due to drop off point being located off of Whitacre Street; • Substantial land and property requirements; • Rebuild of Whitacre Street Overbridge (MVL3/101) required (significant closure time); and • Substantial earthworks and retaining walls required which may lead to requirement for acquisition of properties.
Option B – Relocate the station further down the greenway to the west of the existing station location	**Advantages:** • No disruption to existing businesses; and • Accessed from Whitacre Street as per existing. **Disadvantages:** • Poor intermodal connectivity; • Low prominence with limited natural surveillance (cul-de-sac location); • Poor Disability Impact Assessment (DIA) performance; and • Environmental impact on open land adjacent to the Birkby Bradley Greenway, visual impacts to local residents, requirement for permanent vegetation removal along the greenway.

3.3.68 The preferred option was to retain the existing location of the station. The alternative site would result in a station in a remote location which are likely to make it less attractive to passengers (particularly lone passengers) and so gives rise to a poor DIA rating. The relocation would also impact on the open space land surrounding the greenway including the vegetation in this area.

3.3.69 Further design development has taken place on the earthworks solution and soil nailing is now proposed which has enabled the retention of the station at its current location also gives the key benefit that no properties are required to be permanently acquired or demolished.

Mirfield Station

3.3.70 The design development has been informed by the flood risk requirements of the site particularly around access and egress points from Station Road.

Ravensthorpe Station

3.3.71 Construction of the grade-separated junction at Ravensthorpe resulted in a need to relocate the Ravensthorpe Station to the west of Calder Road.

3.3.72 Consideration given to station facilities and whether these should be located to the north or south of track.

3.3.73 The preferred option is to locate the drop off and station access from the south of the track as this will have less impact on the businesses surrounding the station site. The proposed station

location would also provide easy access should the Dewsbury Riverside scheme (approximately 4000 housing units) be brought forward.

Structures

Overbridges and Underbridges

3.3.74 The following section sets out the options considered for the overbridges and underbridges within the Scheme area. Environmental and sustainability issues have been considered where appropriate.

Huddersfield Viaduct (Span 2-3) Underbridge (MVL3/92(2))

3.3.75 Historic England and Kirklees Council have been involved in ongoing stakeholder consultation with Network Rail through the development of the Scheme.

3.3.76 Regular meetings with both these historic environment stakeholders have been held to discuss structures of heritage significance on the alignment of the railway which are subject to impacts during the construction or operation of the Scheme. The first of these meetings was held in December 2018[4], with subsequent meetings held approximately every six to eight weeks, however not every structure/element was discussed at every meeting.

3.3.77 The following options were considered:

- Do nothing – Does not work due to several girder clashes;
- Option 1 – single deck replacement;
- Option 2 – Two symmetrical spans;
- Option 3 – Two asymmetrical spans; and
- Option 4 – Three-span.

3.3.78 Option 1 is considered the preferred option as this results in a continuous of existing conditions for pedestrians and road users. Options 2 to 4 introduced additional piers into the bridge design which would have led to a tunnelling effect. This may have resulted in perceived safety concerns by pedestrians using the footway. Option 1 also reduces the requirements for utility diversion works which reduces the construction programme, a key constraint on one of the main access roads into Huddersfield Town Centre.

3.3.79 Further design development of the replacement structure over John William Street focused on the design of the deck, in particular the width of the deck with respect to the proposed platforms above and the style of the parapets.

3.3.80 The design of the parapets of the replacement deck was developed to respond to the significance of both the Grade II Listed Huddersfield Viaduct (MVL3/192) and the adjacent Grade I Listed station, with an awareness that the existing metallic deck forms part of an integrated historic environment of 19th century railway infrastructure and is also of a distinctive form and style. It was considered that the best way to achieve this was for a replacement structure of modern interpretation but reflecting the historic character of the bridge and thereby its relationships with the wider historic environment. A completely new design approach to the structure would risk introducing an element of discord into the townscape around the viaduct and degrading the legibility of the span as being an element of the wider Grade II Listed Huddersfield Viaduct (MVL3/192). The design of the parapet for the replacement structure was therefore developed to maintain the existing visual appearance of

[4] Meeting held on 19 December 2018 in Leeds.

the bridge, with the proposed parapet design for the edge girders reflecting the existing stylistic approach.

3.3.81 The design for the replacement structure also realises opportunities where possible for the retention and reuse of existing historic fabric.

Huddersfield Viaduct (Span 29) Underbridge (MVL3/92(9))

3.3.82 The existing metallic extensions to Span 29 over Northgate/Bradford Road, are in a poor condition and have been redundant for a number of years. The proposed track alignment and line speed at this location requires alterations to the structure. The design of the proposals to Span 29 was developed through a process of optioneering around form and materials taking into account both operational requirements and the impact on the appearance and significance of the Listed viaduct.

3.3.83 For the design approach to develop the proposals for the metallic sections of Span 29, six options were considered:

- Option A: Strengthening the existing deck in-situ;
- Option B: Replacing part of the existing structure with new girders and strengthening the remainder;
- Option C: Replacing with a half through steel construction (typical railway underbridge);
- Option D: Replacing with a bespoke steel box directly below each track (different configuration to existing box girder with cross girders);
- Option E: Replacing with prestressed concrete beams on new abutments; and
- Option F: Replacing with an in-situ precast block arch in either concrete or masonry.

3.3.84 Option A was discounted as it is not possible to strengthen the existing deck *in-situ* to meet the requirements of the Scheme across this part of the Viaduct.

