



## **The Network Rail (Leeds To Micklefield Improvements) Order**

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### **Alternative Options Evaluation Study: HUL4/20 Crawshaw Woods Overbridge**

Author	Network Rail
Date	June 2023
Revision Number	Rev 1



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**1. INTRODUCTION****1.1 Purpose**

- 1.1.1 This report considers the proposed development options for the HUL4/20 Crawshaw Woods Bridge, relating to Transpennine Rail Upgrade electrification works, setting out options considered, the assessment methodology and resulting preferred option design.
- 1.1.2 This document will be submitted as part of the Listed Building Consent for the works alongside the Heritage Statement.

**1.2 Scope**

- 1.2.1 This report contains the following sections:
- A summary of the technical justification for the bridge works and resulting benefits.
  - An outline of the options that were considered and retained or rejected ahead of the assessment.
  - A description of the assessment methodology
  - The options assessment result
  - A summary of findings and justifications for the preferred option
- 1.2.2 This report focuses on work associated with HUL4/20 Crawshaw Woods Bridge (hereafter 'the bridge'). The bridge is a Grade II listed building and forms part of the original Selby to Leeds Railway, constructed in the early 1830s. It is one of a number of bridges along the route, of which eight are listed and a further four are considered to be of historic interest. A concise Statement of Significance is presented in Section 4.
- 1.2.3 The bridge is in active use as a farm access over the Leeds to York mainline railway (NGR SE 3870 3420). It is located between Cross Gates Station and Garforth Station, West Yorkshire within an area of agricultural fields bordered by the M1 to the east and Thorpe Park Retail Park to the west. The railway is at this point within cutting, with an access track and public bridleway carried over the railway at grade.

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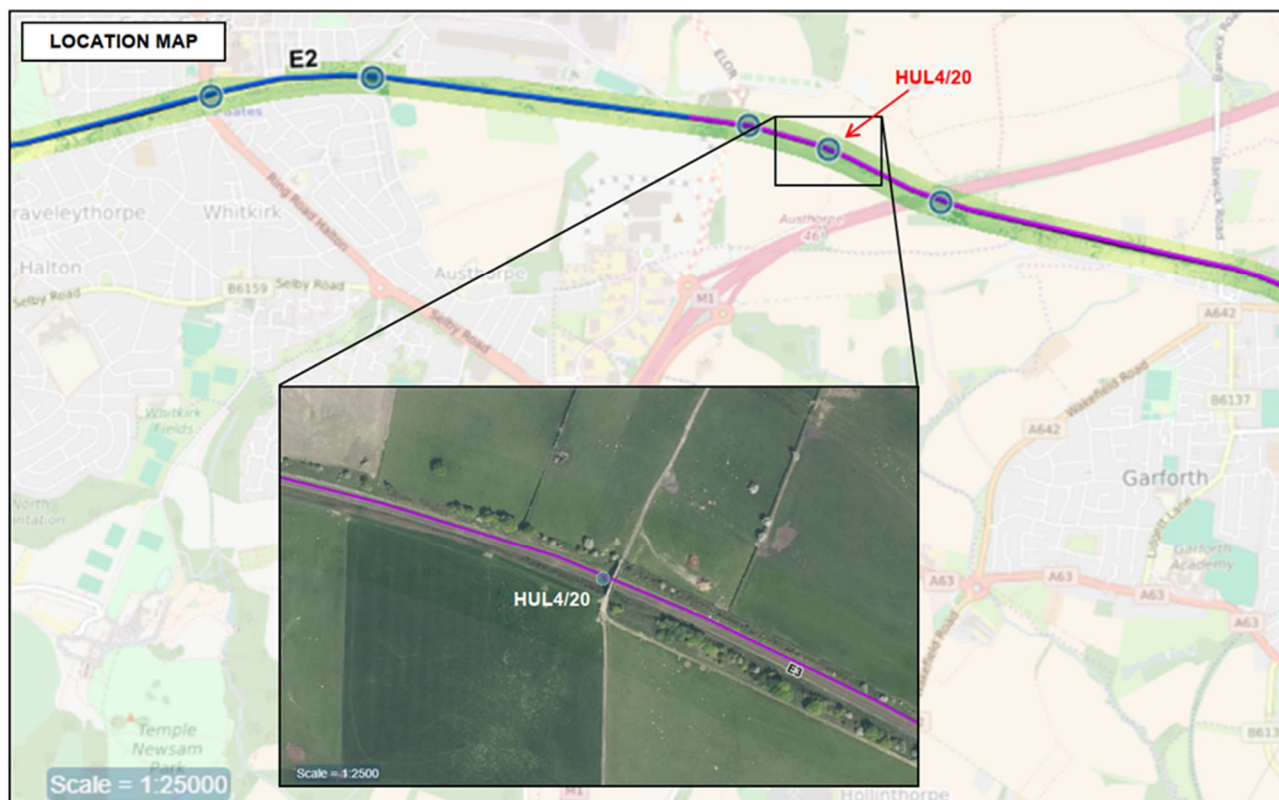


Figure 1 – Location Plan

## 2. DEFINITIONS

Term to be defined	Concise definition of term
Listed Building	A structure identified on the National Historic List of England due to its special historic and architectural interest. Protected by law.
TMLA	Track Lift Maintenance Allowance – allowance given for future maintenance tamping for the track to maintain the geometry for the safe passage of trains
VCC	Voltage Controlled Clearances
WLC	Whole Life Costs

Table 1 Definitions

## 3. ABBREVIATIONS

Abbreviation	Full terminology
BMV	Best and Most Versatile (relating to agricultural land)
GRIP	Governance for Railway Investment Projects
NHLE	National Heritage List Entry
OLE	Overhead Line Electrification
PROW	Public Right of Way
TOC	Train Operating Company



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<b>TRU</b>	Transpennine Route Upgrade
<b>TWAO</b>	Transport and Works Act Order
<b>WRaCCA</b>	Weather Resilience and Climate Change Adaptation

**Table 2 – Abbreviations****4. REPORT CONTENT**

4.1.1 This section of the report summarises the strategic need for the TRU project which requires alterations to the Grade II listed Crawshaw Woods Overbridge (HUL4/20; NHLE 1419062) and the benefits that will be derived from the project.

4.1.2 TRU will help to promote sustainable transport in accordance with the National Planning Policy Framework (2021) (Chapter 9) and the government objectives set out in the National Policy Statement NPS for National Networks (2015). Section 2 of the NPS states:

*The Government will deliver national networks that meet the country's long-term needs; supporting a prosperous and competitive economy and improving overall quality of life, as part of a wider transport system. This means:*

*Networks with the capacity and connectivity and resilience to support national and local economic activity and facilitate growth and create jobs.*

*Networks which support and improve journey quality, reliability, and safety.*

*Networks which support the delivery of environmental goals and the move to a low carbon economy.*

*Networks which join up our communities and link effectively to each other.*

4.1.3 Further paragraph 2.2. of the NPS states that “there is a critical need to improve the national networks to address road congestion and crowding on the railways to provide safe, expeditious and resilient networks that better support social and economic activity; and to provide a transport network that is capable of stimulating and supporting economic growth.” Paragraph 2.10 confirms that at a strategic level that there is a compelling need for the development of national networks.

4.1.4 TRU is an important commitment made by the Secretary of State for Transport that aims to create a better performing railway that passengers can depend on; one that provides more trains, more seats and creates a better-connected North. This will include a large number of key interventions between Manchester, Leeds, and York. The government commitment to delivering TRU was confirmed in the Integrated Rail Plan for the North and Midlands

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(November 2021), as the first phase of the wider Northern Powerhouse Rail project.

