TRANSPORT AND WORKS ACT 1992

TRANSPORT AND WORKS (INQUIRIES PROCEDURES) RULES 2004

NETWORK RAIL (HUDDERSFIELD TO WESTTOWN (DEWSBURY) IMPROVEMENTS) ORDER

ENGINEERING AND DESIGN

PROOF OF EVIDENCE

GRAHAM THOMAS

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GLOSSARY

Abbreviation	Definition
ASP	Auxiliary Supply Point (for railway signalling power)
DfT	Department of Transport (The Scheme “Client”)
EMC	Electro-Magnetic Compatibility
ETCS	European Train Control System (pan-European digital signalling system standards)
FOC	Freight Operating Company
GRIP	Governance for Railway Investment Projects
HGV	Heavy Goods Vehicle
HV	High Voltage
ITSS	Indicative Train Service Specification
JTI	Journey Time Improvement
LNW	London North Western (historic railway company)
NR	Network Rail (the Scheme “Owner” and Promoter)
NTPR	Northern Transpennine Railway (The existing route from Manchester to Leeds via Huddersfield)
NTSN	National Technical Specification Notices (Previously known as Technical Standard for Interoperability or TSI)
OBC	Outline Business Case
OCLZ	Overhead Clear Line Zone
OLE	Overhead Line Electrification
OSR	Option Selection Report
PPM	Passenger Performance Measure
PRM	Persons with Reduced Mobility
PROW	Public Right of Way
PSP	Principle Supply Point (for railway signalling power)
RAILSYS	Computer software for modelling rail system performance
RIA	Rail Industry Association
RRAP	Road Rail Access Point
S&C	Switches and Crossings
SoC	Statement of Case
TOC	Train Operating Company (e.g., Transpennine Express)
TRU	Transpennine Route Upgrade
TWAO	Transport and Works Act Order
VP	Validation Panel (A TRU control point meeting for validating option selection choices)

Abbreviation	Definition
VRS	Vehicle Restraint System
W3	“The Scheme”, TRU Project West 3, Huddersfield to Westtown

1. QUALIFICATIONS AND EXPERIENCE

1.1.1 I am an Associate Director at Ove Arup & Partners "Arup". During my 34 years at Arup, I have been involved with the planning, design, and construction of major civil engineering infrastructure in the rail, highway and other industry sectors working in the UK and overseas (Hong Kong, USA, Sweden, and Turkey). Many of my projects have been recognised through leading industry awards including the 2004 BCIA Prime Ministers special award for the A650 Bingley Relief Road.

1.1.2 I am highly experienced with all stages of project procurement from acting as clients' technical advisor, through managing or leading design teams to working closely with Contractors on Design and Build (D&B) projects. Through this variety of work, I have obtained a sound understanding of the whole project cycle from initial planning, funding, and consents phases through to contract management, commissioning, and maintenance.

1.2 Selected Project Experience

<u>UK Railway Projects</u>

Network Rail, TRU West of Leeds GRIP 3-8 (2017-current)

1.2.1 Alliance Design Lead (& Arup responsible Director) and Assistant Engineering Manager (CEM) heading a multi-disciplinary team on the route section between Huddersfield and Westtown, Dewsbury. This includes preparation of a TWA Order. The works briefly comprise the 4-tracking and electrification of an existing 2/3 track section of railway, re-construction of 4 stations including substantial re-modelling at Huddersfield and a major grade separation scheme at Ravensthorpe. Estimated costs at end of GRIP 3 are c.£1.3bn.

Network Rail, CP5 Frameworks GRIP 3-8 (2014-2019)

1.2.2 Project Director and/or Structures CEM/CRE for bridge rehabilitation projects as part of NR's Control Period 5 frameworks. **LNE Region Package 9 Framework,** approximately 15 underbridge structures requiring substantial refurbishment or replacement works. Mixture of brick viaducts and metallic bridges. **East Midlands Region IP Framework**. Multi-disciplinary D&B projects, which included Bedford to Kettering 4-tracking. Assessment, option selection and detailed design of strengthening works to several large brick arch and multi-span metallic lattice truss structures.

Network Rail, Ipswich Chord GRIP 5-8 (2012-2014)

1.2.3 Design Team Leader, Project Manager and Structures CRE for a complex D&B multi-disciplinary design of a circa. £60m railway scheme. This was to construct 1.5km of new twin track railway chord to link the existing Norwich and Felixstowe lines just north of Ipswich town centre. Scope of work included administering and gaining consents approval to DCO planning conditions, 4 major bridge structures (including two river bridges), 0.5km of retaining wall, sewer diversion, 7m high earthwork embankments on soft ground, permanent way, signalling, OLE, Lineside Civils, E&P and telecoms. The project won the "Best Large Project" Award at the NR Partnership Awards 2014.

Network Rail, Brigg Line Freight Enhancement GRIP 2-8 (2008 – 2009)

1.2.4 Team Leader and CRE for the structural elements of the line enhancement between Brigg and Gainsborough. Structural works include strengthening/ reconstruction of two underline bridges plus reinforced soil walls as part of an embankment strengthening. Project taken through GRIP stages 2 to 8 including form A and form B for the structural elements. This project has won numerous industry awards including the 2009 Rail Industry Award for best Civil Engineering Project.

London & Continental Railways Ltd, Channel Tunnel Rail Link (1998 – 1999)

1.2.5 Project Manager and Lead Engineer for the concept and detailed design of three road bridges, three rail bridges, and associated structures on phase 2 of the CTRL project. Two of the rail bridges involved jacked launches over existing lines during possessions.

<u>Other Selected Projects</u>

Highways England, Hull A63 Castle Street Improvement (2014-2017)

1.2.6 Engineering Director for this very complex c.£300m trunk road scheme being procured as an ECI D&B arrangement. The project includes a 250m long RC underpass structure constructed 6m below ground water level in challenging geotechnical conditions. It also includes two new footbridge structures, one of which is to be a landmark design plus numerous retaining walls and structural assessments of existing walls and nearby buildings.

Highways Agency, A650 Bingley Relief Road (2001 – 2004)

1.2.7 Structures Project Manager and Design Team Lead for the winning D&B tender & detailed design of this multi-award winning 5km urban dual carriageway. The scheme included many types of complex and innovative bridge and structural earthworks construction including the cable stayed Britannia Footbridge, which itself received a RIBA regional design award.

JFK International Airport, New York, USA (1996 – 1998) various projects

1.2.8 **British Airways Terminal:** Project Manager and Lead Engineer of civil structures for the redeveloped road and rail network around the BA, and TWA terminals at JFK airport. **International Air Terminal:** Project Manager and Lead Engineer for the design of highway and light rail structures as part of the new redeveloped airport terminal building.

New Hong Kong Airport, Hong Kong (1994 – 1995)

1.2.9 Project Manager and Lead Engineer responsible for the concept and detailed design of all bridges and civil structures for the arrivals and departures transportation system at the new terminal site. This involved design road & rail viaducts, a railway station and multi-level concourse adjacent to the main terminal.

1.3 My role and position on the project including key responsibilities

1.3.1 I have led the design development of the Huddersfield to Westtown Scheme (TRU West Project W3) from the commencement of GRIP Stage 3 in April 2017. This was following the appointment of the TRU West Alliance (formerly known as the Transpire Alliance) to the TRU Programme. I began in the role of Contractors Engineering Manager (CEM) for the Design and was subsequently appointed as the overall Project Lead for the completion of GRIP Stage 3.

1.3.2 Following the completion of GRIP3 in December 2019, the TRU West Projects were re-structured with a Project Leadership Team (PLT) formed for the delivery of all ensuing GRIP phases. Since that time, I have been a member of the W3 PLT specifically in the role of the Project W3 Design Lead with the following key responsibilities:

- Part of W3 Project Director Leadership Team with overall accountability for the direction of, and overall strategy for delivery of all design activities within the Project.
- Supports the W3 Project Director in delivering all design activities on programme and to cost
- Provides leadership and continuous development of the design organisation as appropriate for the Project GRIP stage including integration of all design disciplines (project specific and route wide).
- Working with the Design PM team and Design function leads, to forecast and secure resources to maintain a high-performance team.

- Act as a focal point for design inputs into section proposals (internal Alliance tender stages). This includes mobilisation of appropriate resources to ensure the delivery of section proposal scopes / prices / programmes in parallel with ongoing design delivery.
- Promote a collaborative ethos throughout the design function in line with the TRU West Alliance Charter.

2. SCOPE OF EVIDENCE

2.1 Introduction

2.1.1 My evidence will be structured in two parts:

- Engineering & Design Response to the Statement of Matters
- Engineering & Design response to submitted Objections

2.1.2 Within my evidence I have not described the generalities of the Scheme Development, Option Selection, or the full detail of the proposed works. These items are extensively documented in the NR Statement of Case (NR28), the relevant parts of which I also authored. Specifically, the reader is referred to the following sections of the Statement of Case (SoC):

- SoC Section 6 – Scheme Development
- SoC Section 7 – Scheme Description and Construction
- SoC Appendix B – Option Selection Detail (which supports Section 6)

2.1.3 My evidence will cover the overall scheme option selection including the evaluation of alternatives and the railway works. Within the Scheme there are several complex highway interventions, and where indicated, I will defer to the Proof provided by our Highways Expert Witness, Chris Williams. He will provide additional detailed evidence with respect to the engineering and design development of those specific highway proposals and responses to related objections.

2.2 Response to Statement of Matters

2.2.1 My evidence given in Section 3 is in response to the following points of the Statement of Matters, which are affected by the chosen design option:

- **Point 2**. The main alternative options considered by NR and the reasons for choosing the preferred option. My evidence will cover the period of design development from GRIP Stage 3 through to submission of the Order

- **Point 3**. The likely impact of the proposed TWA Order on local businesses, tenants, and occupiers. My evidence will primarily describe the key impacts where these have been directly influenced by the preferred design option, and how the design has addressed such impacts.

- **Point 4**. The potential effects of the Scheme on cycling and walking and how these have been addressed by the design submitted. This section will also include effects on Public Rights of Way (PROW) and accessibility.

- **Point 6**. The impact of the Scheme as designed on other development proposals in the local area. My evidence will demonstrate how the Scheme has positively responded to development proposals which are directly influenced by the Scheme.

2.3 Response to Objections

2.3.1 My evidence given in Section 4 is in response to the submitted Objections as listed below. Several the Objections address similar geographies, topics, or "themes" and therefore my response is structured to address these in a holistic way with specific objections referred to in text covering a specific geography, topic, or theme. Where objections cover a singular issue then I have addressed these directly.

2.3.2 The structure of my response is as follows:

- **Huddersfield Area**. This covers an outline description of the works and the design choices affecting the Grade I listed Huddersfield Station and its environs including Huddersfield Viaduct. Objections (whole or part) addressed within this section include:
  - **OBJ 14** Yorkshire Children's Centre
  - **OBJ 15** Kinder Properties
  - **OBJ 16** DP Realty
  - **OBJ 23** HD1 Developments
  - **OBJ 25** Kirklees Cycling Campaign
  - **OBJ 40** West Yorkshire Combined Authority
  - **OBJ 43** CUBICO UK Ltd.
  - **OBJ 45** R&D Yorkshire Ltd**.**
- **Ravensthorpe Area.** This covers an outline description of the works and design choices affecting the railway grade separation proposed in the Ravensthorpe Area. This section specifically addresses the issues and impacts cause by the works required to re-align the Calder Road in Ravensthorpe. Objections (whole or part) addressed in this section include:
  - **OBJ 07** Shackleton's Ltd.
  - **OBJ's 18 to 22** Hargreaves (GB) Ltd, Newlay Asphalt Ltd, Newlay Readymix Lt, Newlay Concrete Ltd, Dewsbury Sand and Gravel Ltd.
  - **OBJ 29** Wakefield Sand and Gravel
  - **OBJ 42** Veolia
  - **OBJ 44** Mrs Newton

- **Bradley and Deighton Area.** This covers the railway corridor works within the environs of Deighton Station and the A62 Leeds Road. Objections (whole or part) addressed in this section include:
    - **OBJ 09** Bramall properties Ltd.
    - **OBJ 13** JJIG Ltd and Buy it Direct Ltd.
- OBJ 26 Dr Reddy's
- OBJ 35 Canal & River Trust

3. ENGINEERING AND DESIGN RESPONSE TO STATEMENT OF MATTERS

3.1 Alternatives Considered

3.1.1 This section will consider the major strategic alternatives considered during my involvement with the Scheme development during GRIP3 (see below for definition of the Network Rail GRIP process) and the early parts of GRIP4 up to submission of the TWA Order. Alternatives considered for specific localised features such as highway re-alignments, stations, bridges, etc., will be described where required in my responses to objections.

<u>The Network Rail GRIP Process</u>

3.1.2 The Governance for Railway Investment Projects (GRIP) is Network Rail's management and control process for delivering projects on the operational railway and is mandatory for all significant rail projects. This is the process that the TRU Programme has followed during the Scheme development.

3.1.3 GRIP divides a project into eight distinct stages. The overall approach in GRIP is product rather than process driven, and within each stage an agreed set of products are delivered. The eight GRIP stages are:

- GRIP 1 - Output Definition
- GRIP 2 - Pre-Feasibility
- GRIP 3 - Option Selection
- GRIP 4 - Single Option Development
- GRIP 5 - Detailed Design
- GRIP 6 - Construction Test & Commission
- GRIP 7 - Scheme Hand Back
- GRIP 8 - Project Close Out

<u>Background to Option Selection</u>

3.1.4 The alternatives considered were driven by the existing operational conditions and requirements of the overall TRU Programme. This had a direct bearing on the subsequent Engineering and Design decisions that I made.