3.3.85 With the discounting of Option A it was accepted that the proposal would entail the replacement of at least some of the span with new structures. Option F was discounted partly on the basis of these design principles. The high skew and long span of the structure dictate that precast arch sections would not be viable. Moreover, extensive formwork would be required for such a structure, along with a considerable cost and complicated construction sequence that would bring with it a lot of disruption to both the railway and the highway. Though an arch would be in keeping with the original viaduct, it would not reflect the nature of the 1880s change and would also not bring with it any additional operational benefits compared with different approaches.

3.3.86 Option B was also discounted due to a combination of the constraints of the existing masonry arch and the condition of the existing structure, elements of which would need to be retained and strengthened. Option B would have involved the replacement of the inner I-section girders and part of the cross-girders, with the rest of the existing structure retained *in-situ* and strengthened. The poor condition of the existing elements deem their retention and strengthening to be unviable, with the configuration of the structure currently meaning there is considerable risk of hidden defects. The increased weight of the replacement structure due to the requirement for a ballasted deck would also have necessitated the strengthening of the abutments of the span. Option B would also have had considerable construction complexity during replacement of the inner elements.

3.3.87 Options C and D both approached the replacement of the sections of the span with similar metallic decks; essentially providing a modern equivalent of the existing structure. In the case of Option C this was with a standard through-girder arrangement, while the alternative Option D used bespoke box girders. Though both these approaches could provide structures which

realised the width of the span and delivered solutions with familiar materiality and structural arrangement, each also posed operational and maintenance issues.

3.3.88 Option E comprised constructing new widened abutments to Span 29 on either side of the structure and replacing the metallic sections of deck with a precast concrete beam deck. Option E was considered preferable to Options C and D from an operational perspective, as the deck provides complete freedom for the placement of the track alignment, as well as avoiding exposed steelwork, thereby delivering maximum flexibility of track arrangement across the structure. The approach also removes the loading from the existing abutments; placing a concrete deck on the existing abutments would not be practicable, as the wider span would necessitate a considerably larger deck, which would have a greater visual impact, including obscuring the crown of the arch of the original 1840s viaduct.

3.3.89 Though it was recognised that Options C and D delivered a design approach in keeping with the materiality of the 1880s widening of the span through the use of metallic structures, Option E delivered considerable operational and construction benefits. Option E also presented the opportunity to acknowledge the loss of the metallic elements of the existing span and the historic character of the structure in its design, for example by cladding the widened abutment in stone to reflect the appearance of the existing masonry of the viaduct, and the incorporation of panels or patterns on the edge beam to reference the lost 1880s metallic elements.

3.3.90 Considering the operational and construction benefits, and the opportunities to mitigate some of the impact of the change in appearance of the structure, Option E was progressed as the preferred approach.

3.3.91 Further design development of the preferred approach focussed on the materiality and style of the concrete deck parapets, in particular in considering how the design could respond to the existing structure and acknowledge the loss of the 1880s metallic spans. With regard to the material finish of the parapet, three options were considered:

- Option 1: A fully concrete structure, with the potential for the concrete parapet to be designed in a way which reflects the historic metallic parapets;
- Option 2: Installing metallic panelling comprising painted steel onto the exterior of the concrete parapet; and
- Option 3: Installing metallic panelling comprising weathering steel onto the exterior of the concrete parapet.

3.3.92 The development of the approach to the design of the parapet included consideration of both operational and structural requirement, as well as the impact on heritage significance and appearance in the context of the wider built environment. From an operational perspective, Option 1 was preferred to Options 2 and 3, as installing metallic panelling onto the outside of the concrete deck poses maintenance and health and safety issues, as it introduces a secondary element of a different material into the structure.

3.3.93 The materiality of the three options was also considered in terms of impact on the significance of the Grade II Listed structure. It was considered desirable to try to ensure the design responded to the 1880s metallic spans which would be lost in terms of the language of the parapet, and therefore Options 2 or 3 were initially preferred from a heritage perspective; however, it was recognised that being honest in the style of replacement and acknowledging the loss of the metallic spans was also an important design driver. Option 3 was dismissed, as a weathering steel parapet was considered to not be as compatible in style with the rest of the viaduct nor the surrounding townscape, thereby appearing an incongruous addition to the structure. Though Option 2, the painted steel panelling, would reflect most closely the existing 1880s metallic spans, it was considered that Option 1 would also provide opportunity for reflecting the lost historic structure, due to the potential to design a pattern in relief into the

concrete parapet to reflect the metallic panelled style.

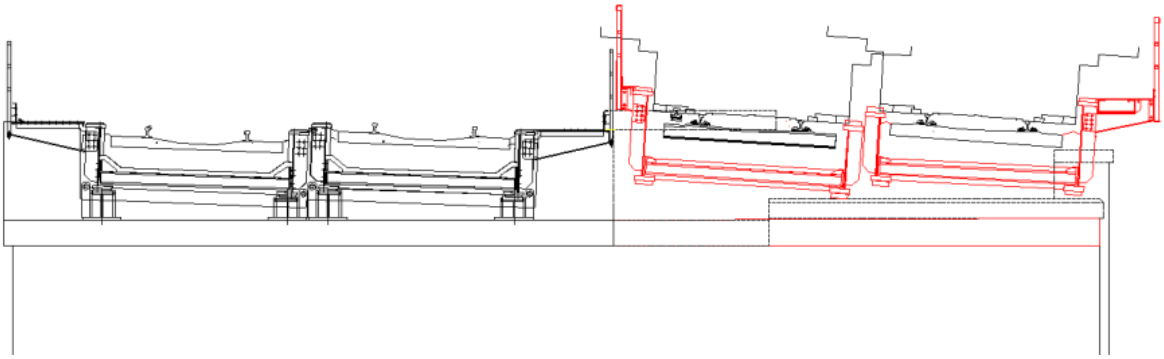
3.3.94 Based on the operational issues around introducing a secondary metallic element into the parapet of the structure, and the potential for a relief design on a concrete parapet to both respond to the lost metallic elements of the historic span and also provide honesty in acknowledging the change to the structure, Option 1 was considered to be the most viable approach to the parapet design.