- 4.1.5 TRU will facilitate the provision of electrification of an operational railway. The project will, therefore, improve the provision of public transport (rail) through the local area and across the region in the long term, due to the intended provision of longer, faster and more reliable rolling stock on the route, alongside the reduction in freight across the road network. TRU will also support the UK response to the climate challenge through the electrification of the Transpennine route and subsequent de-carbonisation of rail transport.
- 4.1.6 In section 4.9 of the Leeds City Council Core Strategy (2019) notes that the electrification of the Transpennine route (the TRU) is an important part of its sustainable transport plan.
- 4.1.7 The City Council 'Connecting Leeds Transport Strategy states that "*The Transpennine Route Upgrade will enhance connections to Huddersfield and Manchester, providing reliable connections and quicker services.*" The delivery of the TRU is a major element of the West Yorkshire Combined Authorities Transport Strategy 2040.
- 4.1.8 Works to HUL4/14 Ridge Road Overbridge are essential in achieving the proposed electrification of the route. Without works to the Listed Structure then the TRU Programme cannot be delivered at this location and the benefits of the TRU Programme will not be realised.

## 5. STATEMENT OF HERITAGE SIGNIFICANCE

- 5.1.1 Crawshaw Woods Bridge is a Grade II listed building. It was designated in 2015 as part of a thematic review of the structures associated with the upgrade works to the Transpennine Railway from York/ Selby through to Manchester. The bridge is part of the original construction of the Leeds to Selby Railway in the 1830s. The bridge was designed by James Walker, engineer for the line; however, unlike the majority of bridges across the line, Crawshaw Woods was constructed in cast iron with stone abutments (Figure 2). It was originally one of two across the route, but the other has since been removed.

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**Figure 2 - Crawshaw Woods Overbridge**

- 5.1.2 The bridge is located between Cross Gates Station 2.5km to the west and Garforth Station 2.0km to the east. It is situated in a largely open rural landscape, although modern development associated with Thorpe Park Business Park and Retail Park are encroaching to the west. The character of the area has also been subject to change with the construction of the East Leeds Orbital Route. Historically the bridge provided farm access over the railway, a function that it still performs. During World War I the bridge provided valuable access for workers at the Barnbow Munitions Factory which was located to the north (now a Scheduled Monument).
- 5.1.3 The bridge is constructed from cast iron with sandstone and quarry faced limestone abutments. The arch is of segmental span of 50ft, formed by cast iron arched girders with vertical struts. It is braced by X-section and I-section ties which support the cast iron deck. The stone wing walls are topped by moulded string courses with curved stone piers. The parapets are of wrought iron and plain in execution, being simple closely spaced balustrades. A new deck was added above the original in the 1940s, itself replaced with the present deck in the 1970s. Sheet steel parapets were also added inside the iron railings in the 1990s.
- 5.1.4 The structure is Grade II listed in recognition of its historic and architectural interest. It has historic interest in its association with the Leeds to Selby Railway, one of the earliest railways in the country, representing one of the original structures along the line dating to 1830-32. Its historic interest is

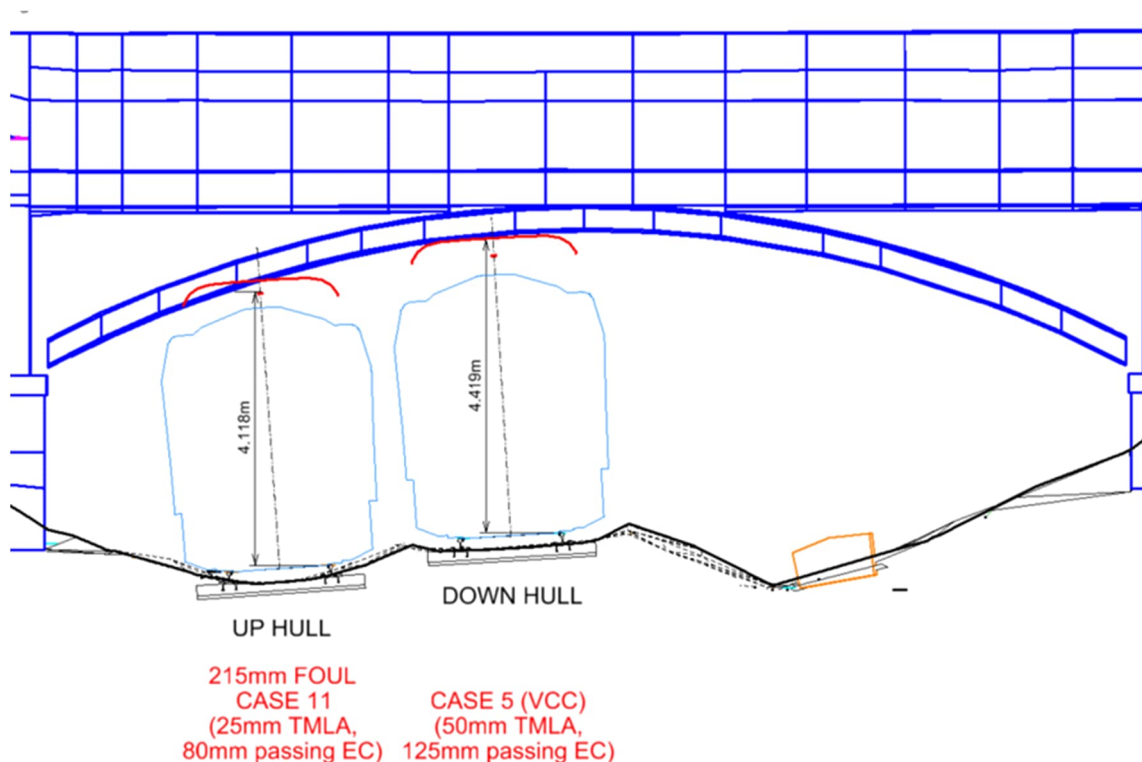
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increased due to its association with the Barnbow Munition Factory which has local and national significance. Architecturally the structure is simple in execution and has few of the aesthetic details employed on the stone bridges seen elsewhere along the route. Its interest is also somewhat diminished by the later alterations. However, the bridge is the only surviving example of cast-iron structures along the Selby to Leeds Railway. It is also believed to be the earliest cast-iron railway bridge in the world still in use over an operational railway.

## 6. REASONABLE ALTERNATIVES

- 6.1.1 The aim of TRU is to create a better performing railway that provides more trains, more seats and creates a better-connected North, in line with the commitments made by the Secretary of State. Non-electrification solutions were explored during the early phases of the project; however, these did not provide the outputs required by the project.
- 6.1.2 In order to achieve the benefits delivered by TRU, overhead line electrification (OLE) infrastructure is needed to power faster and more environmentally friendly electric trains. Due to the historic construction of the line, a number of historic structures cannot accommodate the proposed electrification in their current form. This includes Crawshaw Woods Bridge which is not of sufficient height to accommodate the operational minimum requirements for clearance distances between the trains and the OLE.