The TRU Project Brief

3.1.5 The Transpennine Route Upgrade (TRU) Programme is a targeted rail upgrade aiming to increase capacity, reduce journey times and improve reliability of the existing rail network between Manchester Victoria and York, via Huddersfield and Leeds. This is part of the key inter-regional rail corridor connecting the main Northern towns and cities from Newcastle and Hull in the East through Leeds and Manchester to Liverpool in the West.

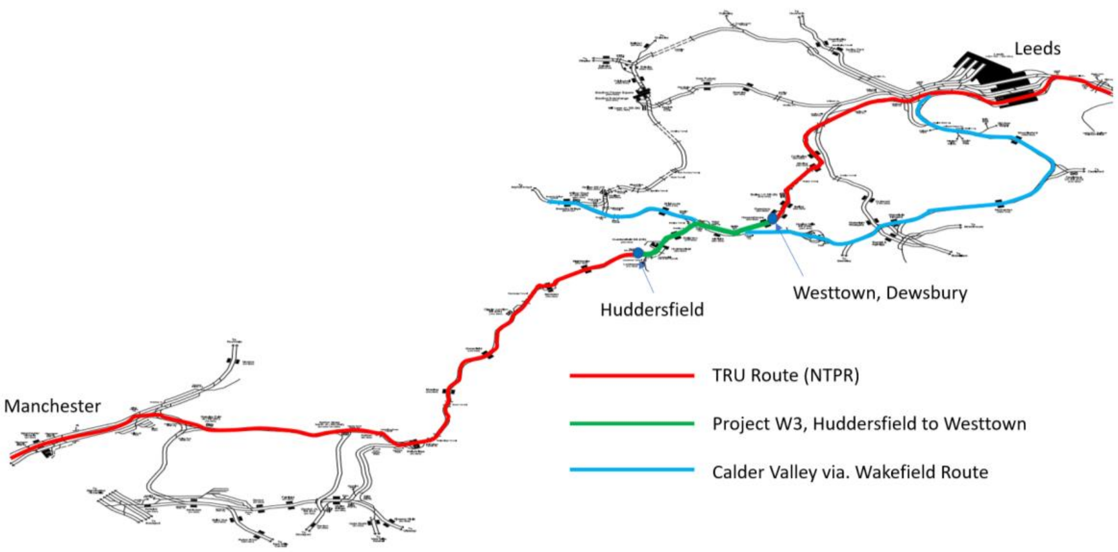
3.1.6 At the outset the Client specified 9 outcomes that were to be satisfied by the TRU Programme subject to engineering development and Business Case approval. I understand the brief set out below was the basis of studies carried out by Network Rail during GRIP1 and GRIP2, which I have then taken forward into GRIP3:

1. A Manchester to Leeds journey time of 40* minutes (for fast trains) with one stop at Huddersfield. (*This target was subsequently revised during GRIP3 to 42 minutes based on the 2018 OBC submission and Interim Train Service Specification (ITSS) v1.1).
2. A Manchester to York journey time of 62* minutes including two stops at Leeds and Huddersfield. (*This target was subsequently revised during GRIP3 to 67 minutes based on the 2018 OBC submission and ITSS v1.1).
3. Capacity for four fast, two semi fast (stopping at selected stations) and two stopping (all stations) trains per hour.
4. The capability to operate express trains of 192m in length allowing for sets of 8 x 24m cars, 2 x coupled sets of 4 cars and local services of 4* x 23m *(* modified for GRIP3 to 6 x 24m)* cars. This requires minimum operational platform lengths of 200m at major stations and 150m at minor (local) stations.
5. Capacity to accommodate freight access rights at existing levels*. *(* ITSS v1.1 allows for at least one freight train path per hour)*
6. A Passenger Performance Measure (PPM) of 92.5% based on the 0–5-minute regime including all intermediate stations on the Manchester Airport to York and Liverpool to York corridors.
7. Electrification to support the operation of electric trains between Stalybridge and Leeds, and between Leeds and York/Selby*. (* At the time of writing the Client has committed to a partial electrification scenario between Leeds and Huddersfield and Manchester to Stalybridge).
8. Electrification configured to support the operation of existing and proposed electric and “bi-mode” rolling stock.
9. The introduction of rail traffic management technologies to support the required improvements in capacity, performance and operational resilience including ETCS (Digital) signalling.

The problem between Huddersfield and Westtown (Dewsbury)

3.1.7 Between York and Manchester there are several very constrained route sections, the unlocking of which are fundamental to achieving the TRU programme outputs. The most important of these identified, is the section of line between Huddersfield and Thornhill LNW Junction at Ravensthorpe. During GRIP3 the TRU Programme Interventions were grouped into geographic projects, Project West 3 (W3) became the Scheme, Huddersfield to Westtown.

Figure 3-1: TRU West Route and Location of Project W3, Huddersfield to Westtown

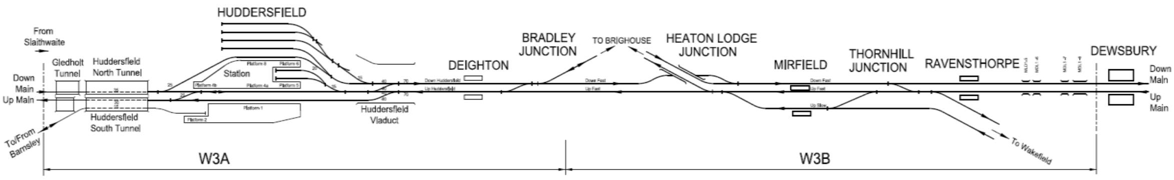


3.1.8 Along the W3 section of the Transpennine route there are a significant number of conflicting train movements as the corridor is crossed by the Brighouse to Wakefield (Calder Valley) route. Furthermore, Huddersfield is a busy regional interchange station with many services terminating or originating, which adds further conflicting train paths. These conflicting train paths severely limit the available capacity in this area, and any late running services have an enormous impact on punctuality and overall performance of train services on the entire Transpennine route.

3.1.9 Transpennine trains are a mixture of local, regional, and inter-regional services with a wide variety of departure and termination points across a complex and constrained route network. Therefore, it is very common in the W3 section for trains to present themselves running out of timetable sequence, with delays magnifying themselves for long durations especially at peak periods. I understand that studies undertaken along the route show that less than 38% of services run to timetable (within 1min) and the overall PPM measure (0-5min delays) across the 4 core stations of York, Leeds, Huddersfield, and Manchester is less than 75%. The recent introduction of a new enhanced timetable in May 2018, with additional Transpennine services running via Manchester Victoria, led to a significant decline in overall performance and further demonstrated that the railway is running at or beyond capacity, with a very significant portion of delays severely affecting stations in the Huddersfield, Dewsbury, and Leeds demographic.

3.1.10 The existing operational layout in this section is predominantly a 2-track railway, although there is a passing loop in the Up direction between Ravensthorpe and Heaton Lodge junction, which allows some regulation of freight and stopping passenger services heading towards Huddersfield via the NTPR or Brighouse via the Calder Valley route. In the Down direction towards Leeds there are no similar opportunities for train regulation. There are three flat (at-grade) junctions; at Ravensthorpe (Thornhill LNW junction), Heaton Lodge Junction and Bradley Junction, all of which contribute to train service conflicts.

Figure 3-2: Project W3, Existing Operational Layout



3.1.11 In summary the operational layout of the railway in this route section is inadequate for both existing and proposed future enhancements to rail services. It has numerous points of movement conflict and very limited ability to regulate train services to overcome those conflicts or recover from a late running timetable, with a tendency for delays to be magnified over long periods affecting a wide geography extending well outside of the immediate region. This situation is one of the prime contributors to the inadequate experience for long distance, regional and local passengers alike, and is a severe drag on economic and social activity within the Kirklees district.

3.1.12 It is of note that the Huddersfield to Thornhill LNW Junction (Ravensthorpe) section of the NTPR was historically a 4-track railway, which was rationalised during the 1960's and 1980's to account for falling demand at that time. In more recent years, with extensive growth in passenger and conflicting freight traffic, this section of railway has become one of the most congested and underperforming parts of the rail network.

3.1.13 The historic 4-track formation and supporting infrastructure is still largely complete and within Network Rail's ownership. Therefore, restoring additional rail infrastructure, such as 4-tracking, along this section is very feasible. However, there are some difficult engineering challenges to be resolved, primarily around safely constructing, and then operating, a modern railway within a Victorian railway corridor, which has in places been encroached upon by subsequent development.

The Proposed Solution

3.1.14 From the outset of GRIP3 in April 2017, when I became involved with the TRU programme, it was clear that a very significant change was required along the Scheme corridor to achieve the TRU output specifications. I understood that the principal requirement for the Scheme was to achieve Capacity, but also to realise the opportunities for journey time and performance improvements, that had been identified during the preceding GRIP1 and 2 studies.

3.1.15 As part of the early feasibility studies, it was identified that the Huddersfield to Ravensthorpe section, if re-built to 4-track standard and grade separated, could support much higher line speeds. At GRIP2 a flat linespeed capability of 100mph was proposed through this section, which is a substantial improvement above the current 70/75mph capability. This would generate significant reductions in sectional running times, therefore contributing towards the overall TRU programme journey time targets. It was also identified at GRIP2 that there were opportunities for increasing linespeeds further, particularly in the section between Heaton Lodge and Ravensthorpe.

3.1.16 It was also clear to me, that in achieving the TRU Programme outputs, the Scheme, with its level of investment, should become a catalyst to improve the socio-economic outcomes for the travelling public and the wider population centres in Kirklees district and beyond. Therefore, an important aspect of the Scheme development was working with local and regional stakeholders and associated planning policies or initiatives, to create the best outcomes for the taxpayer. This point is specifically addressed in Section 3.4 of my Evidence.

3.1.17 At the end of GRIP2 it had been established that the Huddersfield to Ravensthorpe section was a vital component of the overall TRU programme for the following reasons:

- **Capacity**. It is a key component in providing the operational capacity to run the ITSS, as proved by substantial operational modelling carried out by Network Rail using RAILSYS software. Most importantly the timetable planning to support the ITSS relies on the ability for fast trains to overtake slow trains within this route section.
- **Journey Time**. It provides approximately 2 minutes improved sectional running times contributing significantly towards the overall TRU journey time targets.
- **Performance**. With grade separation eliminating flat junctions on the new fast lines, and additional operational flexibility at Huddersfield Station, it reduces train service conflicts substantially along this section

of the TRU route. This allows for the efficient and reliable operation of the timetable, thereby significantly contributing towards the overall PPM.

3.1.18 As stated above, the principal driver of the Scheme proposals through the Huddersfield to Westtown area is the operational rail capacity to run the ITSS. These capacity improvements are achieved by three principal means:

- **4-tracking** within the approximate 13km of this route section to separate fast, slow, passenger and heavy freight trains. Extensive RAILSYS operational modelling carried out by Network Rail has determined that this is the best location between York and Manchester for fast trains to overtake slow trains and to regulate services, therefore allowing a workable timetable to be constructed to support the remitted ITSS.
- **Grade Separation** to deconflict train service patterns within the Heaton Lodge Junction to Thornhill Junction section, to allow fast trains to overtake slow passenger and freight trains unimpeded by flat junction arrangements.
- **Huddersfield Station Re-modelling** to provide additional operational flexibility and resilience to operate the ITSS. This requires the re-modelling and lengthening of all platforms in accordance with the core TRU requirements. The re-modelling would also require new junction arrangements at either end of the station to allow flexible sorting of trains in and out of platforms. This is particularly required during times of perturbated working.

Why 4-tracking?

3.1.19 I understand that the timetable used for operational capacity modelling has been constructed around very specific train service patterns. This timetable and sequence of train operations within it, has some intrinsic features which depend on the re-instatement of 4-tracking in the Huddersfield to Ravensthorpe area:

- The four fast “express” services per hour run to a clockface timetable with set 15-minute intervals between trains.
- Between each fast service leaving Leeds or Manchester, a slow (or semi-fast) service is “flighted” straight behind. For example, when a fast train leaves Leeds a slow stopping train follows immediately behind. The slow service, which stops at intermediate stations, is caught by the next fast train service following behind in the Ravensthorpe area.
- Slow (all station stoppers) between Manchester and Leeds “split-stop” at Huddersfield. This enables them to be turned back at Huddersfield in either direction to be “flighted” back behind fast services. In this way the slow train services can be regulated to account for perturbed out of timetable working without impinging on through fast services.

- Fast train services must be separated from conflicting services emerging from the Bradford, Calder Valley and Wakefield directions to produce a workable clockface timetable. This is enabled by a grade separation of the fast lines to avoid those timetable conflicts.

3.1.20 Therefore a 4-track section of line is required to allow overtaking of fast and slow services to run the ITSS and enable Journey Time Improvements for the whole TRU Programme. The proposed reinstatement of the former 4-track section between Ravensthorpe and Huddersfield is the only viable place where this can occur due to the former 4-tracking in this area, and the resulting system performance has been validated by operational modelling.

3.1.21 It is therefore understood that the 4-tracking, plus grade separation provided by this Scheme is the key enabler to allow a reliable, fast, and high-frequency timetable to operate between Leeds, Manchester, and destinations beyond.

<u>Option Selection</u>

3.1.22 During GRIP3, I thoroughly tested the engineering assumptions underlying the GRIP2 outputs and carried out a comprehensive Option Identification, Option Sifting and Option Selection process in a thorough and consistent manner. This process was repeated across the whole TRU programme, and is documented in the SoC Appendix B4, which includes the programme wide option appraisal criteria used.