Red Doles Road Underbridge (MVL3/96)

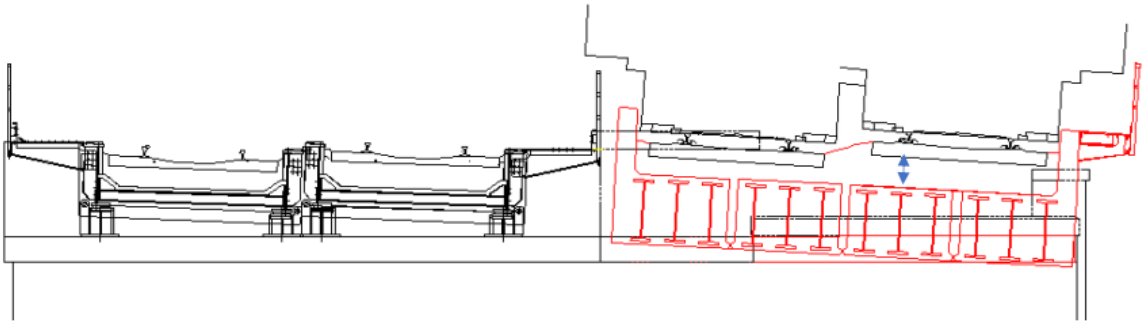
3.3.95 Four options were considered for Red Doles Road Underbridge (MVL3/96):

- Option A – Do Nothing – not viable as it's not possible to accommodate the Scheme;
- Option B1 – Z-Type Underbridge with Filler Beam Floor or Steel Floor.
- Option C – Concrete Underbridge - Significant reduction in headroom compared to existing structure; and
- Option D – U-Type.

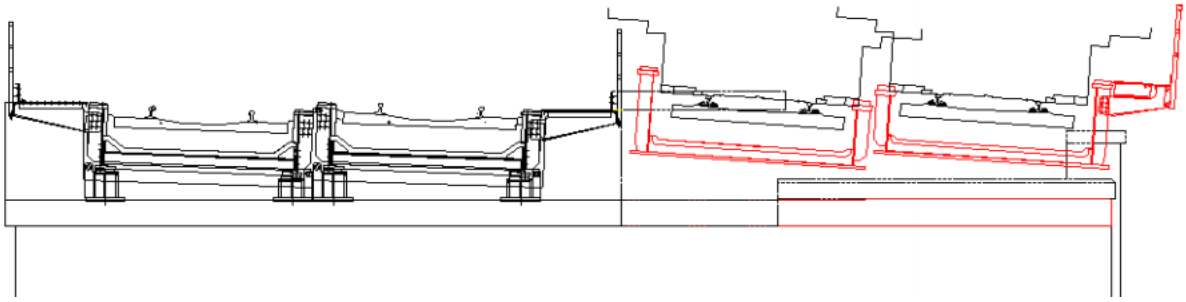
3.3.96 The options are shown in Inserts 3-7 to 3-9.



Insert 3-7 Option B1



Insert 3-8 Option C



Insert 3-9 Option C

3.3.97 The preferred solution is mainly engineering driven. Option B1 was selected as the preferred option as there will be no reduction in headroom compared to existing structure and there was increased flexibility in construction methodology i.e. the bridge deck can be installed in sections, if required which limits potential effects relating to transportation of materials to site and any conflicts with oversized vehicles along Red Doles Road. Flexibility is also key in reducing impacts to the PRoW in this area and whilst temporary closures will be required these will be short term in nature.

3.3.98 In terms of material, consideration was given to weathered steel and painted steel. The weathered steel solution is preferable as it has lower long-term maintenance and lower capital costs.

Field House Overbridge (MVL3/98)

3.3.99 Four options were considered for Field House Overbridge (MVL3/98):

- Option 1 – Do Nothing - This option proposed no works to the existing metallic deck;
- Option 2 – Replacement with new underbridge; and
- Option 3 – Refurbish, strengthen and retain the existing metallic span.

3.3.100 The preferred option is for removal of the bridge deck and replacement with a new 16m span steel bridge. The internal face would be painted, the outside would be weathered steel.

3.3.101 Following consultation with Kirklees Council, the access point to the south has undergone design refinement. Proposals are for a ramp and step solution to ensure DIA compliance as far as possible within the land available.

A62 Leeds Road Overbridge (MVL3/102)

3.3.102 Early in the design, options were considered which would avoid reconstruction of the bridge. These options were discounted due to engineering complexity and impact to third party landowners. Therefore, the Scheme proposes to reconstruct the bridge and the following three options were considered:

- Rebuild online;
- Rebuild offline; and
- Rebuild half-offline.