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**Figure 3 – Current clearance**

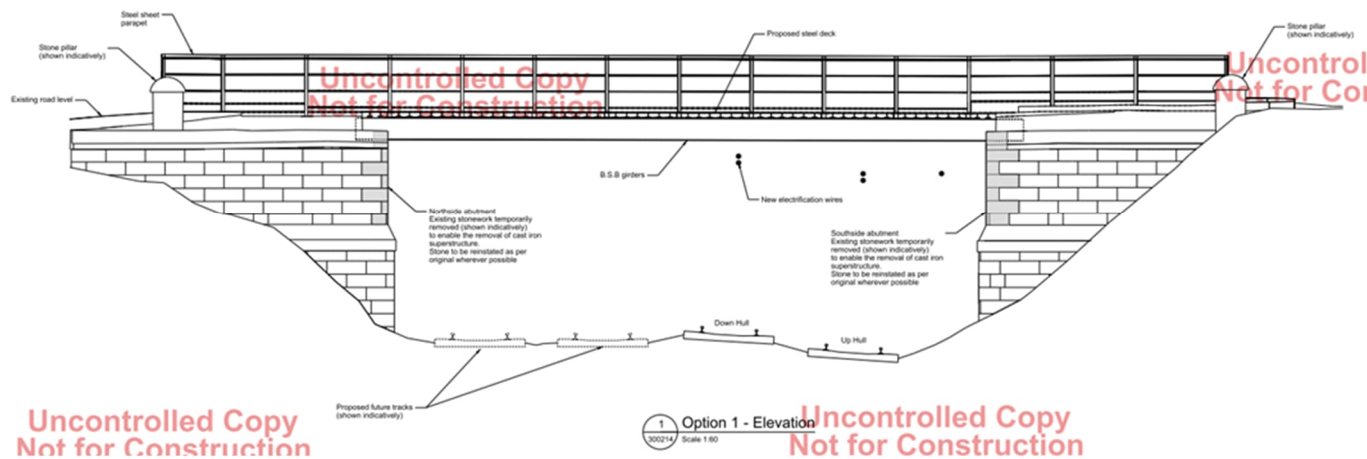
- 6.1.3 An initial engineering review was undertaken to identify alternative options which would facilitate OLE construction through the bridge. This process looked at various high-level options to achieve electrical clearance for the installation of OLE through the bridge;
1. Structure intervention to increase soffit height
  2. Track lowers/slews to increase soffit height
- 6.1.4 These options included reviewing potential reduced electrical clearances with additional control mitigations i.e., surge arrestors, voltage limiting devices, where this provided economic or heritage benefits.
- 6.1.5 The outcome of the initial engineering review was the identification of two potentially feasible options to enable the installation of new OLE.
3. Option A (1 and 2) – Structure Intervention to raise soffit height
  4. Option B - Track Slue – discounted, slue intervention alone does not meet project requirements
  5. Option C - Track Lower – discounted, lower intervention alone does not meet project requirements
  6. Option D – Track Lower and Slue – Track Intervention to realign and lower the track to achieve electrical clearance.
- 6.1.6 For option A, two sub options have been reviewed, Option A1 removal of the bridge to another location, and Option A2 raising of the existing cast iron structure. For options B and C, early review identified that neither a track slue nor track lower on their own, would achieve an engineering solution that would meet the project requirements to not frustrate future enhancement to a four track railway. Therefore Option D looked at a combination of both a track lower and track slue to achieve electrical clearance. The magnitude of the track slue/lower also included a sub-functional electrical clearance for the structure, as to achieve basic functional clearance would have required even greater track lowers. The acceptance of sub-functional electrical clearance requires a deviation from normal Network Rail standards following bespoke assessment of the specific conditions at the bridge location in question.
- 6.2 Option A – Structure Intervention**
- 6.2.1 Option A involves a structure intervention to raise the existing soffit height of the structure to accommodate OLE.

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#### Option A1

- 6.2.2 Option A1 proposes the removal of the present cast iron arch. All cast iron elements will be removed alongside the stone abutments and wing walls. A new superstructure will be installed to maintain the brideway. The form of the arch is subject to detailed design, but is likely to form a flat deck due to the limited construction depth available in order to generate the necessary clearance. The new bridge would be constructed from concrete for the purposes of future maintenance; however, the new elements would be faced in reclaimed stone to reflect the original. The new parapets will also be higher to deliver electrical clearance. Refer to Figure 1 below.



**Figure 4 – Reconstruction with composite flat deck**

- 6.2.3 There is the option to donate the cast iron elements to a suitable repository should one be found willing to take it. This could either be to a museum, or to a working heritage railway.

#### Option A2

- 6.2.4 Option A2 would involve the lifting of the cast iron arch to achieve the required clearance. This would be more involved than bridge jacking and would require the dismantling of the cast iron structure piece by piece, to be reconstructed 1.4m higher than present. The additional height will be achieved by adding additional stone courses to the existing abutments. The wing walls would also be removed and reconstructed at a higher level.
- 6.2.5 The cast iron elements would be removed from site for restoration prior to being reconstructed. A condition survey of the bridge has identified a number of defects which could be repaired offsite. It did not identify a requirement to replace any element. The additional courses of stone for the abutments would be in matched stone taken from elsewhere within the scheme.



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- 6.2.6 Parapet works would be required to ensure consistency with safety. The modern sheet steel parapets would be removed and replaced with something more sympathetic. In addition, a new deck would be installed above the restored historic one to ensure acceptable load bearing.

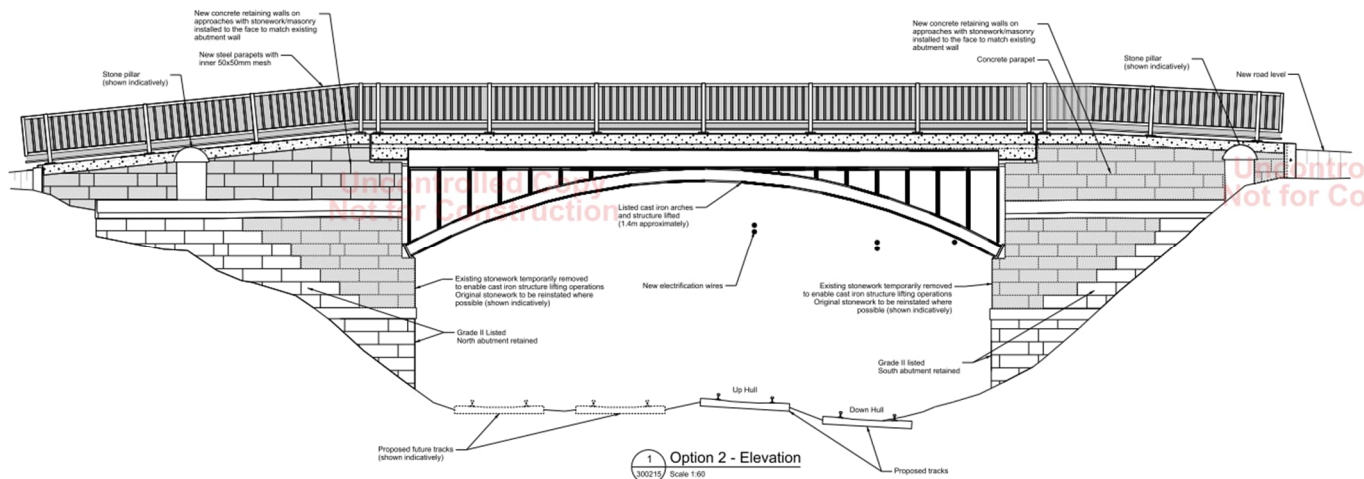


Figure 5 – Lifting of arch



Figure 6 – Reconstruction showing lifting of arch

## 6.3 Option D – Combination of Track Slue and Lower

- 6.3.1 This option involves moving both tracks to facilitate the installation of OLE under the existing structure. To achieve this, the rail, sleepers, track drainage

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and track level services would need to be slued 1130mm horizontally and lowered 720mm vertically.