3.1.23 In addition to the capacity, journey time and performance targets, we also studied the effects of 25KV overhead electrification (either with or without) on those targets. The electrification impact was accurately recorded across the whole programme option selection against each discrete intervention so that the cost, programme, and engineering feasibility could be modelled in the selection of the optimum "end to end" scheme for the TRU Programme business case.

3.1.24 Given that previous GRIP studies had identified the criticality of the 4-tracking and grade separation, in broad terms, the high-level option selection for the Scheme can be summarised around following key decision points, which I will elaborate on in the following sections:

- **Ordering of the fast and slow lines** through the route section and their effects on existing junctions and lineside infrastructure. This defines the Scheme "end to end" operational layout.
- **Location of the Grade Separation** and type of vertical grade separation (either over or under), which follows on from the selection of the "end to end" operational layouts.

- **Junction layout and operational functionality** particularly at either end of the 4-track sections at Huddersfield and Ravensthorpe where the railway needs to converge back into a 2-track layout.
- **Huddersfield Station platform and track layout** being the critical intermediate station on the route between Leeds and Manchester where all trains stop and where there is an opportunity to order trains to suit the day-to-day timetable variables and account for the many issues caused by perturbed working including timetable recovery.

Working within Railway Standards

3.1.25 In developing the design, I had to consider a wide range of requirements including railway industry standards, which not only define physical geometry (such as track, stations, structures, etc.), but also establish a hierarchy of decision making to provide the best possible safe working conditions for both the operational railway and for future maintenance.

3.1.26 Within these standards there a are number of critical clauses setting the geometry which underpinned the progression of design. In the following sub-sections I will set out these elements to assist the reader in understanding their impact on the optioneering of the Scheme.

3.1.27 It is important to note that throughout the option selection and in ensuing design development of the preferred option, I have continuously questioned the application of standards to ensure that we are, within reason, pushing the boundaries of acceptable design practise. This is to limit the impact of the railway scheme on land, property, and the wider environment. Of particular significance are elements of track and OLE design standards, which I shall describe in following sub-sections.

Railway Cross-Section Geometry

3.1.28 Relevant Network Rail Standards which provide further background information include NR/L2/TRK/2102 – “Design and Construction of Track” and NR/SP/OHS/069 – “Lineside Facilities for Personnel Safety”. Some useful railway terminology and dimensions which define cross-section geometry are as follows:

Table 3-1: Railway Cross-Section Terminology and Dimensions

Term	Description	Linespeeds <= 100mph	Linespeeds > 100mph	Notes
“4-Foot”	Distance between rail running edges	1435mm	n/a	The UK standard track gauge

Term	Description	Linespeeds <= 100mph	Linespeeds > 100mph	Notes
"6-Foot"	The gap between adjacent tracks	1970mm	n/a	For pairs of tracks in a 2-track railway
"10-Foot"	The gap between pairs of tracks	3188mm*	n/a	Between 2 pairs of tracks in a 3 or 4-track railway. *This can be reduced to 2883mm minimum where tracks are being re-introduced in a historic rail corridor, referred to as the "9-Foot"
Cess	The verge at the side of the railway to provide clearances to trains in which equipment can be installed and to provide access for personnel	1300mm	2100mm	Generally, this is the minimum allowable width, but may be reduced in exceptional circumstances.
POS	Position of Safety	400mm above min. Cess width	400mm above min. Cess width	Either a refuge at <= 40m intervals or a discontinuous line where personnel can safely stand to let trains pass
CPOS	Continuous Position of Safety = Cess + 400mm	1700mm	2500mm	Minimum width which provides a continuous position where personnel can safely stand to let trains pass

Term	Description	Linespeeds <= 100mph	Linespeeds > 100mph	Notes
CSWR	Continuous Safe Walking Route = Cess + 700mm	2000mm	2800mm	Minimum width which provides a continuous walking route while trains are operating.

3.1.29 Safe access to maintain the railway was a key requirement for the Scheme design, and this is particularly so in the 4-track sections, which are inherently more hazardous to maintain. Where possible we have aimed to provide at least a CSWR along one side of the railway (adjacent to slow lines preferred), or if not possible at least a CPOS. This requirement has driven the width of the corridor required. In very constrained locations we have had to provide reduced cess clearances, but in these areas, we have positioned trackside equipment where it can be readily accessed from the high-street environment rather than requiring along track access.

Railway Curve and Gradient Geometry

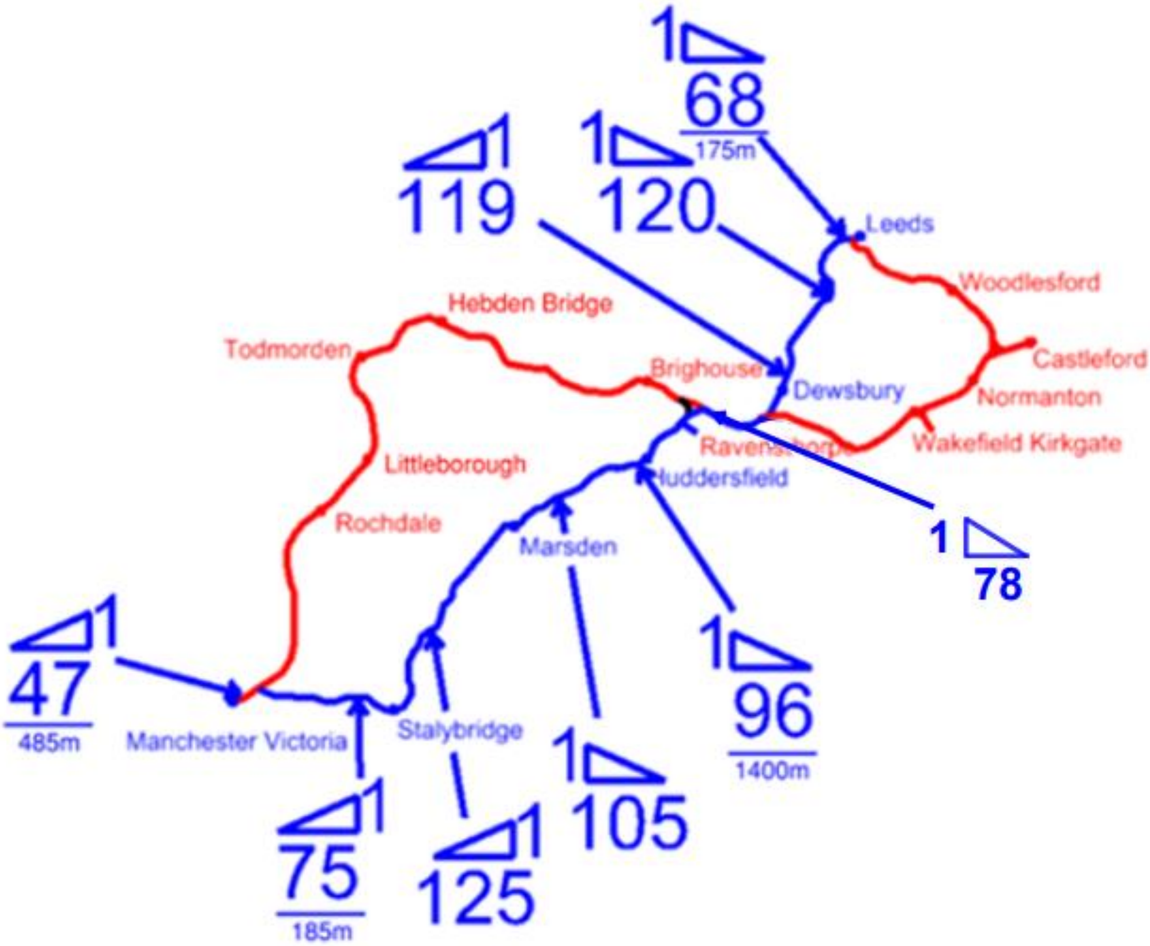
3.1.30 Track design standards contained within NR/L2/TRK/2102 define the range of “normal” and “exceptional” rules for track design. Of relevance to this scheme are the rules surrounding application of “Cant” and associated horizontal curve transitions as well as vertical track gradients. This was particularly relevant to the design where the requirement for greater linespeed potential required land outside of the existing railway boundary. Exceptional design values were considered on curves to test the effect on the scheme proposals, especially where 3rd party land was required.

- “Cant” is the cross fall between individual rails to give a “banking” effect through corners. This is the generation of an inward transverse force component through gravity to resist the outward centripetal force as the train travels around the curve. The normal maximum value of cant is 150mm although exceptionally this may be increased to 180mm. However, this limits the type of trains that can use a curve. Most track mounted maintenance equipment is limited to 150mm cant, and freight trains to a maximum of 160mm cant. Therefore, values above 150mm are not normally permitted, except in very exceptional circumstances on existing lines. For new construction (such as our proposed grade separation) this would require a derogation against standards.
- “Cant Deficiency” is the deficiency of the inward gravitational effect against the outward centripetal force. At greater cant deficiencies the train wheels will press against the upper high rail and passengers will

experience an increasing outward force. The maximum values of cant Deficiency are generally governed by passenger comfort criteria rather than train safety. Also, the rate at which cant is applied through curve transitions is governed by passenger comfort values i.e., the rate of change of outward acceleration.

3.1.31 Standards governing vertical gradients were also very relevant, as these directly affect the geometry of any grade separation proposed in the Scheme. On the NTPR the general ruling gradient is 1:100 over long graded lengths, for example out of Huddersfield Station to Diggle Summit. This was common practise for the historic construction of mainline railways in hilly terrain using steam traction. Such gradients would often require double heading (2 steam locomotives) for the heaviest freight trains, but modern diesel and electric traction power can generally handle these gradients with single heading (albeit with reduced acceleration capabilities). On very short sections of line where there were difficult physical challenges, some steeper gradients were constructed, as shown in the diagram below (with steeper gradients above 1:100 shown with their application length).

Figure 3-3: North Transpennine Route, Existing Gradients



3.1.32 Current Network Rail Standards propose absolute maximum gradients of no more than 1:80 for new railway construction for mixed passenger and freight traffic (with the preferred maximum gradient being 1:100). However, in exceptional circumstances, short sections up to 1:50 may be proposed subject to operational assessment. On the NTPR the maximum existing gradient out of Manchester Victoria station (1:47) is a severe limitation on operations and is considered unsuitable for heavy freight operation without double heading (freight generally takes alternate pathing through Guide Bridge). By studying the existing steep gradients on the route, it could be seen that short gradient lengths up to around 1:70 may be acceptable, subject to site specific geometric constraints and passenger comfort criteria.

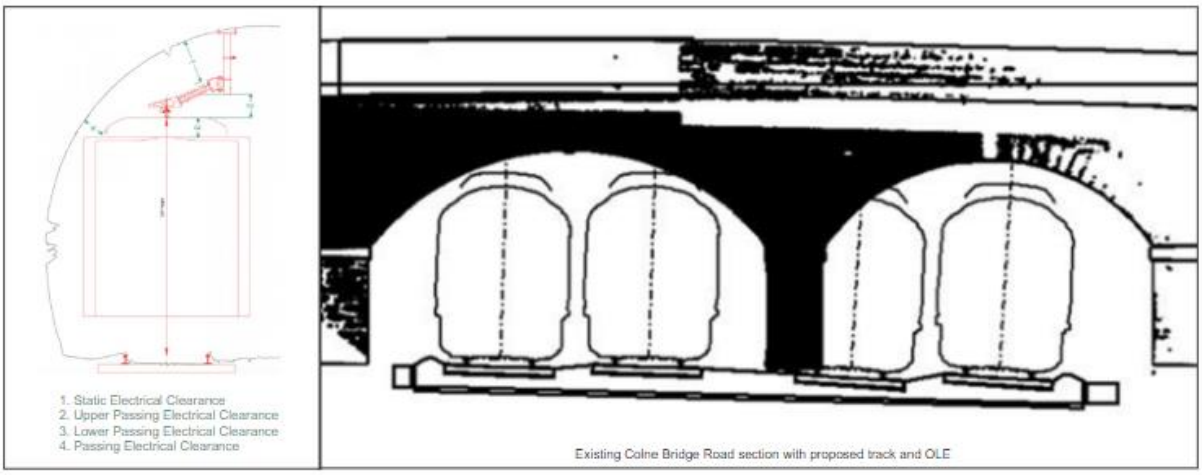
3.1.33 Therefore, during option selection grade separation geometries were initially developed using 1:80 as the ruling maximum gradient, with the possibility of further refinement once a preferred option (or range of preferred options) had been selected. Note that the grade separation options proposed are always on the fast line alignments, and therefore will be predominantly used for express passenger services, which will be generally untroubled by such gradients. However, in perturbed situations and during maintenance operations, the lines may be used for mixed traffic including freight. Consequently, steeper gradients required a detailed operational assessment to prove their suitability for occasional freight traffic.

Overhead Line electrification (OLE) Clearances

3.1.34 Engineering and Design of an OLE system fitted within an existing railway corridor generally results in two difficult spatial challenges; vertical clearance to existing bridges, and horizontal space within the corridor to locate the OLE supports and foundations. Consideration of these multi-disciplinary challenges was a critical part of the design development in response to the lessons I learnt from recent electrification projects delivered in the UK, notably the Great Western Electrification Project. This is detailed in the Railway Industry Association (RIA) Electrification Cost Challenge report, dated March 2019.

3.1.35 Many factors influence the design of OLE, and the related electrical clearance required to safely run an electrified railway. These are captured within GL/RT/1210 and associated railway standards. From an OLE perspective the preferred solution is for “free running” OLE under structures (i.e., wires not “fitted” to the structure), defined as a static clearance to equipment of 270mm (minimum), 370mm (preferred), or greater under a structure. However, delivering OLE on this rail corridor within existing restricted clearances makes this difficult to achieve. Therefore, to avoid excessive works interventions, the Scheme proposes the use of reduced electrical clearances, fitted wire solutions at low overbridges, and use of voltage-controlled clearances (VCCs). Any reduced standard applications are subject to a safety risk assessment.