3.3.103 The preferred solution was to rebuild half-offline. This will minimise disruption to the highway network as far as possible. To minimise disruption to the A62 during the construction phase, it is proposed to reconstruct the new bridge to one side, partially overlapping the existing bridge (i.e. half offline). This enables a temporary road alignment to be provided during the

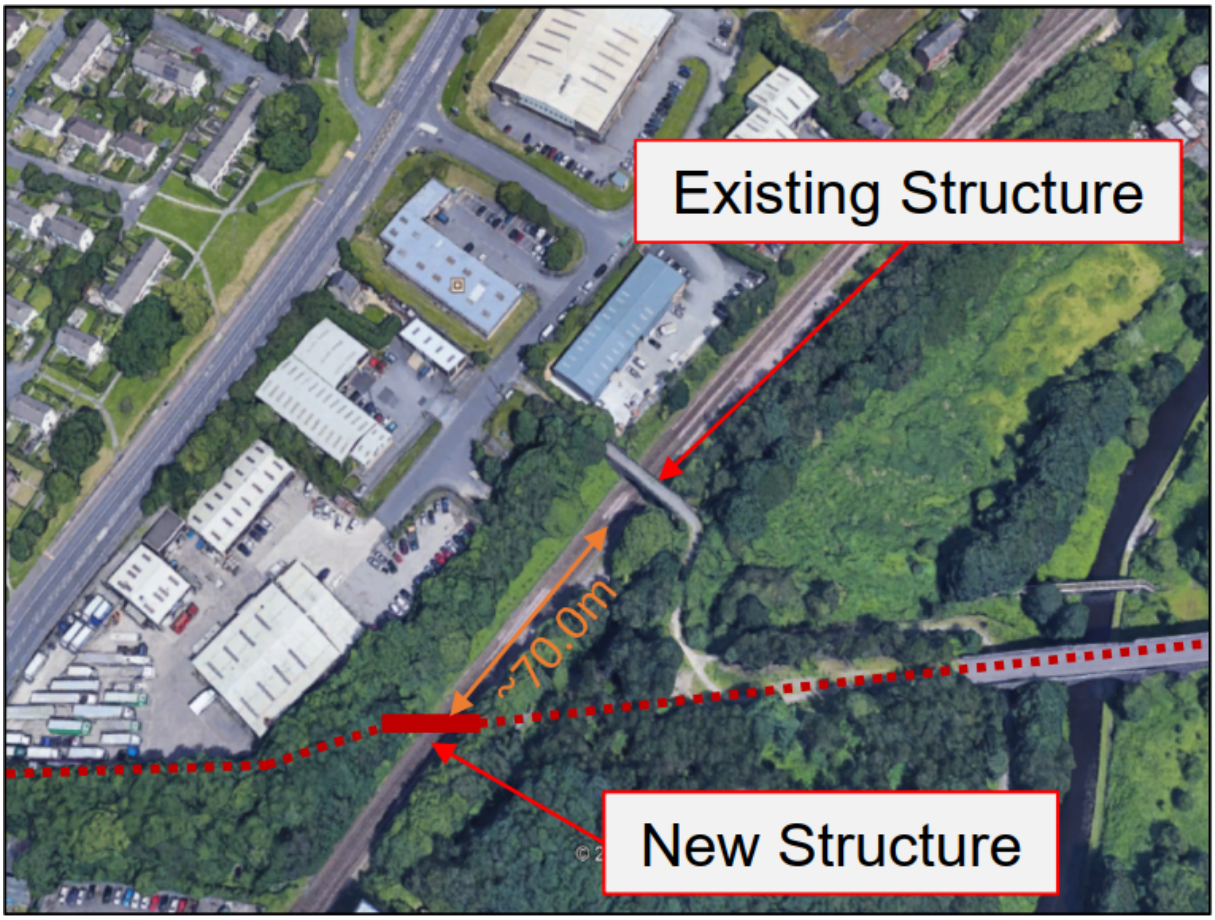
demolition of the existing bridge and construction of the new bridge. The existing bridge can therefore be retained in use until the temporary alignment is ready, avoiding lengthy road closures or traffic diversions. This also enables a pedestrian and cycle route to be retained throughout the works in the vicinity of the existing bridge. The preferred solution also seeks to minimise impacts on 3rd party land owners and ensure that surrounding business could remain viable.

Wheatley's Overbridge (MVL3/103)

3.3.104 The proposed works relating to the construction of the new replacement overbridge and demolition of the Grade II Listed bridge, will comprise:

- Construction of a single span replacement overbridge of approximately 23m length, with 1.8m high parapets, directly to the south-west of the existing Listed bridge;
- Diversion of the utilities into those constructed within the new bridge structure; and
- Realignment of the approach of the cycle path on either side of the structures.

3.3.105 Three options were considered in terms of the construction of the bridge and the alternative locations are shown in Insert 3-10. Further details, together with the environmental considerations for each, are provided in Table 3-4.



Insert 3-10 Location of options considered for Wheatley's Overbridge (MVL3/103)

Table 3-4 Wheatley's Overbridge (MVL3/103) design options

Options considered	Environmental considerations
Option A – On-line bridge Longer construction period to carefully demolish existing bridge around the utilities.	No diversion of utilities. Longer construction period to demolish existing bridge around the utilities.
Option B – Slight off-line construction	Cycle route could be kept open during construction Diversion of utilities required Small land take required for access to new structure (can be avoided with a skewed structure/overlap with NE corner of existing bridge
Option C – Bridge at Chainage 45575 (MVL3/106 Abutment)	• Precast structural members lift in place; • Cycle route can be kept open during construction of the new bridge; • Lowest risk of damage to existing water pipes; • Improved cycle route as reduced time on roads; • Significant diversion of utilities; and • Significant increase to land take.