- 6.3.2 Due to the extent of track realignment required to achieve even a sub functional electrical clearance, achieving full basic electrical clearance was not even considered as this would have required even greater track lowers.
- 6.3.3 1400m in length of each track and 1030m of track drainage would need to be slued and lowered to achieve this option. The vertical alignment to achieve the track lower would create a sump effect under the bridge, resulting in a potential requirement to have a pumped drainage system due to levels of the nearest outfall. There is also a shallow mine workings risk with the Third Metal Brown and Middleton Little coal seams present in the vicinity of the bridge and 500m to the east of the bridge. It is likely given the extent of the lower that mining remediation will be required over this length.
- 6.3.4 To achieve a 720mm lower at the structure the existing abutments would need permanent works (ground beams or similar) installed to support the existing shallower foundations.
- 6.3.5 The proposed realignment would extend into the area of the proposed Thorpe Park Station, compromising the track geometry and platform interface, which currently sits on a straight section of track.
- 6.3.6 The cutting slopes approaching Crawshaw Woods bridge would need to be either reprofiled, necessitating permanent landtake at the top of the cutting on the southern side of the railway or the installation of a significant earthwork retaining structure in the region of approximately a few hundred metres to the approach/exit of the structure.

## **7. ALTERNATIVE OPTIONS ASSESSMENT METHODOLOGY**

- 7.1.1 This section of the report describes the alternative options assessment methodology that was developed to assess the four options and sub-options and identify a preferred option.
- 7.1.2 An Options Assessment Matrix (OAM) was created to ensure all relevant matters (topics) were identified and considered by planning, engineering and environmental specialists as relevant.
- 7.1.3 The topics and assessment criteria were defined in order to allow an objective and consistent assessment of alternative options across all options. However, categorisation (Highly Unsupportive – Highly Supportive) did rely on an element of professional judgement and consistent application of professional judgement was ensured via a quality review.



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- 7.1.4 The assessment topics and sub-topics are set out in the OAM at **Appendix A** of this report. A summary of the topics and sub-topics used is listed below.
- Environment and Consent Risk – addressing environmental concerns, planning risks and consents risk.
  - Land & Property – addressing land access and availability concerns.
  - Cost – addressing capital and maintenance cost constraints.
  - Design / engineering feasibility – to address varying levels of design complexity.
  - Construction – to address varying levels of construction complexity.
  - Maintenance – to address varying levels of maintenance burdens.
  - Deliverability – to address the impact on wider project programme timescales.
- 7.1.5 A RAG (Red Amber Green) type rating was assigned to each component of the assessment. The RAG rating includes five grades from Highly Unsupportive (red) through Unsupportive (amber) and Neutral (yellow) to Supportive (pale green) and Highly Supportive (green). The assembled factual evidence was assessed against the evaluation parameters by qualified professionals to award a grade (i.e., Highly Unsupportive – Highly Supportive), based on professional judgement and supported by a statement setting out the justification for each categorisation. Following all of the individual assessment, these were reviewed by a senior professional to moderate and ensure consistency.

## **8. ASSESSMENT OF ALTERNATIVE OPTIONS**

- 8.1.1 This section of the report presents the findings of the options evaluation against the assessment topics.
- 8.1.2 The section below identifies overall considerations that are applicable to all options and sets the wider context for the options. These are summarised upfront to avoid repetition. Specific considerations relevant to each option are then identified under each option in the subsequent sections.
- 8.1.3 The below is a factual description of the relevant matters for each option to enable an understanding of the optioneering process. It is not intended to provide a justification for the options. This will be presented within the Heritage Statement which accompanies the Listed Building Consent.

### **8.2 Overall Considerations**

- 8.2.1 Works to the bridge and track are considered to constitute permitted development (PD) under Part 18 of the General Permitted Development Order

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(2015), on the basis that prior approval is first obtained and Listed Building Consent is obtained for the overbridge.

- 8.2.2 Temporary acquisition of land would be required for all options during the construction phase. This acquisition may lead to a temporary adverse impact on a PROW which would need to be diverted while construction work was ongoing. However, this would not be a permanent diversion.
- 8.2.3 All options are to facilitate the provision of electrification of an operational railway; therefore, all options have the potential to replace diesel power on this route.
- 8.2.4 The existing bridge has bat roost potential and its reconstruction could have potentially significant effects on the protected species. All options would disturb any protected species present.

## 8.3 Option A1 - Bridge Deck Reconstruction

### Environment and Consent Risk

- 8.3.1 Option A1 requires the demolition of the removal Grade II listed bridge and the construction of a replacement flat soffit bridge deck. Listed structures are protected by the Planning (Listed Buildings and Conservation Areas) Act 1990<sup>1</sup> and consent will be required for this option. In planning policy terms, clear and convincing justification is required for the harm caused to the structure (National Planning Policy Framework<sup>2</sup> (NPPF), paragraph 200). Leeds City Council Local Plan policies<sup>3</sup> P11 (conserve and enhance the historic environment, including the 19th century transport network), and P12 (conserve and enhance the character and quality of Leeds' townscapes and landscapes, including historical and cultural significance) are also relevant. Although it can be demonstrated that the alterations to the heritage asset is necessary to achieve substantial public benefits that outweigh that harm, this option has been graded Unsupportive on cultural heritage grounds to reflect the great weight to be applied to conservation of nationally designated heritage assets in national planning policy. If this option is pursued there is the potential for some harm to be offset by donating the bridge to a heritage railway. This option would need to be explored further.
- 8.3.2 Option A1 will require temporary closure of public rail transport as works to reconstruct the bridge can be done within standard possession access

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<sup>1</sup> The Stationary Office, 1990, Planning (Listed Buildings and Conservation Areas) Act

<sup>2</sup> Ministry of Housing, Communities & Local Government, 2021, National Planning Policy Framework

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opportunities, although a temporary diversion of public bridleway will be required. All options will be accessed from nearby secure compounds which are to be created temporarily, and access to the site will be via the rail line (or adjoining roads) during closure. The bridge is in use for agricultural access and does not carry any public highway, therefore, diversions are not required. The option is therefore Supportive.

Land and property

- 8.3.3 Option A1 is Highly Supportable in terms of land availability. No permanent land take is required as all work would be within Network Rail Land. Temporary acquisition of land would be required during the construction phase.
- 8.3.4 There is a PROW which runs over the bridge would be temporarily diverted during construction; however, this would not be a permanent diversion and the option is considered to be Supportive.

Cost

- 8.3.5 If a standard concrete flat deck option is installed, the cost of Option A1 is considered Highly Supportive as it can be achieved at low cost with reduced maintenance costs due to its simpler deck to inspect and maintain whilst achieving the necessary clearance for electrification. Whole Life Cycle (WLC) costs for a bridge reconstruction (circa £1.4m) are considerably less than those for the track slue options and track lower options.

Design/ Engineering Feasibility

- 8.3.6 The proposed structure is of a straight forward form and design and engineering point of view and as such have been scored as Neutral. This option also allows additional capacity should a four-track railway be proposed in the future.

Construction

- 8.3.7 The site has good accessibility, and although it will require temporary land access, it is expected that these would be of a manageable duration.
- 8.3.8 Given the above and the relatively minor nature of any temporary works to achieve the superstructure replacement, this option has been scored as Supportive.

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### Maintenance

- 8.3.9 The proposed new structure will require minimal ongoing maintenance for the next 50 years. This option is Highly Supportive as it will replace a structure that currently needs regular maintenance checks and significant life extension works in due course.

### Deliverability (timescales)

- 8.3.10 Option A1 will require several extended weekend possessions of the railway, but can be designed and delivered in line with the proposed TRU build programme. There are no public highways crossing the bridge so the works will not require any highway closure. On this basis, the option has been scored, Highly Supportive.