Figure 3-4: OLE example gauge clearance sketches



3.1.36 In addition to the solutions described above, the Scheme has also considered the following multi-disciplinary optioneering to arrive at the most cost-efficient solution. This has been notably undertaken at the Huddersfield Tunnels, Westgate Bridge, A62 Leeds Road, Bradleys Overbridge, Colne Bridge Road, Coppers Intersection, Calder Road, and the Ravensthorpe Flyover Structure.

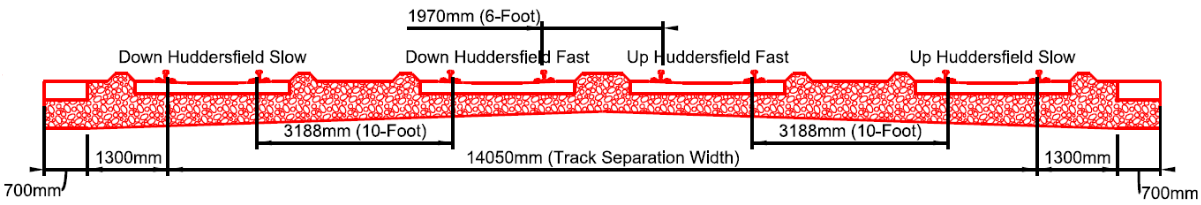
- **Structural form of overbridge structures**. Where reasonably possible the scheme has sought to retain structures to maximise sustainability, while minimising cost and disruption. Where new structures are required, the form has been considered carefully to minimise the overall structural depth and maximise clearances.
- **Alignment of highways, footpaths, and cycle paths,** which pass over a structure. Scheme designs have been developed to minimise, where reasonably possible, the extent of highway, footway, and cycleway tie-in works because of raising structures to allow OLE to pass underneath.
- **Positioning of OLE supports**. The placement of OLE portals adjacent to overbridge structures and, where applicable, the use of OLE fixing to the structures has been considered to minimise wire heights.
- **Track Lowering**. The vertical design of track has been considered to maximise use of opportunities to reduce the track level through structures and therefore increase vertical clearance. This has been a complex undertaking considering local issues such as flooding, and wider route constraints such as tie into existing overbridges.
- **Use of Voltage Control Units (Surge Arresters)**. Use of a new technology, recently implemented on the Great Western project, have be considered as a final measure to install OLE in very low clearance zones whilst reducing wider disruption, and ensuring a safe system.

Ordering of Fast and Slow Lines

3.1.37 Having established the principal operational standards which govern the Scheme, I will now present in the subsequent sections the development of the four key decision points that underly the engineering design.

3.1.38 From a railway operational viewpoint only, the optimum solution for a new railway would be to place fast lines in the centre with slow lines on the outside. This gives the best layout for intermediate stations for stopping/local trains with side platforms simply accessed from the boundary. It separates the fast-moving trains into the centre of the corridor and combined with wider “10-Foot” track intervals between the slows and fasts, results in the safest layout for maintenance access. Merging junctions can filter in trains from the outside using flat junctions, assuming that it is acceptable to delay trains on the slow lines when conflicting train movements occur. The disadvantage of such an arrangement is the space needed to achieve adequate separation between the slow and fast lines as two “10-Foot” intervals are required shown in the cross-section below. This shows an overall corridor footprint of about 18m is required with preferred cess width provision.

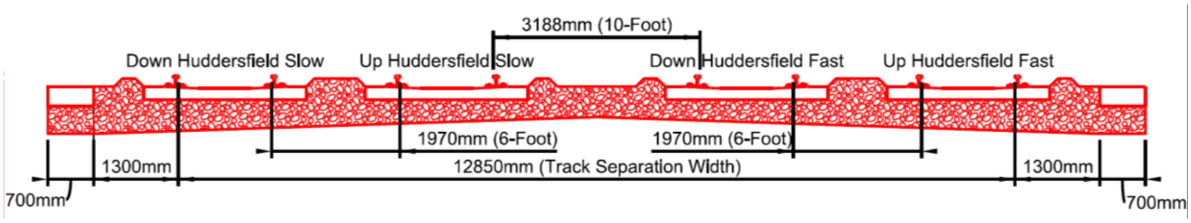
Figure 3-5: Slow, Fast, Fast, Slow, 4-track cross-section



3.1.39 However, historically most 4-track railways were constructed as widenings of existing 2-track railways. These widenings had to account for existing infrastructure layouts including stations and junctions and the need to keep trains moving while the widening was being built. This generally resulted in fast express lines being built to one side of an existing corridor. This layout generates conflicting train movements where junctions occur, since trains joining or leaving the fast lines will nearly always have to cross one or more adjacent lines. On sections of railway with intensive train operations, this can lead to severe limitations in capacity due to the required safe headways between trains controlled by interlocked signalling systems. When operating at the determined line capacity, such a railway will experience poor performance/reliability, since any trains operating out of timetable can then cause delays to trains operating on other lines. This problem is resolved by grade separating junctions, and throughout the history of the railways, junction grade separation has been the means to resolve capacity issues and create a more reliable railway operation. In recent times Network Rail has undertaken several junction grade separation schemes to improve capacity on busy express routes such as those on the East Coast Mainline at Doncaster North Chord, Hitchin, and Werrington (nr. Peterborough).

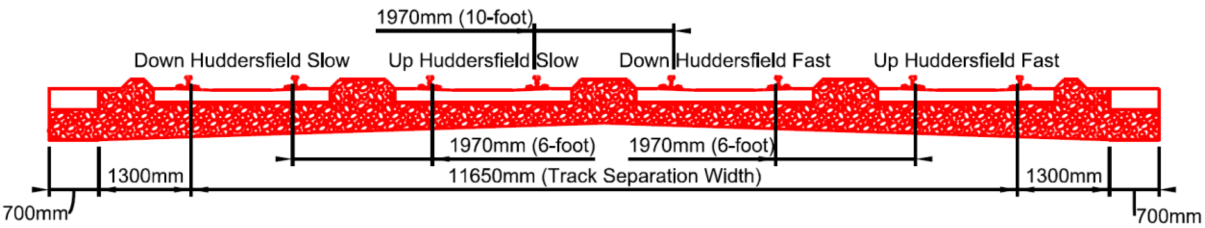
3.1.40 A typical 4-track railway corridor with slow lines on one side and fast lines on the other is a shown in the diagram below. The advantage over the more optimum arrangement above, is the narrower corridor requirements due to the need for one “10-Foot” to separate the slow and fast lines. The “10-Foot” gives sufficient space to create a safe position to work with necessary fenced separation or an emergency position of safety for track workers in a line open “red zone” situation. The overall corridor width required is now approximately 16.8m with preferred cess width provision, which can reduce to 16.5m with a safe walking route on one side.

Figure 3-6: Slow, Slow, Fast, Fast, 4-track cross-section



Where space and available land was limited, some of the historical 4-tracking schemes were constructed with minimum separation between all lines (i.e., all track intervals were placed at "6-Foot" centres). This is shown in the diagram below. From an operational perspective this is workable, however, from a maintenance viewpoint it is unsafe and can be very limiting if equipment needs to be accessed within the track footprint. This type of cross section is not recommended in modern practise although it is acceptable to consider reduced "10-Foot" dimensions within defined limitations as described in Table 1 above. This cross section shows a reduced corridor width of about 15.6m, which could reduce to 15.3m with a safe walking route on one side, or even down to about 14.5m with minimum lateral clearances and restricted access.

Figure 3-7: Reduced 4-track cross-section (with all lines at minimum centres)



3.1.41 On the Huddersfield to Ravensthorpe 4-track section, I considered all the above scenarios in the selection of the best fit operational layout. The route section between Huddersfield and Bradley Junction is particularly narrow in parts, with the historic formation being generally formed of 4-tracks at "6-Foot" intervals. (This can be validated against the historic dimensions between overbridge abutments being 50 feet or about 15.2m). Consequently, a great deal of consideration and design development underpins the chosen track geometry within this area to minimise unnecessary 3rd party land and property impacts. Conversely, the section of line between Heaton Lodge Junction and Thornhill Junction was historically built to what we now consider modern mainline standards, and the corridor can support a 4-track cross-section with a standard "10-Foot" interval, therefore the 4-track re-instatement within this section is relatively straightforward.

Operational Layout, Alternatives Considered

3.1.42 Referring to the SoC Appendix B Section B.5, five basic operational layouts of slow and fast lines were considered during the option identification process. Following an option sifting process, two viable layouts were taken forward for detailed development during GRIP3. These were:

- **Operational Layout 1** – Fast lines are positioned to the south side of the 4-track corridor between Huddersfield and Ravensthorpe. It requires a new grade separation at Ravensthorpe to pass the new fast lines either over or under the existing Wakefield lines where they diverge at Thornhill LNW Junction.
- **Operational Layout 5** – The fast lines run along the south of the 4-track corridor between Huddersfield station and Heaton Lodge. At Heaton Lodge the fast lines are taken either over or under the Calder Valley lines by a new grade separation. The fast lines are then positioned on the north side of the 4-track corridor through the Mirfield and Ravensthorpe areas.

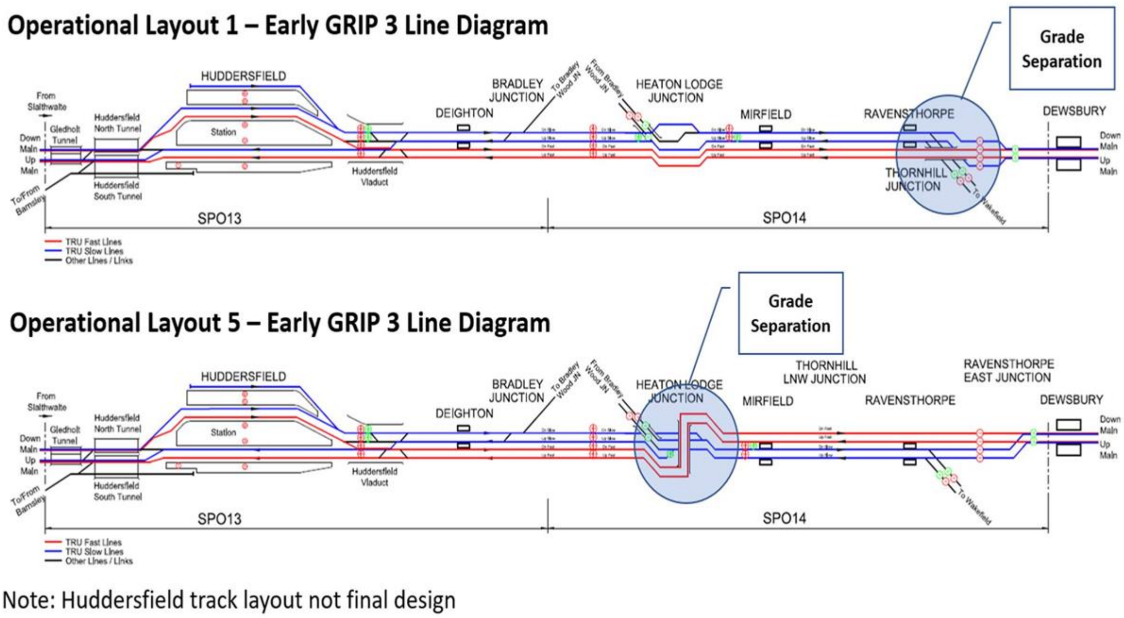
3.1.43 The main criteria favouring the two above options were:

- These layouts are the only ones which require a single grade separation along the route section whilst maintaining the desired capability of a 100mph (or better) continuous linespeed throughout.
- Fast lines to the South side of the corridor were considered as the only viable option between Huddersfield and Heaton Lodge Junction to avoid grade separating Bradley Junction (or having an undesirable flat junction across the fast lines). Grade separation at Bradley was studied and ruled out as non-feasible from both an engineering and a land/property perspective.

Location of Grade Separation

3.1.44 From the above study of the fast and slow line operational layouts, the only two viable locations to construct a vertical grade separation were in the vicinity of Ravensthorpe (Thornhill LNW Junction) for Operational Layout 1 or at Heaton Lodge Junction for Operational Layout 5. These operational layouts and location of Grade Separation are shown in the line diagrams below.

Figure 3-8: GRIP3 Operational Layout Alternatives



3.1.45 As described in the SoC Section 6, both these Operational Layouts were studied extensively through GRIP3. Schemes were developed in both locations for Flyover and Diveunder solutions and using a variety of linespeeds from 100mph to 110mph and track geometries which complied with “normal” or “exceptional” design values.

Grade Separation, Alternatives Considered

3.1.46 With the two viable grade separation sites identified, four alternative layouts were studied in the early (interim) GRIP 3 phase with minor sub-variants defined using “normal” or “exceptional” track design standards for curved alignments as described in previous sections.

3.1.47 For Operational Layout 1, with a grade separation at Thornhill LNW Junction Ravensthorpe, design development undertaken throughout GRIP 3 showed that it was viable to engineer either a Flyover (sub-option 1A) or Dive-under (sub-option 1B) solution using a broadly similar plan layout with the new fast lines passing over or under the diverging Wakefield lines at Thornhill LNW Junction.