3.3.106 Option B is preferred due to the risks associated the utilities works and the ability to keep access to the Calder Valley Greenway open for longer.

3.3.107 The design of the new bridge took into consideration sympathetic design solutions that aimed to reflect the historic bridge's original design and character. This included the careful choice of materials and finishes such as weathering steel in the replacement bridge's design to portray and enhance the area's historic industrial character, the cladding of the new bridge's approach walls and abutments with stonework that is similar to the historic fabric to reflect the overbridge's original design and aesthetic and finally the simplistic design style to clearly delineate that this is a new structure, in the same location. It

3.3.108 The proposed demolition and replacement of Wheatley's Overbridge (MVL3/103) was deemed the only practical way to deliver the Scheme's operational requirements, whilst minimising, where possible, impacts on the heritage significance of the structure.

B6118 Bridge Road Overbridge (MVL3/107)

3.3.109 A number of options were considered with the aim of retaining the heritage fabric of the bridge whilst delivery the operational benefits required for the scheme. Briefly, these included track lowering and jacking of the bridge. Upon evaluation neither option was deemed feasible. For more information see B6118 Colne Bridge Road Heritage Assessment.

3.3.110 A new bridge will be constructed to the east adjacent to the existing structure in order to minimise disruption to traffic and pedestrians during construction. The width of the crossing will be increased to 7.3m in line with modern standards. One 2.0m footway will be provided to tie into the existing provision.

3.3.111 The new structure will comprise reinforced concrete abutment walls and a deck formed from steel beams and a concrete slab. The new parapets will be steel and will be infilled across the structure in order to protect the public from the OLE below the bridge.

3.3.112 Options considered have been influenced by multiple constraints, most notably highway geometry, railway geometry, the highway alignment tying into the existing roundabout to the north of the bridge and the Listed canal bridge to the south (Colne Bridge taking Colne Bridge Road NHLE 1221180), and the constraints of adjacent businesses. The design development

process has also involved extensive and thorough engagement with a number of different stakeholders, including Historic England and Kirklees Council.

Option 1: Track lowering

3.3.113 This would have involved lowering both of the existing tracks and the proposed new fast lines and aligning the proposed new fast lines further to the south to fit through the span of the arch thereby negating works being required to B6118 Bridge Road Overbridge (MVL3/107). However the alignment of the fast lines would have led to a reduction in speed which would result in the Scheme not meeting a core objective of line speed improvement.

3.3.114 Passenger comfort was also a key consideration, due to the need to raise the tracks quickly to cross the Huddersfield Broad Canal at Huddersfield Broad Canal Underbridge (MVL3/108 and MVL3/108S). MVL3/108S has limited headroom over the canal so it would not be possible to lower the fast lines over the canal enough to maintain passenger comfort levels while providing the required clearance at B6118 Bridge Road Overbridge (MVL3/107).

Option 2: Bridge jacking

3.3.115 Bridge jacking was considered as a possible solution to enable retention of B6118 Bridge Road Overbridge (MVL3/107). This would involve the bridge being increased in height through the lifting of the arch barrels up from the tops of the piers. There are no previous examples of multi-span bridge arches being jacked and therefore there was no guarantee on the long-term viability of the approach. Given the additional criticality of the highway route carried by the structure, it was considered that this would not be an appropriate test scheme for jacking a multi-span masonry arch structure.

3.3.116 The bridge-jacking solution would also not resolve the horizontal rail alignment clash around the central piers and as with option 1, the horizontal realignment of the lines would lead to reduced train speeds. Furthermore, utilities diversion works within the bridge would require temporary diversion that would result in prolonged temporary road closures.

3.3.117 Consequently, it was considered necessary to explore options to demolish the central spans and replace the B6118 Bridge Road (MVL3/107) with a new structure. The design development process considered alternative approaches to attempt to avoid or reduce the impact to the Grade II Listed structure, which included aiming to retain as much of the existing fabric of the structure as possible

3.3.118 Two options were considered for a replacement structure:

- Offline to the west; and
- Offline to the east.

3.3.119 The preferred solution is the offline to the east option as this will minimise disruption to traffic and pedestrians during construction. The width of the crossing will be increased to 7.3m in line with modern standards. One 2.0m footway will be provided to tie into the existing provision.

3.3.120 In terms of heritage value, the design development process has resulted in mitigation being embedded within the design of the new bridge for B6118 Bridge Road Overbridge (MVL3/107). The following design considerations have been taken into account in response to the partial loss of the Listed structure:

- The desirability to retain part of the existing structure with the exception of the two spans over the railway to maintain the legibility of the former bridge's alignment and use; and

- The remaining arches would be infilled in a sensitive manner, with a recessed masonry façade sympathetic to the existing structure's aesthetics, thereby retaining the historic character of the surviving elements of the Listed structure.