### Feasibility

- 8.3.11 Option A1 remains feasible within the constraints of the project.

## **8.4 Option A2 - Bridge Reinstatement**

### Environment, Sustainability and Consent Risk

- 8.4.1 Option A2 would involve interventions into the historic fabric of the Grade II listed structure; however, the key elements of the historic fabric would be retained. In addition, the cast iron elements would be restored as part of the works. Listed structures are protected by the Planning (Listed Buildings and Conservation Areas) Act 1990 and consent will be required for this option. In planning policy terms, clear and convincing justification is required for the harm caused to the structure (NPPF, 200). Leeds City Council Local Plan<sup>4</sup> policies P11 (conserve and enhance the historic environment, including the 19th century transport network), and P12 (conserve and enhance the character and quality of townscapes and landscapes, including historical and cultural significance) are also relevant. This option would retain the key feature of the bridge and a significant amount of its original material. In addition, there will be benefits through the restoration of the cast iron elements. It is considered that this would constitute less than substantial harm to the significance of the asset in terms of the NPPF and local planning policy.
- 8.4.2 Lifting of the arch deck would result in a visual difference due to the increased height of the structure, parapets and the infill material on the abutments/wingwalls. The exact lift required would be in the order of 1.4m in order to achieve functional clearance.

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<sup>4</sup> Leeds City Council, 2019, Leeds Local Plan: Core Strategy

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- 8.4.3 Option A2 will require temporary closure of public rail transport as works to reconstruct the bridge can be done within standard possession access opportunities, although a temporary diversion of public bridleway will be required. All options will be accessed from nearby secure compounds which are to be created temporarily, and access to the site will be via the rail line (or adjoining roads) during closure. The bridge does not carry any public highway, therefore, diversions are not required. The option is therefore Supportive.

Land and property

- 8.4.4 Option A2 is Unsupportive in terms of land availability. Some permanent land take is required to allow for the re-grading of approaches as a result of the raised deck level. Temporary acquisition of land would also be required during the construction phase.
- 8.4.5 There is a PROW which follows the bridge. The PROW would be temporarily diverted during construction; however, it would be reinstated upon completion and the option is considered to be Supportive.

Cost

- 8.4.6 Due to Option A2 being relatively risky in comparison to Option A1 with the cast iron arches being lifted out, refurbished off site and then reinstated, there are additional costs in comparison to a standard bridge deck replacement. There are also additional works to do the existing bridge abutments and approach roads to accommodate the circa 1.4m deck lift. That said the costs associated with Option A2 (circa £3.7m) are still significantly less than those associated with the track slue/lower option and as such this option is still Supportive from a cost point of view.

Design/ Engineering Feasibility

- 8.4.7 A condition survey has been undertaken on the bridge abutments and cast iron arches and highlighted a number of issues; however, it has concluded that the issues with the cast iron arches can be repaired off site on successful removal. The abutments will require modification for the increased deck height and load. The over-spanning deck is to be replaced. Option A2 although complex, is considered structurally feasible.
- 8.4.8 There is no active highway over the bridge; therefore, there are no highway engineering constraints associated with the Option. This option also allows additional capacity should a four-track railway be proposed in the future.
- 8.4.9 Given the Design Complexity involved, this option would generally be considered "Unsupportive" within the matrix rating. However a significant

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amount of work has been done on the feasibility of this option by designers, construction team and specialist sub-contractors due to the heritage significance of the structure and as such there is a level of confidence and understanding in the proposal. This option is therefore considered to be supportive.

### Construction

- 8.4.10 The site has good accessibility, and although it will require temporary land access, it is expected that these would be of a manageable duration. It is anticipated that the arch structure will be able to be lifted out and reinstated as a single piece, as such most of the work can be undertaken off site.

### Maintenance

- 8.4.11 Due to the retention of historic fabric there is a need for more intrusive ongoing maintenance of the structure, During the works, the cast iron elements will be repaired and restored which will extend their structural life; however, as with all historic fabric there is anticipated to be a gradual decline and regular maintenance will be required. For this reason the option is neutral.

### Deliverability (timescales)

- 8.4.12 It is anticipated that the bridge could be lifted out and reinstated in a single piece limiting the time required for track closure. Option A2 will still require several extended weekend possessions of the railway, but can be designed and delivered in line with the proposed TRU build programme. There are no public highways crossing the bridge so the works will not require any highway closure. On this basis, the option has been scored, Neutral.

### Feasibility

- 8.4.13 The option is structurally feasible and will not require extended track closure. In addition, there are no associated highway works associated with this option. Option A2 is, therefore, considered to be feasible.

## **8.5 Option D Combined Track Slue/Lower**

### Environment and Consent Risk

- 8.5.1 Option D will retain the Grade II listed bridge and the significance of the listed structure would be sustained and the context, while undergoing minor visual changes, would not be altered from its present context or setting.
- 8.5.2 The scale of this track lower/slue options will require significant disruptive track access resulting in temporary closure of public rail transport for a

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prolonged period. All options will be accessed from nearby secure compounds which are to be created temporarily, and access to the site will be via the rail line (or adjoining roads) during closure.

- 8.5.3 Option D will require excavation and will, therefore, generate large volumes of material, c. 10,800t of spoil for the track works plus c. 1250t of earthworks regrading on the cutting slopes. There is the potential that this material may be utilised in other areas of the Project and thereby reduce the use of primary aggregates, however, due to volumes (and potential unsuitability) this cannot be guaranteed. In addition, works are in an area of known shallow mine workings, which would need to be considered for remediation given the extent of the track lowers.
- 8.5.4 Options D involves excavation within the existing cutting, which, due to the requirements for shallow gradients, may involve excavation within areas at High (>3.3% annual) risk of surface water flooding west of the bridge, into which surface water flooding is likely to flow and which may increase the likelihood of flooding in a given year due to the lowering of ground level. While it is expected that suitable drainage will be installed for these options, this will increase the risk of damage to the railway from surface water flooding and increase the risk to operational users. The option is therefore Unsupportive.

### Land and Property

- 8.5.5 Options D is graded Neutral in terms of land availability. Temporary acquisition of land would be required during the construction phase and potentially some permanent land take would be required at the crest of the railway cutting on the south side, dependent on the earthworks design solution. The option would have no effect on private property including access to private properties and tenants and there would be no loss of community assets. There would be effects on agricultural land including Grade 2 BMV (Best and Most Versatile) land. Standard best practice guidelines would be followed to reinstate agricultural land following construction to the original BMV grade.
- 8.5.6 Option D will require works to the embankment. This may require some permanent land take making the option Unsupportive.

### Cost

- 8.5.7 The WLC's for Option D are estimated at £14.5m, four times that of Option A and with higher ongoing maintenance costs to maintain sub optimal alignments, pumped drainage systems and clearances. For these reasons this option was graded Highly Unsupportive on cost.

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- 8.5.8 Option B is graded Highly Unsupportive due to the compromised track geometry, complex drainage solution, impact on the structures foundations and the earthworks required. The works are also in an area of known shallow mine workings which would require remediation to support the railway. The implementation of the proposed track slues would also impact on the proposed design solution for third party project at Thorpe Park Station, potentially incorporating sub optimal track alignment and platform interfaces.
- 8.5.9 The lowering of the track to obtain the clearance required at the bridge would create a sump in the vertical alignment solution and would likely require a pumped drainage solution.