Figure 3-9: Operational Layout 1, Flyover (1A) and Dive-under (1B) Visualisations

3.1.48 For Operational Layout 5, with a grade separation at Heaton Lodge, design development early in GRIP 3 at the option sifting stage showed that a Dive-under solution (sub-option 5B) was not viable. This was primarily due to inherent ground risk issues due to high ground water levels and potential for flooding, but also sub-surfaces clashes with the existing Dive-under grade separation at Cooper Bridge and several high-pressure gas mains passing through the area. Consequently, the option selection concentrated on developing a Flyover grade separation at this site (sub-option 5A).

Figure 3-10: Operational Layout 5A, Flyover Visualisations

3.1.49 All three sub-option layouts were developed to a similar level of detail through GRIP3 to enable a like for like option comparison. After detailed evaluation the two Ravensthorpe Options (1A and 1B) were taken forward and the Heaton Lodge option (5A) was deferred. The main reasons for preferring the Ravensthorpe location for the grade separation was:

- It concentrated the main civil engineering works including new embankments and flyover structures into a single location, which was more readily accessible for construction, and avoided significant detrimental impacts in the Battyeford area.
- Brownfield non-developable land is available in a largely industrial setting at Ravensthorpe. This is ideally situated at the convergence of the existing NTPR and Wakefield railway lines, as well as being crossed by an existing major electric grid supply. This land can be put to good use by the Scheme to construct grade-separation works completely off-

line from the existing railway (thereby minimising disruption during construction), and to house an electricity sub-station to provide power for the proposed overhead electrification of the railway.

- The Scheme produces significant quantities of earthworks cut and fill, the balance of which varied depending on the operational layout chosen. Operational layout 1 with a grade separation at Ravensthorpe presented the best opportunity to balance cut and fill operations across the project.
- Operational Layout 1 is the more economical of the two end to end layouts considered, for the above reasons and because it reduces the amount of railway that must be re-constructed on-line. It is safer and simpler to stage for construction leading to a shorter overall schedule for completion of the works and entry into service.
- There were also significant railway operational benefits created by the Ravensthorpe grade separation option, due to the beneficial layout of railway junctions it affords. Junction layouts and operation are covered in detail in the following sub-section.

3.1.50 Development of Option 1A and cross comparison with Option1B continued into the early part of GRIP 4 including a further detailed review of both schemes to make a final option selection. The final selection of Option 1A, a Flyover grade separation, was arrived at for three key reasons:

- The Flyover option had the lowest overall capital and operational cost leading to a significantly lower whole life cost.
- The Flyover option had the shortest overall schedule duration leading to the earliest possible entry into service date.
- The Flyover option when compared against the Dive-under option had a broadly comparable third-party impact.

3.1.51 In my response to objections in Section 4, I have expanded in detail on the option selection process that has taken place to present the preferred option for the grade separation.

Junction Layouts and Operation

3.1.52 A critical factor in determining the best operational layout and engineering impact of options was the effects at each junction location.

Huddersfield Station

3.1.53 Refer to a later section on Huddersfield Station, which describes the platform and track layouts considered, including junctions.

Bradley Junction

3.1.54 At the early GRIP3 option sift stage, any layout options that required a grade separation at Bradley were discounted due to engineering feasibility. Consequently, the only options studied from Huddersfield to Heaton Lodge always positioned the new separated fast lines to the South side of the existing track corridor. This left the operation of Bradley Junction largely unaltered. However, the final 4-track option requires a slight re-alignment of the junction, which has been used to the benefit of the project to allow higher junction speeds and increased capacity for future operations. See arrangement Drawing 1 in Appendix 1, which shows the existing and proposed track layouts for Bradley Junction.

Heaton Lodge Junction

3.1.55 For both alternative operational layouts considered there were some amendments to Heaton lodge Junction required:

- Operational Layout 1 requires a minor re-working of the junction by de-commissioning the Up-loop switch alongside commissioning the new fast line alignments constructed to the south side. In this option most work at Heaton Lodge is carried out off-line with relatively minor changes to existing infrastructure, thereby allowing trains to operate on the NTPR and Calder Valley routes with minimum disturbance during construction. See arrangement drawing 2 in Appendix 1, which shows the new fast lines and section of decommissioned track described above.
- Operational Layout 5 would require a re-modelling of the existing Huddersfield Down chord to enable the construction of the new embankment and flyover for the grade separation. This would require substantial civil engineering works within a difficult to access railway corridor. This work would require additional line possessions or blockades to carry out, and therefore some additional disruption will occur for this option compared to Layout Option 1. In addition, a substantial embankment and flyover structure required would need to be constructed over all operational lines with further associated disruption. See arrangement drawing 3 in Appendix 1, which shows the works as described above.

Mirfield East Junction

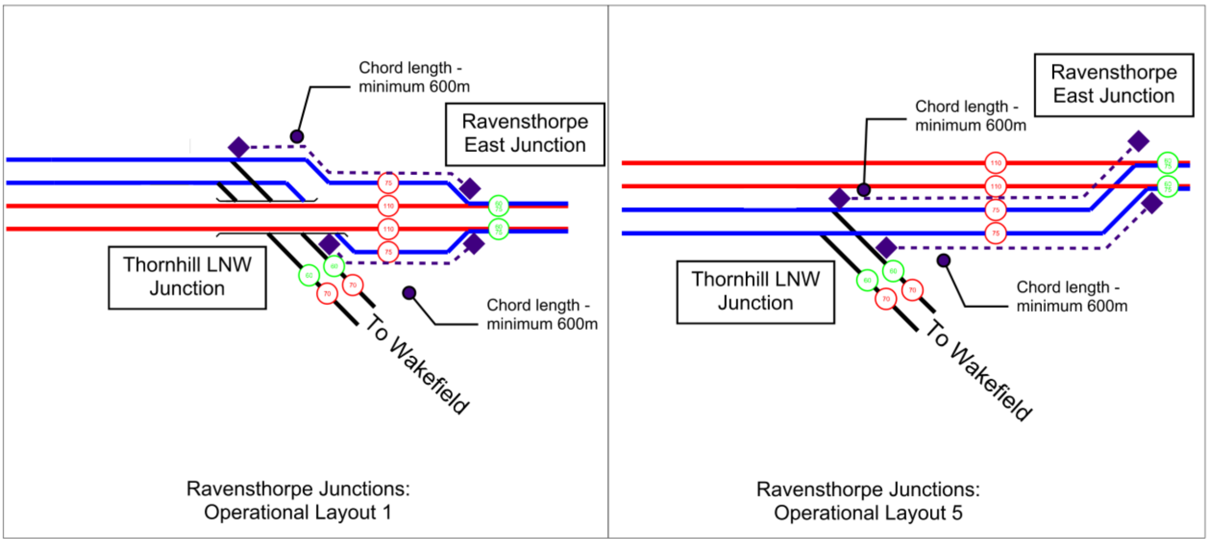
3.1.56 In all options Mirfield East Junction (between Mirfield Station and Thornhill LNW Junction) is no longer required by the proposed operational layout and is to be decommissioned.

Thornhill LNW Junction (Existing) & Ravensthorpe East Junction (New)

3.1.57 For all operational layouts the configuration of the new Ravensthorpe East junction (subsequently renamed Baker Junction) is a critical element of the scheme. This is where the existing 2-track railway from Leeds splits into separated slow and fast lines. The slow line chords then subsequently junction at-grade with the existing route from Wakefield.

3.1.58 Whilst the fast lines are grade separated the slow lines still join the Wakefield lines with an at-grade junction. To generate the required system capacity and regulation of trains, an important operational feature is that slow line chords are required between the proposed Ravensthorpe East Junction and a re-modelled Thornhill LNW Junction. In simple terms, this is a piece of plain line in-between the junctions where trains, if required, can lay over “pause” whilst awaiting a clear signalled path. Without these chord lines the new junction would not function as required, due to slow trains becoming stationary on the preceding 2-track section from Leeds whilst waiting at a clearing signal. At this location slow trains are being quickly “caught” by the next timetabled fast service (see previous commentary), therefore a layout without a regulating chord would severely inhibit capacity and associated performance of the system. See illustration sketches below showing how chord lines are arranged for the different operational layouts.

Figure 3-11: Ravensthorpe Area Junctions, illustrative slow line chord layouts



3.1.59 Whether the Fast line grade separation is positioned at Heaton Lodge (as in operational layout 1) or Ravensthorpe (as in operational layout 5), this capability to regulate trains via chord lines is still required in the Ravensthorpe area where the NTPR and Wakefield routes converge. In the specific case of our Scheme, the only practical area where this type of layout can be arranged is across the River Calder valley adjacent to the existing River Calder and Hebble & Calder Navigation Viaducts (MDL1/16 and MDL1/18). This basic operational principle was established at GRIP2 and included within all subsequent capacity modelling. This operational feature has therefore been a key part of the GRIP3 option development, as it drove the need for significant railway works at Ravensthorpe whatever option was selected.

3.1.60 There are many practical challenges in defining the slow line chord lengths and geometry required, however, in simple terms for Capacity and Performance the longer the chord the better. From an operational perspective, the most advantageous solution would be to extend the 4-tracking from Ravensthorpe into Dewsbury station, with the chords effectively beginning where slow trains pull into the station. However, the operational modelling carried out in GRIP2, showed that this is not required to achieve the required capacity to run the remitted ITSS, extended 4-tracking into Dewsbury has therefore not been considered as part of the GRIP3 Scheme development. However, I understand that any future enhancement project to achieve more capacity on the TRU route would need to consider such a feature.

3.1.61 At GRIP2 it is understood that the slow-line chords were initially sized to accommodate possible future freight train lengths of up to 750m. In practise, there are no current plans to operate such long train formations over the Leeds route (in normal service), and as part of the GRIP3 development I proposed that the minimum the chord lengths under consideration should be sufficient to stable a 200m long passenger services (in accordance with the ITSS) exiting or joining the through main line. For a 200m long train, considering signalling and track geometry factors, it was established that the chords needed to be an absolute minimum overall length of about 600m was required to provide safe separation of trains. In addition to establishing the minimum chord lengths, the following principles were used to generate the junction and linking chord geometries at Ravensthorpe:

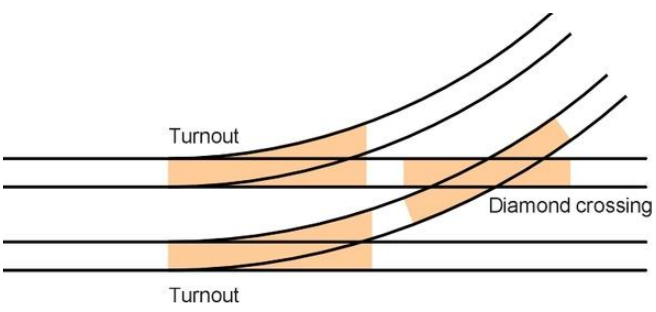
- All slow line routes through junction switches and crossings (S&C) and adjoining chords should enable 70mph running. This allows trains to run as close as practicable to the existing 75mph linespeeds utilising standard S&C track components for ease and speed of future maintenance.
- The through route for TRU fast trains is proposed at 100mph (or more) to exploit the most efficient and cost-effective line speed capability of the 4-track route section to the west of Thornhill LNW junction (towards Mirfield and Huddersfield).

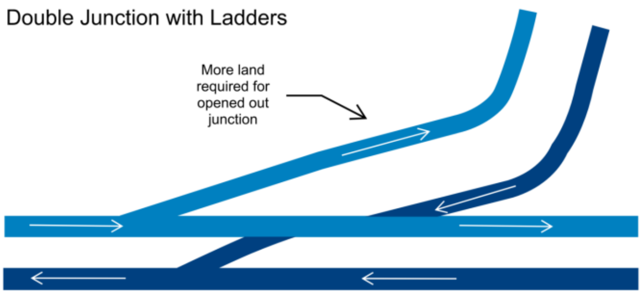
- Critical S&C track components should remain clear of underline bridge/viaduct structures to minimise faults due to vertical deflection, twist, and temperature movements. In practical terms, with consideration of stabling chord lengths, this limits the position of the new Ravensthorpe East Junction to the east side of any proposed viaduct and/or embankment over the River Calder flood plain.
- Junction S&C components should be where reasonably practicable located on straight track at a constant gradient and where joining tracks are vertically coincident.

3.1.62 **Operational Layout 5** would require the fast lines to be separated from the slows and arrive at the North side of the railway corridor through the Ravensthorpe Area as shown in Figure 3-11 above (fast lines in red). This would require a 70mph left-hand “double” junction diverge off the main line for the slows at the new Ravensthorpe East junction. A second double junction layout would also be required at a re-modelled Thornhill LNW Junction to the west side of Ravensthorpe station, which would be re-constructed to a different alignment, but largely in the same location as the existing junction site.

3.1.63 Classic “double” junctions need careful design and are generally avoided on the modern railway, if there is space to construct an alternative opened out junction arrangement. To understand the issues, terminology and design considerations when considering double junction layouts refer to Table 2 below.