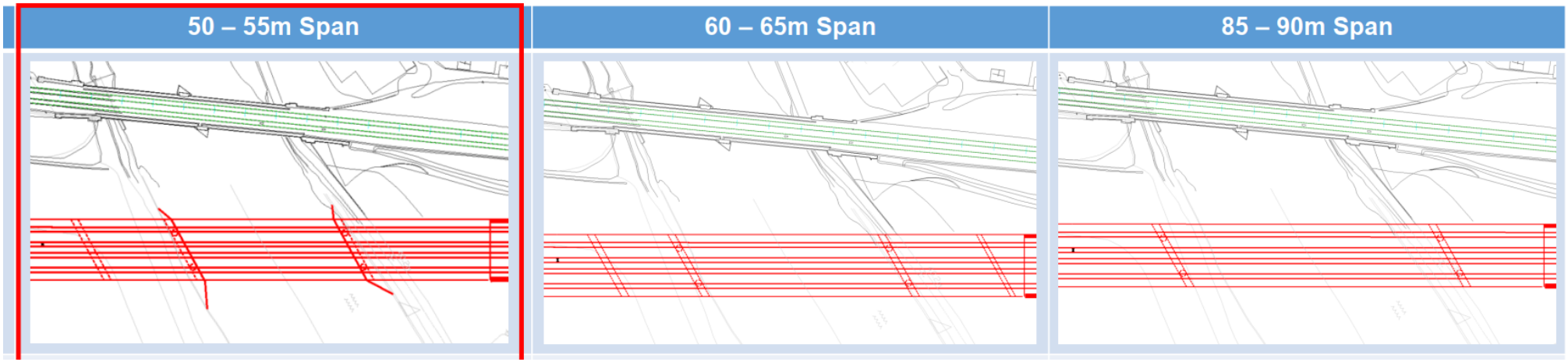
Baker Viaduct Underbridge (RBA/2)

3.3.121 The proposal is for a new viaduct over the Calder and Hebble Navigation and the River Calder.

3.3.122 The following options were considered to minimise impacts on the River Calder:

- Option 1 – Span over river, access track and Calder Valley Greenway (90m span), depth of beam is 6.5m. This presents significant visual impact and headroom constraint to Calder Valley Greenway:
- Option 2 – Piers outside river but within the track/Greenway (65m span), depth of beam is 4.5m. This again presents significant visual impact and may impact on the amenity value of the Greenway; and
- Option 3 – encroachment into the edges of river (55m span), depth of beams: 3.6m. This is the most central structure possibly without the piers being in the centre of the river.

3.3.123 The option to build piers within the river was discounted due to the potential environmental effects on aquatic ecology and impacts on the hydromorphology, water quality and flood risk of the River Calder. Indicative layouts of each of the three options is shown in Insert 3-11.



Insert 3-11 Indicative layout of the three span options

3.3.124 Based on the above constraints and following consultation with the Environment Agency, the preferred option is for the 55m span. It is necessary to position piers in the banks of the River Calder due to the span width across the river. This means piers are located between the river and the access track along the west bank, and between the river and the Calder Valley Greenway.

3.3.125 It was recognised that this could adversely affect sightlines of people approaching from the south, so options to avoid this by providing a longer span were considered. The longer span leads to either a very deep deck which reduces headroom under the proposed viaduct (again constraining sightlines), or a very large structure from which to suspend the deck, which would be imposing in the landscape. Through consultation it has been agreed that a slimmer deck with piers located in the riverbanks is the preferred option. To minimise the impact of the piers on sightlines, the pier design is being developed in the form of three separate columns which will allow views through the structure. The preferred solution would reduce the impacts on the Grade II listed River Calder Underbridge (MDL1/8) and would be less visually intrusive, however it would have potentially greater impact on the biodiversity and water environment.

3.3.126 In terms of the crossing of the canal, the following options were considered:

- Option 1: 8 span viaduct with an abutment west of the canal; and
- Option 2: 9 span viaduct including an additional backspan beyond the canal. This includes light wells within the structure. A bank seat abutment is proposed to reduce the visual scale of abutment and there will not be a wall of concrete between decks.

3.3.127 The 9 span is the preferred option, primarily based on feedback previously received from the Canal & River Trust on the basis of minimising impacts on the canal. Design refinement has sought to minimise the deck widths and the tracks have been brought closer together. The bridge deck with is therefore approximately 30m.

3.3.128 A visualisation of Baker Viaduct Underbridge is shown in Insert 3-12

Insert 3-12 Visualisation of Baker Viaduct Underbridge (RBA/2)

Occupation Underbridge (MDL1/10)

3.3.129 Four design options were considered for Occupation Underbridge (MDL1/10) to achieve the new track alignment and minimise the impact on heritage significance;

- Option A – To widen the structure with a new long span (>25m);
- Option B1 – widen the structure with a new short span (<25m) comprising an integral slab bridge with a similar span to the existing structure;
- Option B2 – widen the structure with a new short span (<25m) comprising an integral slab bridge and precast arch units with a stone or brick clad face; and
- Option C – To infill the bridge, either with or without a new alternative access route to the adjacent property from the south.

3.3.130 Option B2 was identified as the initial preferred design, as this extended the bridge in a manner which was sympathetic to the character of the Listed bridge on the north-western side, through its use of a precast concrete arch, clad with a masonry face. This option was considered preferable to Option A and Option B1, as the widening proposed in these options would unsympathetically alter the appearance of the structure. This was particularly the case for Option A where the size of the span required would mean the deck would infiltrate on the crown of the arch of the Listed underbridge.

3.3.131 Further development of the Option B2 identified a number of issues around constructability, access and disruption to the adjacent property owner. Option B2 would require additional land take to cut back the embankment to the north of the access track on the north-western side of Option C demonstrated considerable benefits to pursuing an option for infilling the structure, particularly in terms of constructability and safety, as well as cost. With regards to constructability, it would be possible to construct Option C without the risks to stability of the track and disruption to the network that were inherent with the construction of a widening option. Infilling the bridge would entail permanent disruption to the adjacent landowner through closure of their access, however alternative access will be provided to the property via Calder Bank Road.