Construction

- 8.5.10 The extent of the track works and associated drainage/earthworks would extend circa 700m each side of the structure in order to tie the track geometry back into the existing alignment. Due to the magnitude of the track lifts and slues, staging of the works would not be possible and as such a temporary closure of the route would be required, impacting services not only between Leeds and York but also between Leeds and Selby/Hull. A temporary closure of the duration required to facilitate this option is not available within the TRU programme. For the above reasons Option D is graded Unsupportive.

Maintenance

- 8.5.11 Option D would result in the management of sub functional electrical clearance, compromised track alignment and a pumped drainage system. It also does not address the existing liability issues with the structure. Therefore, from a maintenance perspective, this option is graded as Highly Unsupportive.

Deliverability (timescales)

- 8.5.12 Option D would require a temporary closure of the route between Cross Gates and Micklefield for a period that is not currently available within the existing programme. It is also unlikely that it will be negotiable with Train Operating Companies (TOCs) due to the significant effect on train services between Leeds and York and Leeds and Hull/Selby. Due to the magnitude of the track lower/slue, it would not be possible to undertake the works over a number of shorter disruptive possessions making it unviable economically and from a programme perspective. This option is, therefore, graded Highly Unsupportive on deliverability.



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- 8.5.13 Due to the length of track works required to enable the track slue and lower this option is not feasible within the constraints of the project. The works would require track closure over a prolonged period which falls outside that possible with the train operating companies.

**9. CONCLUSIONS**

- 9.1.1 Crawshaw Woods Bridge (HUL4/20) is a grade II listed structure which forms part of the original Selby to Leeds Railway. It was constructed in the 1830s and is the only surviving cast iron bridge on the route. The bridge has further significance as the oldest surviving cast iron bridge over an active railway in the world and has an important relationship with the scheduled former Barnbow Munitions Factory to the north. The bridge is designated as a Grade II listed building.
- 9.1.2 The structure does not meet the clearance requirements for the OLE as part of the proposed electrification of the Transpennine Railway. In order to achieve the benefits of the Transpennine upgrade, the height of the structure needs to be increased by a minimum of 1.4m. Three options have been considered to achieve the necessary clearance while meeting Network Rail's minimum functional/ operation requirement. These were assessed against the Assessment Matrix which concluded that the track lower and track slue options are not feasible due to impact on rail users, construction risk, programme impact and cost; therefore, bridge intervention is necessary.
- 9.1.3 Two options were considered, both resulting in changes to the physical fabric. Given the historic interest of the bridge and its Grade II listed status, Option A1 bridge deck reconstruction was ruled out in favour of Option A2 bridge reinstatement. While Option A2 will involve physical alterations to the fabric, including new stonework and parapet replacement, it is considered that the retention of the cast iron arch is achievable. In addition, the option provides the opportunity for the restoration of the historic fabric as part of the works. This options is therefore Highly Supportable.

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APPENDICES

**Appendix A Options Appraisal Matrix**

Assessment Topic	Assessment sub-topic	Evaluation Criteria	Evaluation Parameters				
			Highly Unsupportive	Unsupportive	Neutral	Supportive	Highly Supportive
Environment, Sustainability and Consent Risk	Planning Policy/ Consideration	NPPF policy	Contrary to NPPF golden thread	Some elements inconsistent with NPPF policies	Consistent with NPPF policy	Consistent with NPPF policy	Supported by NPPF policy
		Adopted development plan policies	Inappropriate development in the Green Belt	Partially contrary to adopted and emerging development plan policy and allocations	No relevant adopted or emerging Local Plan policies	In accordance with adopted and emerging local plan policies and allocations.	Proposed development meets and exceeds adopted and emerging local plan policies
		Adopted development plan allocation	Clearly contrary to adopted development plan policy and allocations	Partial conflict with extant planning application	No extant planning application	Consistent with extant planning application	Proposed development meets and exceeds land allocation requirements
		Emerging development plan policies	Clear land use conflict with extant planning application	Partially contrary to adopted or emerging transport or environmental policy		In accordance with to adopted transport or environmental policy	Would enhance extant planning application
		Emerging development allocation					Supports delivery of adopted transport or environmental policy
		Extant planning applications	Clearly contrary to adopted transport or environmental policy				
		Policy land allocation (e.g. Green belt)					
	Consent Risk	Other relevant local transport or environment policy.					
		Number & type of primary consents:	Appropriate Assessment required.	Appropriate Assessment required and outcome expected to be positive.	EIA required.	EIA Screening required.	EIA not required.
		need for listed building consent:	High risk of primary development consent being refused (e.g. due to multiple likely statutory consultee / local authority / local community objections)	Special parliamentary procedures are triggered (allotments, Common Land, National Trust land), which would significantly extend the programme. However outcome expected to be positive.	Habitat Regulations Screening Assessment Required.	Habitat Regulations Screening Assessment Required.	Appropriate assessment under the Habitat Regulations not required.
		need for appropriate assessment:			Multiple primary consents required: planning permission, Transport and Works Act Orders (to enable compulsory purchase of land, planning permission and operational authorisation).	Majority of works are permitted development: single primary consent required.	Primary development consents granted (i.e. all works are permitted development).
		need for EIA:		Medium right risk of primary development consent being refused (e.g. due to likely statutory consultee / local authority / local community objections)	Listed building consents required.	Planning permissions and listed building consents required. However it is assumed that these would be granted subject to conditions.	
		need for special parliamentary procedures.		Listed building consent unlikely to be supported by Historic England	Public Inquiries in some cases anticipated.		
	Landscape/ Townscape and Visual	Visual impact on key receptors.	Permanent adverse visual effect on long views or multiple receptors (individuals / locations) or protected view	Permanent adverse visual effect on limited number of near viewpoints	Replacement of existing with feature of similar scale and design	Design sensitive to setting/ context and character	Introduction of new public space/ access and improvements to existing landscape