Table 3-2: Railway “Double” Junctions

Railway Double Junctions, terminology, and design considerations	
A double junction is formed from two parallel turnouts (or switches) with a diamond crossing. This is a non-preferred arrangement for maintenance due to the proximity of all the S&C components, high wear rates on diamond crossings, and associated difficulty presented in lifting and tamping during maintenance cycles	
At shallow crossing angles required for higher-speed junctions, the diamond crossing requires switch rails (moving parts) to close the large gaps	

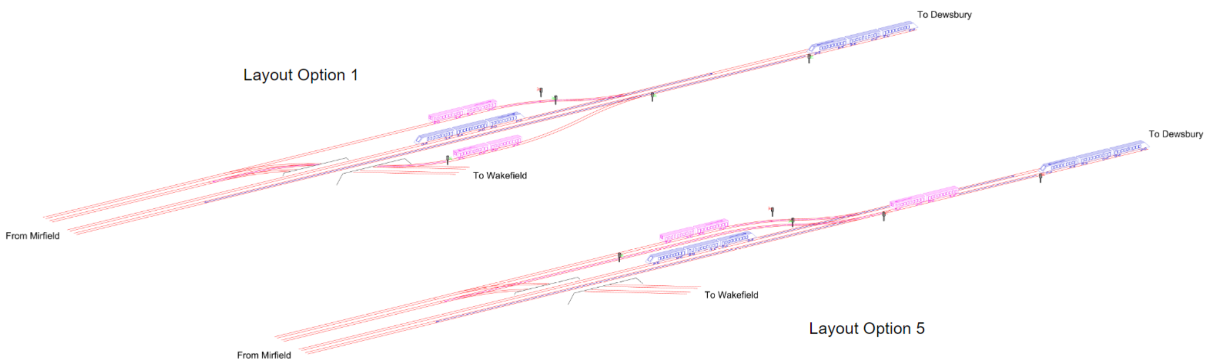
between the crossing rails. These types of "switch-diamond" assemblies are complex and require frequent maintenance. They are a source of regular failures across the rail network and therefore are a non-preferred component	
Where space allows, a preferred arrangement is a double junction formed with turnouts and crossovers (or ladder). This eliminates "switch-diamonds" for high-speed shallow geometries and therefore reduces maintenance. This junction is sometimes referred to as a "opened out" double junction	

3.1.64 **Operational Layout 1** enables a different approach to be taken where the fast lines can be positioned to fall between the slow line link chords due to the grade separation at Thornhill LNW Junction. This has several major advantages over operational layout 5:

- By splitting the slow lines either side of the through fast lines at Ravensthorpe East Junction the one remaining train service conflict in the overall fast line operation between Huddersfield and Ravensthorpe is removed, since the junction diamond crossing is not required.
- The operational safety of Ravensthorpe East Junction is improved as the "head on" collision risk across a double junction with a diamond crossing is removed. This is an important consideration as this will be a high-speed section of railway with through train speeds of 100mph or more.
- The Ravensthorpe East Junction track components are simplified with two identical 70mph turnouts and no "switch-diamond" crossing. Therefore, maintenance is much reduced and operational reliability increased. It is again worth noting that high speed junctions with "switch-diamond" crossings are a source of major delays on the Network Rail Network due to component failure as explained in Table 2 above.

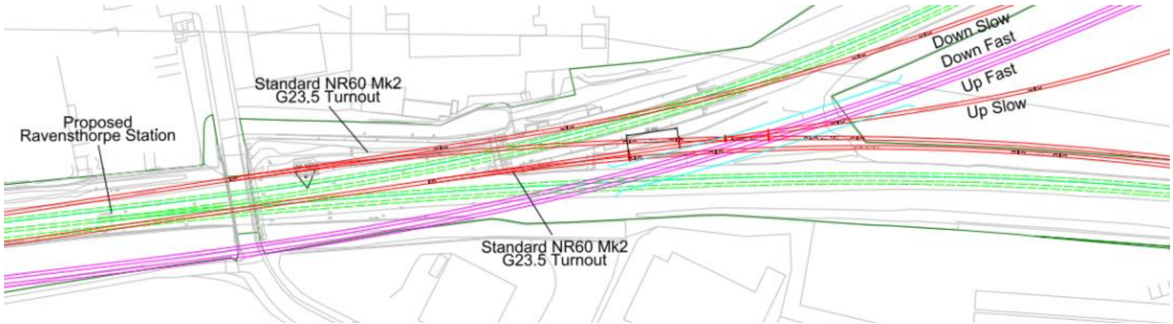
- In effect a double grade separation occurs at Thornhill LNW Junction where the Down Slow chord passes under (or over) the same grade separation structure as its junctions with the Wakefield lines.

Figure 3-12: Ravensthorpe, comparison of junction operation



3.1.65 The line diagram in Figure 3-11 indicates the requirement for a RH double junction at a re-modelled Thornhill LNW Junction. For operational layout 1, the geometry of the grade separation allowed for an opened-out junction layout to be accommodated. Although this retains a “switch-diamond” crossing, all the S&C track components have been standardised and spread apart to allow for a much-simplified and safer maintenance regime, whereby individual switch assemblies can be lifted and tamped separately. See layout in Appendix 1 and summary Figure 3-13.

Figure 3-13: Re-modelled Thornhill LNW Junction, opened out S&C layout



<u>Huddersfield Station Platform & Track Layout</u>

Summary Operational Requirements

3.1.66 The following considerations, to be satisfied by the design at Huddersfield Station, have been summarised in response to the DfT operational targets, the remitted ITSS and the wider Client’s requirements. These are to ensure that with forecast increases in passenger numbers, operational reliability and resilience could be met:

- 4-tracking between Huddersfield and Dewsbury requires re-modelling of the permanent way alignments entering the station from the East.
- To Improve operation resilience additional train regulation needs to be provided by suitable junction arrangement on both station approaches.
- Leeds facing bay platform(s) need to accommodate parked/terminating trains without interfering with the operation of the through routes.
- Increased line speeds through (and accelerating out of) platforms are required to support the capacity required by the ITSS and modelled timetable. Increased speed is particularly important for freight services in the Up direction to ascend the steep 1:100 incline towards Manchester.
- Full overhead electrification with passive (or active) provision to extend beyond Huddersfield.
- To accommodate forecast passenger numbers & the proposed future train fleet at Huddersfield Station, and to improve flexibility at the station, all platforms (other than the Penistone Line) are to have a minimum operational length of 200m.
- Retention of the Penistone Line and extension of its platform to a minimum operational length of 75m.

Alternative Operational & Platform Layouts

3.1.67 The SoC Appendix B Section B 5.1.2 onwards describes the high-level option selection and development process through to GRIP stages 3 and 4. The key operational alternatives studied during the early GRIP3 option identification phase included:

- A 3-through platform layout like the existing station with extended platform lengths to the Leeds side of the station including the existing bay platforms extending back into the existing island platform.
- A 4-through platform layout retaining the existing Leeds facing bays with platform lengthening generally towards the Leeds side of the station.
- A 4-through platform layout with existing Leeds facing centre bays infilled and replaced with long new bay platform provided to the northwest side of the station.

3.1.68 All these basic layouts were subject to operation modelling by Network Rail within the overall TRU RAILSYS model to test their effect on the output performance of the whole TRU network. This was in combination with various layouts of S&C forming new junction arrangements at either side of the station, which allow sorting of trains into the platform tracks.

3.1.69 As an outcome of operational modelling and further development of the ITSS through GRIP3, it was determined that a 4-through platform layout was vital to achieving the capacity outputs and the overall performance/resilience of the system especially when operating under perturbed conditions. Of the 4-through platform options modelled, the option with the new northwest bay platform was preferred as it gave the greatest geometric flexibility for developing the track and platform layouts within the site constraints. This layout became the basis of all further development options studied.

Junction Layouts

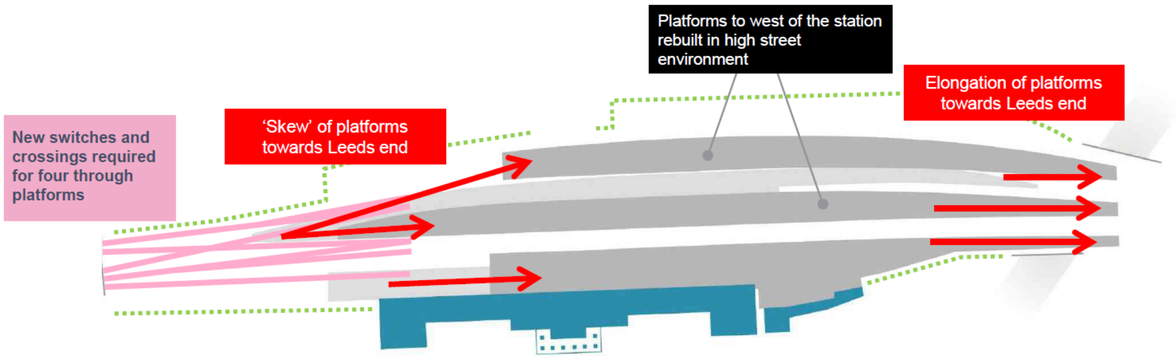
3.1.70 The platform layout at Huddersfield requires train regulation in both the Manchester and Leeds directions to support the proposed ITSS and modelled timetable. This results in sections of complex S&C track geometry. In addition, these areas of complex trackwork, are spatially constrained by the Huddersfield Tunnels and Westgate Overbridge (at the Manchester end of the station) and the Grade II listed Huddersfield Viaducts (at the Leeds end of the station). These hard physical constraints have driven the development of the station platform layouts.

3.1.71 The preferred junction option at the Huddersfield West Junction incorporates a standard fixed diamond crossing. This diamond crossing was a key feature of the RAILSYS operational modelling undertaken during the option assessment of the layout options at Huddersfield. Although not preferred from a track maintenance perspective, this feature was established as a critical piece of infrastructure to achieve the capacity required to run the remitted ITSS and achieve the performance requirements.

3.1.72 This diamond crossing allows flexible train regulation around the re-configured island platform (re-numbered platforms 3 and 4). In the event of services becoming delayed en-route to Huddersfield, the track layout gives the operational ability to quickly re-route fast or slow trains either side of the island platform with minimum disruption to passengers (i.e., passengers would only have to swap platform faces on the island).

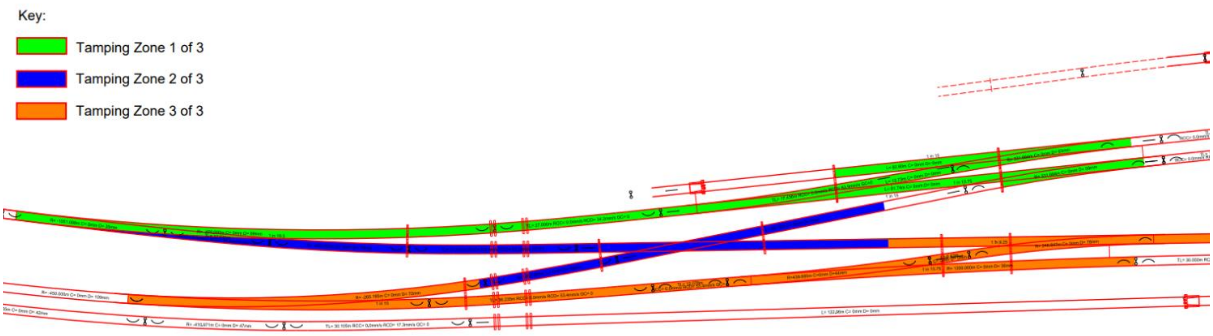
3.1.73 To provide this operational layout with a fixed diamond crossing, this resulted in the station platform arrangement moving in the Leeds direction as shown in the diagram below. This created sufficient space to enable the use of standard track components and maintainable geometry for the S&C.

Figure 3-14: Huddersfield Station, platforms extended towards Leeds



3.1.74 As the diamond is a non-preferred track component requiring regular maintenance, extensive operational studies including maintenance tamping arrangements were carried out at GRIP3 to verify the design.

Figure 3-15: Huddersfield West Junction, Maintenance Tamping Layout

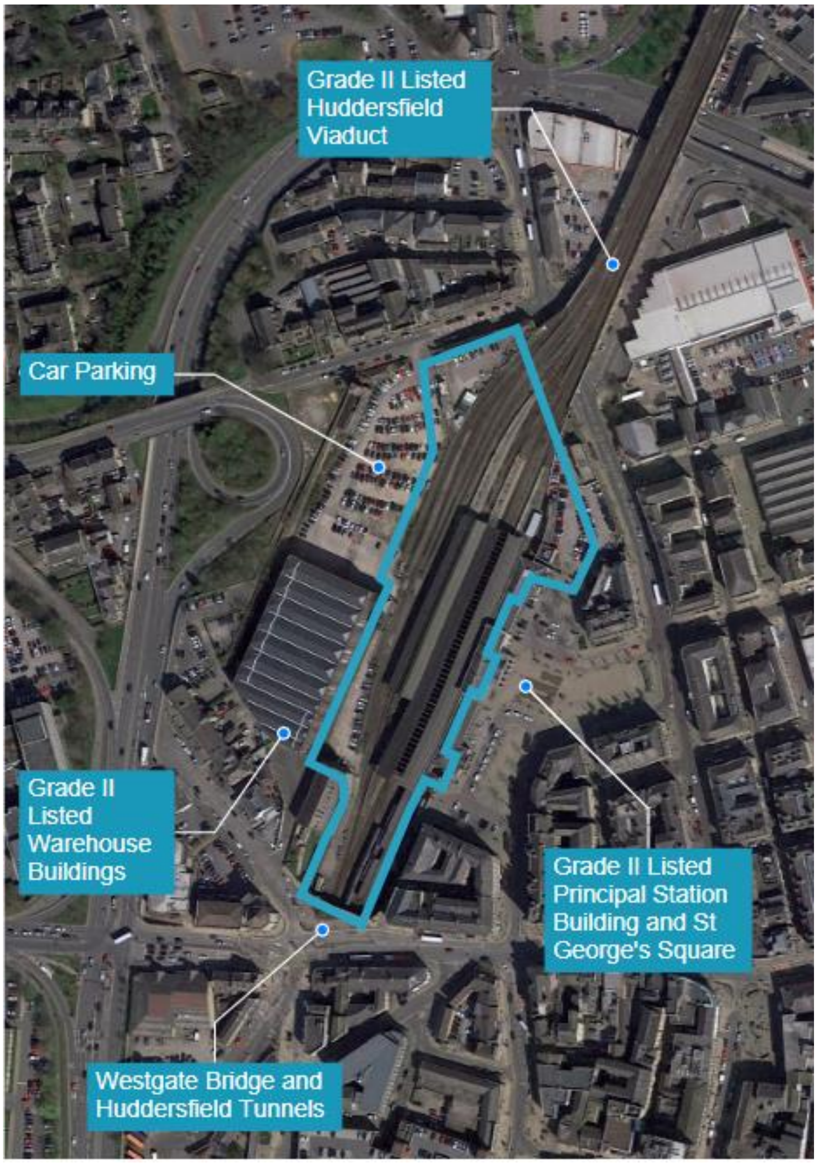


3.1.75 With the focus of the station platforms moving the Leeds side of the station, this has resulted in the Huddersfield East Junction being spread out over the length of the Huddersfield Viaduct. Again, this has been a complex exercise to provide a maintainable and operationally resilient layout whilst reducing the impacts to the grade II listed viaduct structure. This has included arranging OLE portals at regular intervals to coincide with masonry arch pier positions and avoiding placing S&C units over long-span metallic decks.