3.3.132 The design development of Option C has also taken into consideration ways in which the infilling can be as sensitive as is reasonably practicable to the significance of the Listed structure. Consequently, the design has been shaped to reduce the impact on the appearance and character of the structure on the south-eastern side; this approach aims to retain the existing historic aesthetics of the bridge on this side of the structure. Instead of using a battered embankment infill, the design has been developed to include a masonry-clad retaining wall to face the infilling just inside the south-eastern face of the arch. This ensures that the architectural detail from which the bridge derives some of its significance, such as the rusticated voussoirs and wing walls, on the south-eastern side will be retained, and the historic form of the structure therefore remains legible.

3.3.133 Option C has been taken forward as the preferred option.

OLE placement

General

3.3.134 The design proposal for OLE is four-track portals and Twin Track Cantilevers (TTC). An example of OLE infrastructure is shown in Insert 3-13.

Insert 3-13 Example OLE infrastructure

3.3.135 The detailed design process will seek to ensure that the visual impacts are minimised, through consideration of the design of gantries and overhead wire connectors and minimisation of the size and scale of equipment where possible. This refined design will also mean that fewer portals are needed to hold the overhead wires with spacing of 55-65 metres likely to be achieved. The detailed design will also consider sensitive receptors including residents and where practicably possible the gantries will be located on property boundaries rather than directly opposite gardens or windows.

3.3.136 The design of the OLE has also been influenced by its proximity to heritage assets. Due to the presence of Grade I and Grade II listed assets along the route bespoke OLE designs are proposed at the following locations across the Scheme due to their increased sensitivity:

Huddersfield Viaduct (MVL3/92)

3.3.137 The design development process included optioneering to determine the position of the OLE portals along the viaduct. Three design options were considered in an order of preference to try to limit changes to the historic fabric and impact on the appearance and setting of the structure.

3.3.138 The options considered comprised:

- Option 1: To locate the OLE portal masts and foundations on the deck of the existing structure, in board of the parapets. This would be possible if sufficient clearance is

available from the tracks to the parapet. This option would require no modifications to be made to the deck structure, or the parapet structure;

- Option 2: To support the OLE portals within the width of the parapet by locally removing and rebuilding the parapet around the OLE mast and foundation (at the required locations). This option would be pursued if there was insufficient clearance for the portals and their foundations to be located in board of the existing parapets (i.e. if Option 1 was not possible), and where the parapet is of sufficient thickness; and
- Option 3: To fix the OLE portal masts to the exterior of the viaduct at pier locations. This option would be pursued if there was insufficient clearance for the portals and their foundations to be located neither in board of the existing parapets, nor within the existing parapet thickness (i.e. if neither Option 1 nor Option 2 were possible). This option was not preferred due to the greater visual impact.

3.3.139 The clearances required for the OLE portals mean that there would be insufficient space to accommodate Option 1 or Option 2 for the placement of the portals on the eastern side of the viaduct for its entire length. As a result, Option 3 was progressed on the eastern side of the viaduct, with portals attached to the outside. On the western side of the structure, it was similarly necessary to discount both Option 1 and 2 between the station and Span 17, however north of this point there was sufficient clearance to accommodate the portals on the structure.

3.3.140 The design of the OLE with respect to the western side of the viaduct was further developed through consideration of the visual consistency of the approach along the structure. Though the clearances for the OLE mean that the portals could be located on the exterior of the structure from Span 17 northwards, it was considered preferable to maintain the visual consistency of the approach along this section of the viaduct; with the exception of a block of commercial units between Spans 25 and 29, this part of the northern elevation of the viaduct is relatively open to wider views, and therefore a consistent approach to the intervention which reflected the consistency and rhythm of the historic structure is considered a more sympathetic approach at this location. North of Span 33, the western elevation of the viaduct is not visible from the public highways, instead backing onto houses along Alder Street; at this point, siting the OLE inside the parapets on the deck of the viaduct would be a more sensitive approach. Consequently, the design approach taken was for the OLE to be located on the exterior of the viaduct (Option 3) on both sides of the structure from the southern end of the viaduct until Span 33, and from Span 33 northwards for the portals to be attached to the exterior (Option 3) on the east side, and sited on the deck inside the parapets (Option 1) on the west side. This approach was considered to be the best compromise between operational requirement, sensitive design and responding to the setting of the structure and its experience from the surrounding townscape at different sections along its length.

3.3.141 The position of the OLE attachment on the external face of the viaduct, where required, also sought to be designed in a way to be sympathetic to the historic fabric and character of the structure. This resulted in designing the OLE to be attached above the springing points of the arches, avoiding clashes with the pilasters or voussoirs of the arches themselves which would occur if the OLE was attached lower on the face of the structure.

Mirfield Viaduct Underbridge (MVN2/192)

3.3.142 The design development process included optioneering to determine the position of the OLE portals on the structure. Three design options were considered in an order of preference to try to limit changes to the historic fabric and impact on the appearance and setting of the structure. The design development process has also involved extensive engagement with a number of different stakeholders, including Historic England and Kirklees Council.

3.3.143 The three options considered comprised:

- Option 1: To locate the OLE portal masts and foundations on the deck of the existing structure, in board of the parapets. This is the preferred option;
- Option 2: To reduce the parapet thickness on the inside of the viaduct (at the required locations) to accommodate the OLE mast and foundation within the parapet thickness. This option was not preferred due to the greater visual impact; and
- Option 3: To fix the OLE portal masts to the exterior of the viaduct at pier locations. This option was not preferred due to the greater visual impact.