		Landscape character effects including on nationally (National Park / AONB) or locally valued landscapes and/or townscapes.	Permanent adverse effects on landscape character as a result of the introduction of unsympathetic feature within area of national designation/ high landscape value that cannot be mitigated against.	Permanent adverse effects on landscape character as a result of the introduction of unsympathetic feature within area of local landscape designation/value and/ or townscape designation/ value.	Minor and negligible changes to existing structure	No obstacles key view	High quality/ innovative design making positive contribution to context
		TPOs	Removal of tree subject to TPO	Inappropriate development within local context/ unsympathetic to existing character	Location within a landscape / townscape able to absorb change		
		Design quality			Temporary adverse impact from construction works resulting in temporary adverse effects on landscape character and visual amenity		
	Biodiversity	Ecological designations (SSSI, Nature Reserves, Special Area of Conservation, Special Protection Area, Local Wildlife Site, Ramsar)	Works within, or outside, an internationally or nationally designated ecological site resulting in permanent damage to these sites despite mitigation.	Works within, or outside, an internationally or nationally designated ecological site requiring significant mitigation to avoid permanent damage.	No net loss of biodiversity. It is anticipated that this would involve mitigation and compensatory measures.	Overall biodiversity gain.	Enhancement of designated area of nature conservation and habitat of protected species.
		Protected species and/or their habitat	Irremediable loss of protected and/or irreplaceable habitat.	Development within, or outside a locally designated wildlife site likely to cause some harm.		Mitigation measures above what is required to mitigate any harm.	
		Other recognised ecological, biodiversity, nature conservation important receptors (red databook or other notable species)	Development likely to have significant adverse effect on protected species.	Net loss of biodiversity at a scale difficult to offset.			
				Adverse effect on protected and irreplaceable habitat.			
				Adverse effect on protected species.			
	Cultural Heritage	Internationally designated heritage assets (World Heritage Sites)	Substantial harm to, or loss of designated heritage assets : Scheduled Monuments, battlefields,listed buildings , registered parks and gardens and World Heritage Sites.	Less than substantial harm to designated heritage assets	Conserves heritage assets in a manner appropriate to their significance.	Better reveals the significance of heritage assets.	Better reveals the significance of heritage assets.
		Nationally designated assets (Areas of Archaeological Importance; Scheduled Monuments; Listed Buildings; Conservation Areas; Registered Parks and Gardens)			Sustains the significance of heritage assets.	Puts heritage assets to viable uses consistent with their conservation.	Puts heritage assets to viable uses consistent with their conservation.
		Non-designated historic structures (archaeological sites, locally listed structures)				Secures the future conservation of a heritage asset.	Secures the future conservation of a heritage asset.
		Opportunities for enhancement of heritage assets					Puts heritage assets to viable uses consistent with their conservation.
							Enhances the significance of heritage assets.
							Makes a positive contribution to local
	Air Quality	Air Quality Management	Significant anticipated temporary air quality issues associated with construction which cannot be managed using industry standard best practice measures.	Anticipated temporary air quality issues associated with construction which cannot be managed using industry standard best practice measures.	Anticipated temporary air quality issues associated with construction can be managed using industry standard best practice measures.	Anticipated temporary air quality issues associated with construction can be managed using industry standard best practice measures.	Local air quality substantially improved as a result of the development.
			Permanent anticipated adverse operational air quality effects.	Some anticipated adverse operational air quality effects.	No additional operational adverse air quality effects.	Reduced adverse operational air quality effects.	Site lies outside AQMA and actively supports relevant local air quality action plan measures.
			Site lies within an AQMA and is in contradiction with relevant local air quality action plan.	Site lies within an AQMA and is in temporary contradiction with relevant local air quality action plan measures due to construction.	Site lies outside AQMA	Site lies outside AQMA and is aligned with relevant local air quality action plan measures.	
	Noise and Vibration	Noise sensitive receptors (residential properties, community facilities and PRoV)	Likely to affect a large number of noise sensitive receptors	Likely to affect a moderate number of noise sensitive receptors	Likely to affect few noise sensitive receptors.	Operational noise increase between Lowest Observed Adverse Effect Level and No Observed Effect Level.	Construction sound, noise and vibration effects can be effectively mitigated to acceptable levels.
		Noise Important Area	Operational noise increase above Significant Observed Adverse Effect Level (SOAEL).	Operational noise increase above Lowest Observed Adverse Effect Level (LOAEL) but below the SOAEL.	Operational noise increase at or approximating to Lowest Observed Adverse Effect Level (LOAEL).	Slight reduction in operational noise and vibration levels at noise sensitive receptors compared with that currently experienced.	Operational noise increase at or below No Observed Effect Level.
		Tranquil area	Increase to noise within a designated noise important area.	Construction vibration levels evaluated to have potential to result in cosmetic damage to buildings or reach intolerable levels for human receptors.	Construction sound, noise and vibration effects can be partially mitigated to acceptable levels		Moderate or large reduction in operational noise and vibration levels compared with that currently experienced.
			Construction or operational vibration levels likely to result in structural damage to buildings and adverse effect on health and wellbeing of communities.	Operational vibration is likely to be perceptible by human receptors.	New operational vibration levels likely to be perceptible to human receptors.		
			Operational vibration not tolerable for humans.				
	Soils and Geology	Presence of contaminated land	Permanent adverse effects to designated area of international geological conservation	Adverse effects to designated area of national geological conservation.	Effective use of land, including reusing previously developed land.	Best and most versatile agricultural land, restored to a higher agricultural grade following construction.	Removal of existing contamination.
		Designated area of geological conservation	Permanent adverse effects to Soils, including loss of mineral resources, directly supporting an EU designated site.	Adverse effects to soils, including loss of mineral resources, directly supporting a nationally designated site.	Minimised harm to geological conservation interests.	Protects geological conservation interests.	Reveals and expands knowledge of geological conservation interests.
		Safeguarded mineral resource	Creates contaminated land which cannot be mitigated.	Contributes to land instability which can be mitigated.	Where appropriate incorporates extraction of safeguarded mineral deposits prior to development taking place.	Remediates and mitigates despoiled, degraded, derelict contaminated and unstable land.	Makes no contribution to land instability.
			Contributes to land instability which cannot be mitigated.		Makes no contribution to land instability or contributes to land instability which can be mitigated.	Avoids safeguarded mineral deposits.	
						Makes no contribution to land instability.	