Development of the Proposal

3.1.76 The remodelling of Huddersfield station and provision of 4-through platforms and 2 turn-back platforms within its existing site location is extremely challenging. The tracks and station are constrained on all four 4 sides by existing physical features described below. These features provide a fixed geometry in which to set out the station and associated track geometry required for efficient and resilient operation of the railway:

Figure 3-16: Huddersfield Station, Land and Property Constraints



- South (Manchester platform end): The position and portal width of Westgate Bridge and Huddersfield tunnel. Modifying the bridge & tunnel portal to create additional width for the tracks would result in very significant disturbance to the Westgate highway above and directly impact on many surrounding properties and a mains sewer. This option was discounted in favour of retaining this infrastructure as existing.
- West: The two Grade II listed warehouse buildings, car parking, and a Network Rail Maintenance Depot. These boundaries are fixed and were treated as such for design purposes, and the adjacent areas are fully utilised. The warehouse buildings have windowed facades overlooking the station. The new area of station roof has been designed to provide platform cover whilst minimising obstruction to the views from the windows, and to enhance the view through the station to and from the large warehouse building façade.

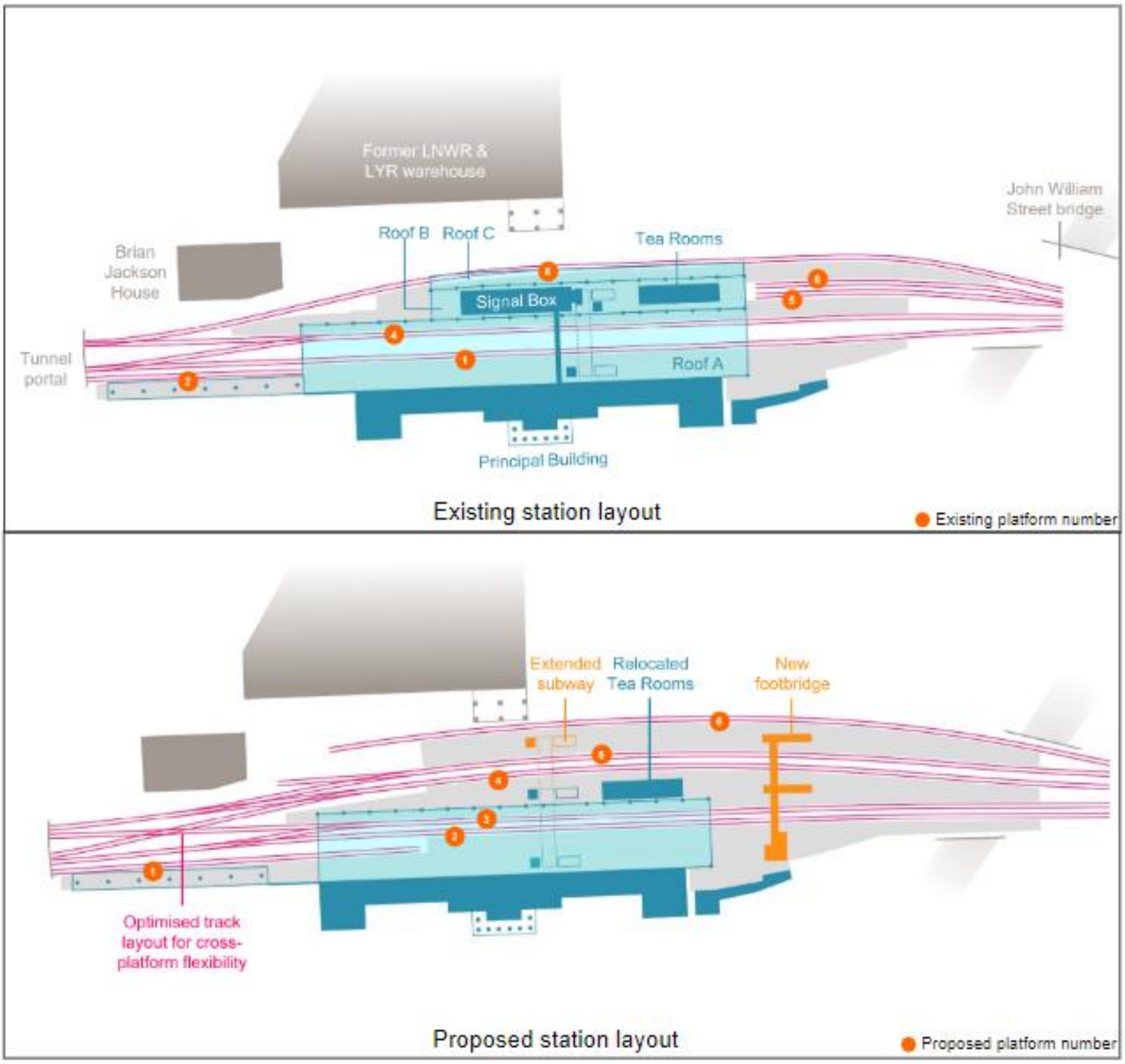
- North (Leeds platform end): The Grade II listed Huddersfield Viaduct structure. The viaduct has a fixed width, with adjacent highways and buildings placing limitations on widening options without causing significant disturbance.
- East: The existing Grade I listed station building. No significant work is allowed or planned for the station building.

3.1.77 Having established the 4-platform option with the northwest bay platform as the preferred operational concept. The developed station layout and construction strategy concluded that Platform 4 (re-numbered Platform 3) should generally remain near its existing alignment, and Platform 1 (re-numbered Platform 2) should be widened to support the western track arrangement. This maintained the current track alignment through Westgate Bridge and Huddersfield Tunnels and enabled delivery of the junction S&C layouts explained above.

3.1.78 The station construction sequence is based around retaining the existing platform 4 face in its existing location and repositioning all the other platforms to suit. Two approximate 30-day rail blockades are planned during consecutive Easter periods during which the station will be closed. Within the first blockade the existing platform 1 face is moved westwards to close the large wideway between tracks. Then existing platforms 1 & 4 are extended towards Leeds to provide in the final configuration 200m long operational lengths, and the existing platforms 5, 6, and 8 are removed. This allows for a construction site to be set up between the back of existing platform 4 and the western boundary.

3.1.79 The operation layout and the decision to align platform positions (described above), in turn dictated the relationship of the new operational railway with the existing station roof. The roof structure is part of the listed building and as such extensive optioneering work was undertaken to explore the impacts of different operational layouts to the roof structures. The selected option requires the removal of the existing smaller trainshed and associated canopy. The movement of platforms in the Leeds direction, alongside the installation of the junction at the Manchester end of the station also results in the loss of 1 bay of the large trainshed. I defer to the Evidence provided by Katie Rees-Gill with respect to the Heritage impacts of the preferred design.

Figure 3-17: Huddersfield platform layout



3.1.80 The Tea Room at the station is location on the existing island platform. The Tea Room is part of the station Grade I listing, and its location on the island platform is part of its Heritage significance. Maintaining the face of the existing platform 4 enables the Tea Room to be retained on the island platform. This would not be possible if the face of platform 1 was retained.

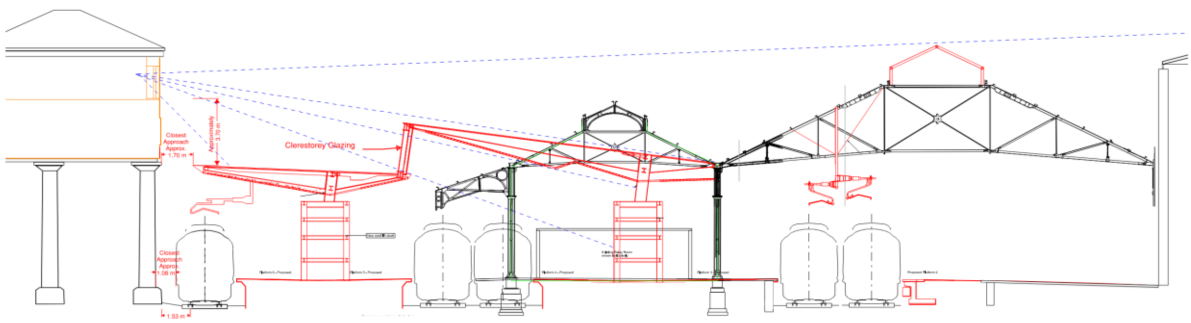
3.1.81 Having established that existing track 4 (proposed re-numbered track 3) must remain where it is, the layout of proposed new tracks 4, 5, and 6 are dictated by minimum platform edge clearances, adjacent track centres, and stair/lift access widths. The resultant geometry positions track 6 very close to the alignment of the current siding which runs adjacent to the Goods Lift. It is not possible to position track 6 any further from the Goods Lift than it is currently proposed.

3.1.82 The additional over-run track and buffer stop at the Manchester end of Platform 5 provides a safe route in the event of a train erroneously passing a red stop signal at the platform. This then allows simultaneous train movements to occur with trains from the Manchester direction into Platform 4 and from Leeds into Platform 5. Loss of this provision would severely reduce the operational capacity and performance reliability of the station and wider TRU route.

3.1.83 Having established the need to remove the smaller trainshed and associated canopy. The height of the two proposed canopy roof areas is governed by the height of the subway lift shaft, the height of the existing Tea Rooms, and the clearance to HV OLE cabling which passes below them. The roof heights have been minimised based on the required maintenance clearance to lift shaft / Tea Rooms, and EM clearance from HV OLE cables to adjacent ferrous elements.

3.1.84 The canted vertical façade linking the two roofs is a fully glazed clerestory, permitting views to & from the platforms and the warehouse building. The angle of the larger roof has been adjusted to minimise the visual impact of that roof from the Goods Lift windows. These measures have been taken to respect the amenities of any future warehouse occupants.

Figure 3-18: Section through Huddersfield Station



Section Through Existing (black) and Proposed (red) Huddersfield Station
Showing Closest Approach to Goods Lift Structure (Northern CI Column)

Note: Existing structures shown in (black), and proposed structures shown in (red)

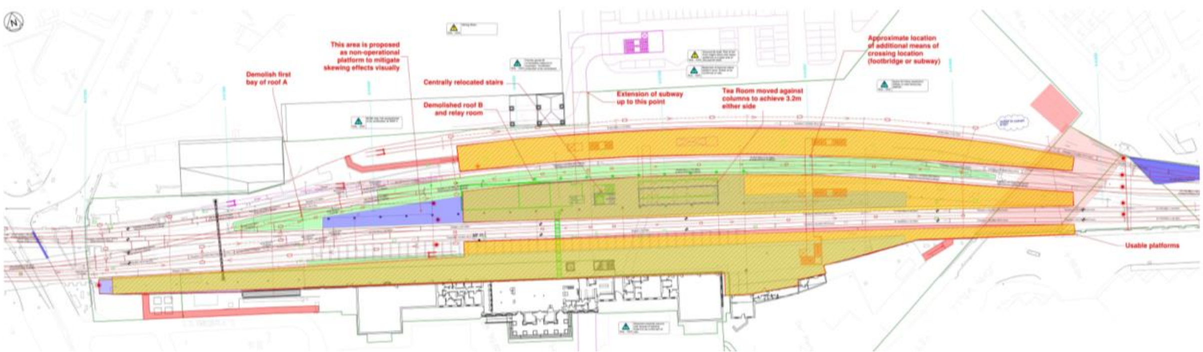
Summary of Option Development

3.1.85 Within the option development a great deal of care has been taken to respect the Grade I listing of the station fabric and to limit effects on neighbouring land, property and other transport networks whilst delivering the operational requirements of the scheme. Within the geometric development of the design several key strategic decisions define the overall layout:

- The station construction sequence is based around retaining the existing platform 4 (re-numbered platform 3) face in its existing location as described above and repositioning all the other platforms to suit. This chose construction sequence enables works are undertaken in two approximate 30-day rail blockades.
- Moving the focus of the station towards Leeds creates sufficient space at the Manchester end of the station to create a new junction layout without the need to re-construct Westgate Bridge (this re-construction was a feature of earlier GRIP2 designs).
- The movement of all through platforms towards Leeds and provision of a new Leeds facing bay platform to the northwest of the site has developed the geometry that allows the existing short Penistone Bay platform to be extended to a minimum operational length of 75m. (with passive provision to lengthen up to 100m).
- Between the rail blockades (approximately one year), Huddersfield station can operate as a 2-through platform layout with the Penistone Bay platform also operational. A temporary platform is then provided at Hillhouse to provide local terminating connections to/from Huddersfield towards the north.
- The above blockade and platform strategy allows for the majority of Huddersfield station to be built off-line in a safe site environment and brought into use immediately following the second blockade period. This arrangement minimises the length and duration of disturbance to the travelling public and brings the new enhanced station facilities into use as quickly as possible.