3.3.144 Option 1 would not involve changes to the fabric of the parapet on either interior or exterior face, whereas the other two options would require some level of change to the parapet. The initial indicative design showing the placement of the OLE is shown in Insert 3-14.

Insert 3-14 Initial indicative design showing the placement of OLE on Mirfield Viaduct looking from Newgate Road.

3.3.145 It should also be noted that the structure derives very little significance from the 1930s Mirfield Viaduct MVN 2/192A steel spans extension and so priority in the design was given to the masonry side of the viaduct.

Transport of materials to and from the Scheme

3.3.146 There are three primary methods of transport for bulk earthworks movements considered along the route; these being road, rail and canal. This section highlights the practicalities and logistical challenges of the different transportation options.

3.3.147 One of the main difficulties for transporting spoil by road is the lack of access to some areas of the Scheme. Route-wide, local, and site-specific traffic management measures will be implemented during the construction of the Scheme on or adjacent to public roads and public rights of way. The impact of road-based construction traffic will be reduced by implementing and monitoring clear controls of vehicle types, hours of site operation, parking, and routes for large goods vehicles. Further detail will be provided in the Construction Traffic Management Plan (CTMP) and Materials Management Plan (MMP).

3.3.148 Rail transport has also been considered for the transfer of bulk materials between Heaton Lodge and Ravensthorpe only. There is a large quantity of material which could be transferred between Heaton Lodge and Ravensthorpe which are both located adjacent to the railway. It would therefore seem appropriate to consider using engineering haulage rather than load this burden onto the local road network.

3.3.149 In order to transfer bulk earthworks arisings by rail, the engineering trains would need to be loaded, transported and off loaded either in possession(s) or via purpose built rail heads at Heaton Lodge and Ravensthorpe allowing works to be carried out under standard day shift working.

3.3.150 Transporting spoil by engineering train in normal traffic would require this section of the route to be re-signalled. Another constraint is the existing access to track. With the current access schedule, it is not practicable to transport spoil under Rules of the Route (RotR), as there are very few possession opportunities available. This has led to this option being discounted.

3.3.151 Canal transport has also been considered for the transfer of bulk materials between Heaton Lodge and Ravensthorpe only. The loaded barges would depart from just south of Battyeford Lock No12 along the River Calder to Mirfield where the barge would enter the cut. The cut would be followed through to Shepley Bridge Lock No11, through the lock and back onto the River Calder. Along the river for a further 200m then into the cut through to Greenwood Lock No10. From the lock along the river to Ravensthorpe Village to enter the cut through to the mooring between the Leeds and Wakefield rail lines. At this point the barges will be unloaded carefully by 360 degree tracked machine with a clamshell.

3.3.152 Each barge could move between 90 and 120 tonnes per normal working day. The number of barges that could be deployed would be governed by the time taken occupying the locks. The two locks Shepley Bridge No11 and Greenwood No10 are approximately 750m apart, which could create a hold point in the timings.

3.3.153 Taking the minimum time of 2hr 30m round trip divided by the time taken occupying one lock of 20 minutes (10 mins each way) would equal a total number of barges which could be deployed to be six. Therefore, six barges in operation generating 120 tonnes of spoil moved each would yield 720 tonnes per day. Given the volumes that need to be moved this option has been discounted.

3.3.154 Road rail is therefore seen as the preferred solution for the transport of excavated materials as this provides the most flexibility to moving material to where it is needed within the Scheme boundary at the appropriate time.

Transport of materials to and from site

3.3.155 When developing the construction methodology, two alternative methods of transporting materials to and from the Scheme have been identified, road and rail.

3.3.156 The use of rail to transport materials will reduce construction traffic and associated environmental effects such as noise and air quality. However, materials would need transporting to and from points on the railway for loading. Haulage by road allows a more flexible approach to distribution of materials throughout the Scheme.

3.3.157 The construction strategy for rail infrastructure works, e.g. ballast and track renewals and signalling and OLE works, will be transported to work sites by rail.

Construction compounds

Longroyd Lane

3.3.158 Based on the arboriculture survey and biodiversity assessment, a stand of alder was identified in the south-east corner of the Longroyd Lane compound. A review of the spatial requirements for the compound was undertaken and the area was removed from the Scheme area to protect the existing stand of trees.

Red Doles Road

3.3.159 Following consultation with the Canal & River Trust, the Red Doles Road construction compound area has been relocated away from the edge of canal to the north-west to reduce impact on the canal and its users.

Fieldhouse Lane

3.3.160 Construction access was proposed from the south. Access was planned via a new bailey bridge across the canal. Given the potential impacts on the canal, including impacts on the bridge itself and users of the canal, a review of the construction access strategy was undertaken. Heavy Goods Vehicles (HGV) will now access the site from the north via the Birkby Bradley Greenway. There is therefore no longer the need for a temporary bridge over the canal near Field House Overbridge (MVL3/98).

Ravensthorpe Area

3.3.161 Two temporary bridges are proposed over the Calder and Hebble Navigation to provide construction access to Ravensthorpe Triangle.

3.3.162 The temporary bridges proposed allow for a towpath and current headroom of 2.85m as per Canal & River Trust guidance[5].

3.3.163 Following consultation with the Canal & River Trust, the temporary bailey bridges have been moved south, to where the canal narrows to reduce the bridge width and impact on the canal.

[5] https://canalrivertrust.org.uk/media/original/32433-waterway-dimensions.pdf.