	Water Environment	Environment Agency Flood zone Surface water groundwater	Development in Flood Zone 3 that occupies flood storage capacity or impacts flow of surface or groundwater - difficult to mitigate.  Could enable pollution pathways that enable migration of contamination from a site.  Groundwater source protection zone 1  Large adverse effect on a sensitive water body that cannot be mitigated.  Sustainable water management measures cannot readily be incorporated into the design.	Development in Flood Zone 2/3 that occupies flood storage capacity or affects flow of surface or groundwater acceptable mitigation solution proposed.  Groundwater source protection zone 2 or 3  Limited sustainable water management measures can be incorporated into the design.	Site within flood zone 1  Temporary disruption to water body quality (including practicable and proportionate mitigation).  Sustainable water management measures can readily be incorporated into the design.	Design reduces flood risk.  Enhances local surface water and groundwater quality.  Sustainable water management measures can readily be incorporated into the design.	Design significantly reduces flood risk.  Removes interruption to surface and groundwater.  Creation of flood storage.  Sustainable water management measures can readily be incorporated into the design and will improve existing situation.
	Transport	Transport impacts on the local community through the transport of materials, waste and employees.  Impacts on connectivity and accessibility for local community, including severance and impacts on walkers, cyclists & horse riders.	Safe and suitable access to construction sites is unavailable and cannot be created.  Removed accessibility of public transport.  Permanent adverse impact on strategic and sustainable transport networks including impact on non-motorised users.	Safe and suitable access to construction sites is unavailable and cannot be created without adverse impacts.  Reduced accessibility of public transport.  Impact on strategic and sustainable transport networks including impact on non-motorised users.	Safe and suitable access to construction sites is available or can be created temporarily.  Temporary impact on accessibility of public transport.  Temporary impact on local transport networks including non-motorised paths.	Safe and suitable access to construction sites is available.  Maintains existing accessibility of public transport.  Maintains existing local transport networks including non-motorised paths.	Utilises opportunities to transfer significant construction related traffic onto sustainable transport modes.  Improves accessibility of public transport.  Utilises opportunities to promote walking cycling and public transport.
	Resource Management	Waste generation  Use of primary materials	Scheme is likely to result in a very large effect in relation to the generation of waste which cannot be reused or recycled; or the substantial use of primary aggregates and materials.	Scheme is likely to result in a large effect in relation to the generation of waste which cannot be reused or recycled; or the use of primary aggregates and materials.	Scheme is likely to result in a near neutral effect in relation to the generation of waste which cannot be reused or recycled; or the use of primary aggregates and materials.	Scheme is likely to result in a positive effect in relation to the minimal generation of waste which cannot be reused or recycled; or the minimal use of primary aggregates and materials. It supports the reuse of renewable resources; uses recycled materials; incorporates recovery, recycling and reuse of materials generated during construction; and energy recovery.	Scheme is likely to result in a positive effect in relation to the minimal generation of waste which cannot be reused or recycled; and maximises use of secondary and recycled materials.  Utilises and/contributes to renewable energy systems (district heating systems etc).
	Weather Resilience & Climate Change	Route Weather Resilience & Climate Change Adaptation (WRCCA) Plan high and medium priority impact areas.	The medium and high impacts are not avoided or expected to be mitigated.	High impacts are not avoided or expected to be mitigated.	All medium and high impacts can be either avoided or addressed through mitigation.	All of the avoidable high impact are avoided.	All of the avoidable medium and high impacts are avoided.
	Carbon	Qualitative assessment	Scheme is likely to result in a very large impact in terms of embodied and lifetime carbon emissions.	Scheme is likely to result in a large impact in terms of embodied and lifetime carbon emissions.	Scheme is likely to result in a moderate impact in terms of embodied and lifetime carbon emissions.	Scheme is likely to result in a small impact in terms of embodied and lifetime carbon emissions.	Scheme is likely to result in a neutral or negative impact in terms of embodied and lifetime carbon emissions.
Land & Property	Land availability  Third party assets	Land Acquisition requirements  Effect on utilities and statutory undertakers	Permanent acquisition of third party land required - sensitive occupiers; residential property; community assets; businesses; land subject to special parliamentary measures (common land, allotments, National Trust) etc.	Permanent acquisition of third party land required - no sensitive occupiers.  Temporary acquisition of land / rights - known obstructive landowners.  Adverse effect on utilities and statutory undertakers (assets)	No permanent acquisition of third party land required.  Requires permanent acquisition of third party air rights.  No adverse effect on utilities and statutory undertakers (assets)	No permanent acquisition of third party land required.  No third party air rights required.	No permanent or temporary third party land requirements.
	Land use and accessibility, including:  - private property & access  - community land & assets  - agricultural land	Effects on private property & tenants  Effects on community land assets including local green infrastructure and open space  Effects on development land and business  Effects on agricultural land holdings	Permanent significant adverse effect on private property or tenants and/ or access to private property  Permanent loss of access to community land assets including local green infrastructure and open space and/ or access to them.  Likely significant adverse effect on businesses  Permanent loss of agricultural land holdings including permanent loss of best and most versatile agricultural land (Grade 1,2,3a) and/ or access to it.	Permanent adverse effects on private property or tenants and/or access to private property  Adverse effects on community land assets including green infrastructure and open space and/ or access to them.  Moderate impact/ adverse effect on businesses  Adverse effects on and/ or access to agricultural land holdings including best and most versatile agricultural land (Grade 1,2,3a).	Temporary loss of access to private property or tenants  Temporary loss of community assets including green infrastructure and open space and/ or access to them.  No impact on businesses  Temporary loss of best and most versatile agricultural land (Grade 1,2,3a) and/or Agricultural Land Classification Grade 4 or 5 - fully restored.	Minimal effect on private property and/ or access to private property or tenants  Enhancement of existing community assets including green infrastructure and open space and access to them.  Beneficial effect on businesses  No permanent loss of best and most versatile agricultural land (Grade 1,2,3a). Minor effects on Agricultural Land Classification Grade 4 or 5.	No effect on private property/ access to private property or tenants.  Creation of new community assets including green infrastructure and open space and access to them.  Significant beneficial effect on businesses  No permanent loss of best and most versatile agricultural land (Grade 1,2,3a). Minor temporary effects on Agricultural Land Classification Grade 4 or 5 due to construction.
	Public Rights of Way (PRoW)	Diversiónary Routes - Convenience & suitability (incl. length, maintenance & accessibility) and enjoyment of diversionary route (for existing users)	Diversiónary route substantially longer than existing route  Long term and costly maintenance of diversionary route required  No accessible alternative access proposed  Amenity of diversionary route (including views, noise, landscape) significantly reduced compared to existing route  Likely significant adverse effect on businesses or other defined user groups of the existing crossing (e.g. horse riders, cyclists)	Diversiónary route slightly longer than existing route  Long term low cost maintenance of diversionary route required  Accessibility of diversionary route is worse than existing route (including level change, quality and evenness of footpath, access for disabled or older people or people with young children)  Amenity of diversionary route (including views, noise, landscape) of lower quality than existing route  Moderate impact/ adverse effect on businesses or other defined user groups of the existing crossing (e.g. horse riders, cyclists)	Diversiónary route of similar length to existing route  Short term low cost maintenance of diversionary route required  Diversiónary route repovides like for like accessibility (including level change, quality and evenness of footpath, access for disabled or older people or people with young children)  Temporary impact on amenity and views of diversionary route  No impact on businesses or other defined user groups of the existing crossing (e.g. horse riders, cyclists)	Diversiónary route shorter than existing route  Diversiónary route poses no safety risks and provides enhancement in some areas  Diversiónary route causes no maintenance issues  Diversiónary route improves accessibility for some users (including level change, quality and evenness of footpath, access for disabled or older people or people with young children)  Some improvement on amenity of diversionary route (including views, noise, landscape)  Beneficial effect on businesses or other defined user groups of the existing crossing (e.g. horse riders, cyclists)	Diversiónary route significantly shorter than existing route  Diversiónary route safer than existing route  Diversiónary route is maintenance free / improves maintenance issues  Diversiónary route provides improved accessibility for all users / the public (including level change, quality and evenness of footpath, access for disabled or older people or people with young children)  Amenity of diversionary route (including views, noise, landscape) is of significantly higher quality than existing route  Significant beneficial effect on businesses or other defined user groups of the existing crossing (e.g. horse riders, cyclists)
	Safety	Safety for all users	Introduces significantly less safe route across railway line than existing route.  Increases need for pedestrians and other non-motorised users to use road network	Diversiónary route poses greater safety risk than existing route.  Increases need for pedestrians and other non-motorised users to use road network, but appropriate pavement/ cycleway is provided	Diversiónary route causes temporary safety risk  Leads to temporary increases need for pedestrians and other non-motorised users to use road network, but appropriate pavement/ cycleway is provided	Diversiónary route poses no safety risks and provides enhancement in some areas  Reduces need for pedestrians and other non-motorised users to use road network compared to existing route	Diversiónary route safer than existing route  Provides enhanced route four pedestrian and other non-motorised users
Cost**	Whole Life Cycle Costs	Capital construction costs  Maintenance costs	High Capital and high maintenance Cost	High Capital and neutral maintenance cost	Medium Capital and neutral maintenance cost	Low Capital and neutral maintenance cost	Low capital and low maintenance cost
Design / engineering feasibility**	Key design constraints, e.g. maintenance and public safety; wire height affecting height of any bridge solution.	Extent of temp works needed  Procurement lead times  Fabrication complexity	High design Complexity	Medium design Complexity	Standard design Complexity	Low design Complexity	Retain /Modify Asset
Construction**	Buildability, including site access.	Extent of site constraints to be managed  Extent of temp works needed  Procurement lead times  Fabrication complexity	High build complexity/Challenging site constraints	Medium build complexity/Challenging site constraints	Standard build complexity/Manageable site constraints	Low build complexity/Manageable site constraints	Low build complexity/No site constraints
Maintenance**	Maintenance Regime	Meets Transversal Requirements  Impact on Maintenance budget  Maintenance staff exposure to lineside risks	High Ongoing Maintenance Burden	Medium Ongoing Maintenance Burden	Standard Ongoing Maintenance Burden	Standard Ongoing Maintenance Burden	Low Ongoing Maintenance Burden
Deliverability (timescale)	Meets Programme Requirements	Access Availability  Alignment with multi-disciplinary programmes  Programme Deconfliction	Impacts proposed commissioning dates	Causes delay to programme timescales	Meets programme timescales	Improves programme timescales for asset delivery	Enables Early commissioning/Benefits