3.1.86 The option development of the 4-through platform station layout is extensively described within the Huddersfield Station Design and Access Statement **(NR15A),** and the reader is directed towards that document for further information. The final GRIP3 layout is as shown below, and I understand that this design has received a letter of support from Heritage England, a key stakeholder who were consulted throughout the development of the design.

Figure 3-19: Huddersfield Station preferred GRIP3 option layout



Alternatives Summary

3.1.87 In the preceding section I have conveyed the essential thinking behind the overall scheme layout presented in the TWA submission. In summary the key alternatives considered, and decision making was as follows:

Operation & Disruption

3.1.88 A full range of alternative layouts for the separated fast and slow lines were considered including their effects on existing junctions and train operations both during construction and in future use. It was concluded that constructing fast lines to the South side of the existing rail corridor (Operational Layout option 1) was the best layout for the following reasons:

- Bradley Junction remains as existing (although re-modelled to a higher speed geometry) and Heaton Lodge Junction only requires minor modifications. It therefore has least impact on the existing network during construction and gives future capacity/operational benefits both at Bradley junction and at the re-modelled Thornhill LNW Junction (including Ravensthorpe Station described below).
- The proposed grade separation at Ravensthorpe removes any conflicting train movements from the fast line operation by effectively providing a "double" grade separation where the Up Slow chord passes under the grade separation flyover at the remodelled Thornhill LNW Junction. This removes a diamond crossing conflict point on a high-speed section of railway improving operational safety and reducing maintenance.
- The re-modelled layout at Ravensthorpe allows a replacement station to be built to the west of Thornhill LNW Junction. This gives much greater operational flexibility with stopping trains able to use the station in all directions as well as providing a useful interchange facility.
- The re-modelling scheme preferred at Huddersfield Station is independent of the choice between operational layouts 1 and 5. The main differentiator was the decision to favour a 4-through platform layout. This was a result of significant operational modelling, which demonstrated that options retaining a 3-through platform layout (as close to existing as possible) would not deliver the required capacity or performance in accordance with the remitted ITSS.

Engineering & Construction

3.1.89 An important and very practical consideration during the option selection process, was "how do I build this". The chosen preferred option plus many of the sub-option selections within, were guided by the need to build this new railway whilst, as far as reasonably possible, keeping the existing railway operational. In addition to this, selected options also took cognisance of programme, safety, and minimising disturbance to railway neighbours during and after construction. Mike Pedley in his Construction Methodology evidence will expand on a number of these points. Some key points from a design perspective included:

- Operational Layout 1 maximises the amount of new railway that can be built off-line and minimises changes to existing railway infrastructure. Once the existing slow lines in the Huddersfield to Deighton corridor are slewed to their final alignment, much of the new fast line construction can be safely built off-line or during short possession windows (where tie-ins are required).
- By providing a grade separation at Ravensthorpe much of the heavy civil engineering work is then concentrated in the Ravensthorpe area negating the need for major additional viaduct work in the Heaton Lodge/Battyeford area. Ravensthorpe was identified as the best site for such construction, being less rural, easier to access and having less severe environmental impacts. A large areas of non-developable brownfield land (the "Ravensthorpe Triangle" between operational railways) is put to good use to help balance the cut/fill operations across the Scheme and for location of a traction power feeder site near to suitable existing HV electricity supply lines.

Capital Cost and Sustainable use of Existing Infrastructure

3.1.90 Capital cost was a key consideration as it supports the business case for the Scheme. However, from an option selection perspective, whilst an important consideration, cost has rarely been the sole differentiator amongst the very wide range of selection criteria that were evaluated.

3.1.91 In an a few isolated cases such as the sub-option selections for the John William Street Bridge re-construction, Deighton Station re-construction, and the A62 Leeds Road highway re-alignment, the Scheme has chosen to use a less cost-effective solution to limit impacts on local businesses, residents, highway users and other third parties.

3.1.92 However, once all factors have been accounted for including items such as railway operational performance, constructability, sustainable use of existing infrastructure, minimising disruptive railway access and overall schedule to completion, I am confident that the preferred Scheme represents the best value for money solution to satisfy the core TRU remit of providing Capacity, Journey Time Improvements, and Performance. A few key items to note are:

- The chosen operational layout with fast lines to the south of the 4-track corridor maximises the re-use of the existing permanent way infrastructure. Between Bradley Junction and Ravensthorpe, the existing slow lines are largely unaffected by the new works and do not require large-scale renewals (including formation re-construction), since TRU will decrease the traffic tonnage on these lines.

- The chosen "end to end" operational layout is less expensive than other options considered due to previous factors outlined above; the reduced amount of track renewals required; the consolidation of major civil engineering works into the one site at Ravensthorpe; and the ability to better balance cut/fill and minimise offsite disposal of excavated materials or import of embankment fill.

Planning Policy and Adjacent Development

3.1.93 Refer to Section 3.4 of my evidence for further commentary around the Schemes effect on local development proposals. In summary, as part of the option selection the following items were important considerations:

- The grade separation works at Ravensthorpe, whilst selected as part of the preferred operational railway layout for the Scheme, I understand that they can also be coordinated to complement a major proposed development at "Dewsbury Riverside", which is Scheme being separately promoted as part of the Kirklees Local Area Plan.
- The re-modelling of Huddersfield Station has been designed and future-proofed to allow for adjacent 3rd party development proposals to the western side of the station to proceed un-hindered (specifically proposals for a new station gateway). In addition, the chosen geometric layout of tracks and platforms future-proofs the ability to add an additional east facing bay platform (platform 7) should it be required as part of a future capacity or train service enhancement.

Environmental and Heritage Impacts

3.1.94 For detailed Evidence with respect to Environmental and Heritage matters, refer to Proofs provided by Jim Pearson and Katie Rees-Gill. With respect to choosing between design alternatives, the following items were particularly important.

- The main environmental impact between the alternative operational layouts considered, is the effect in the Heaton Lodge/Battyeford Area. The operational layout 5 Scheme included a major grade separation viaduct and embankments, which would have had a dominating impact on many private dwellings in Battyeford and surrounding rural vistas. There would also have been considerable visual, noise and physical disturbance to nearby properties and surrounding countryside during construction, due to the very constrained site location and difficult access conditions for construction plant and materials.
- The preferred Scheme, operational layout 1, removes much of the works from the Battyeford area and concentrates them at Ravensthorpe. The new fast line alignment at the Heaton Lodge corner is recessed into the

landscape and therefore hidden from view with minimal disturbance to local residences in Battyeford both during construction and operation. This reduced impact was balanced against the need to take some additional farmland and three private dwellings (former railway cottages) for the new fast line alignment, which cuts the Heaton Lodge corner. The alternative alignments considered at Heaton Lodge corner are discussed in the SoC Appendix B Section B.5.23.

- The main heritage impact is at the grade I listed Huddersfield Station and both main alternatives considered would have had a similar outcome, therefore this was not a differentiating factor when selecting the overall operation layout.

3.2 Impacts on Local Businesses, Tenants and Occupiers

3.2.1 Impacts on neighbouring property and land were a prime consideration in the development of the preferred option. There are many locations along the route where the option selection was informed by consideration of such impacts, and I will summarise the critical ones in the following section, including some of those where we have received objections to the proposed Scheme.

<u>Huddersfield Station</u>

3.2.2 The design has been developed as far as it is reasonably possible so that the permanent works are contained within the current Network Rail operational land boundaries. This includes provision for future proofing of an additional Platform 7 and the works to future proof a subway linkage to St Georges Quarter. The current access to the Brian Jackson House, the St Georges Warehouse and adjacent car parking is not altered in the permanent design. Therefore, effects will be largely limited to construction access for which I defer to the Evidence of Mike Pedley in his Construction Methodology Proof.

3.2.3 Brian Jackson House is located to the west of the operational station and its eastern facade faces onto current Network Rail operational land. In conjunction with the electrification works, an OLE portal (foundation & steel column) is required within proximity of the building. This portal was placed here after other options had been discounted due to insufficient clearance with train operations and other physical infrastructure limitations. To minimise disruption to the building, a standards derogation has been agreed with Network Rail to enable the OLE equipment to be positioned closer to the track, resulting in the OLE Portal being kept electrically clear of the building. This will allow the occupier to open and use existing windows. For further discussion also refer to my evidence in response to **OBJ 14** in section 4 of this document.

3.2.4 The goods lift of the HD1 building is located adjacent to, and in proximity of, the current railway sidings, see Figure 3-18. New station infrastructure will be placed on the site of the existing sidings. The design of the scheme adjacent to the HD1 building has been developed to remain within the current operational footprint. The proximity of the goods lift building results in the requirement to undertake earthing and bonding on that element of the structure. In summary there is limited intervention to the building in the permanent case. For further discussion also refer to my evidence in response to OBJ 23 in section 4 of this document.

3.2.5 The Platform 1 charity is located within the station curtilage and accessed from St George's Square. The design has made provision for the platform charity's building to remain in-situ. This has involved development of the emergency escape route from the Penistone Line platforms to pass around the charity, and careful location of OLE portals to avoid the charity building. Therefore, effects will be largely limited to construction access, which is also covered in the Construction Methodology Proof.

3.2.6 In the permanent case retail offerings on the existing platform 1 and within the station building can be reinstated. As previously described in the alternative option development section, the existing Grade I listed Tea Room structure has been retained on the island platform. The requirement to move the building slightly to achieve compliant platform widths and clearances presented the opportunity to turn the Tea Room building through 180 degrees. This results in the retail element of the Tea Room facing the staircase from the pedestrian subway and is therefore an enhancement to the current situation where the retail facility is remote from the natural footfall routes.

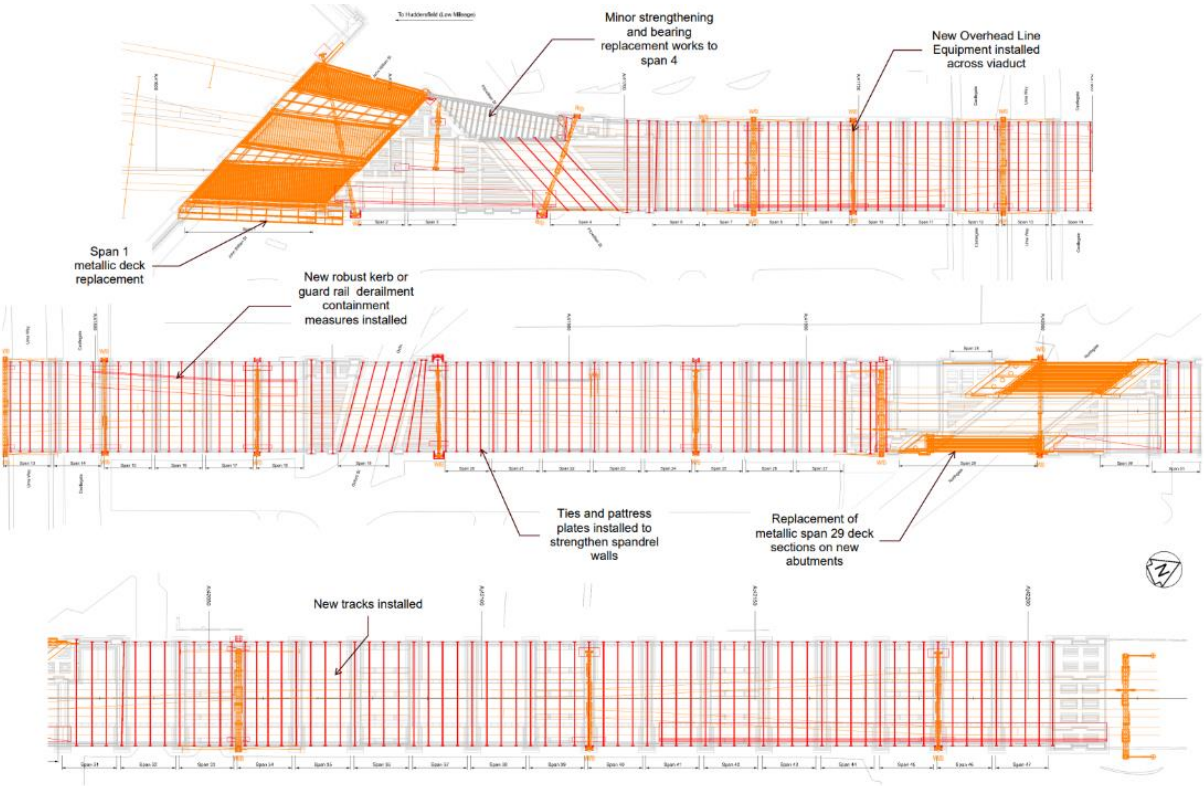
<u>Huddersfield Viaduct</u>

3.2.7 The re-modelling of the track layout within and around Huddersfield Station combined with the lengthening of platforms to obtain 200m operational lengths (as described in section 3.1), inevitably impacts the footprint of Huddersfield Viaduct, which immediately abuts the Leeds end of the station throat.

3.2.8 The Scheme as presented has been intensively developed to minimise the intervention at Huddersfield Viaduct, however due to the significant physical site and geometric constraints some major works are necessary. The works that particularly affect local businesses, tenants and occupiers are:

- Re-construction of John William Street Bridge which forms span 1 of Huddersfield Viaduct
- Strengthening of Fitzwilliam Street Bridge which forms span 4 of Huddersfield Viaduct
- Spandrel Wall/Parapet strengthening along the length of the viaduct including the attachment of Overhead Line Electrification (OLE) gantries and posts.

Figure 3-20: Overview of Huddersfield Viaduct works



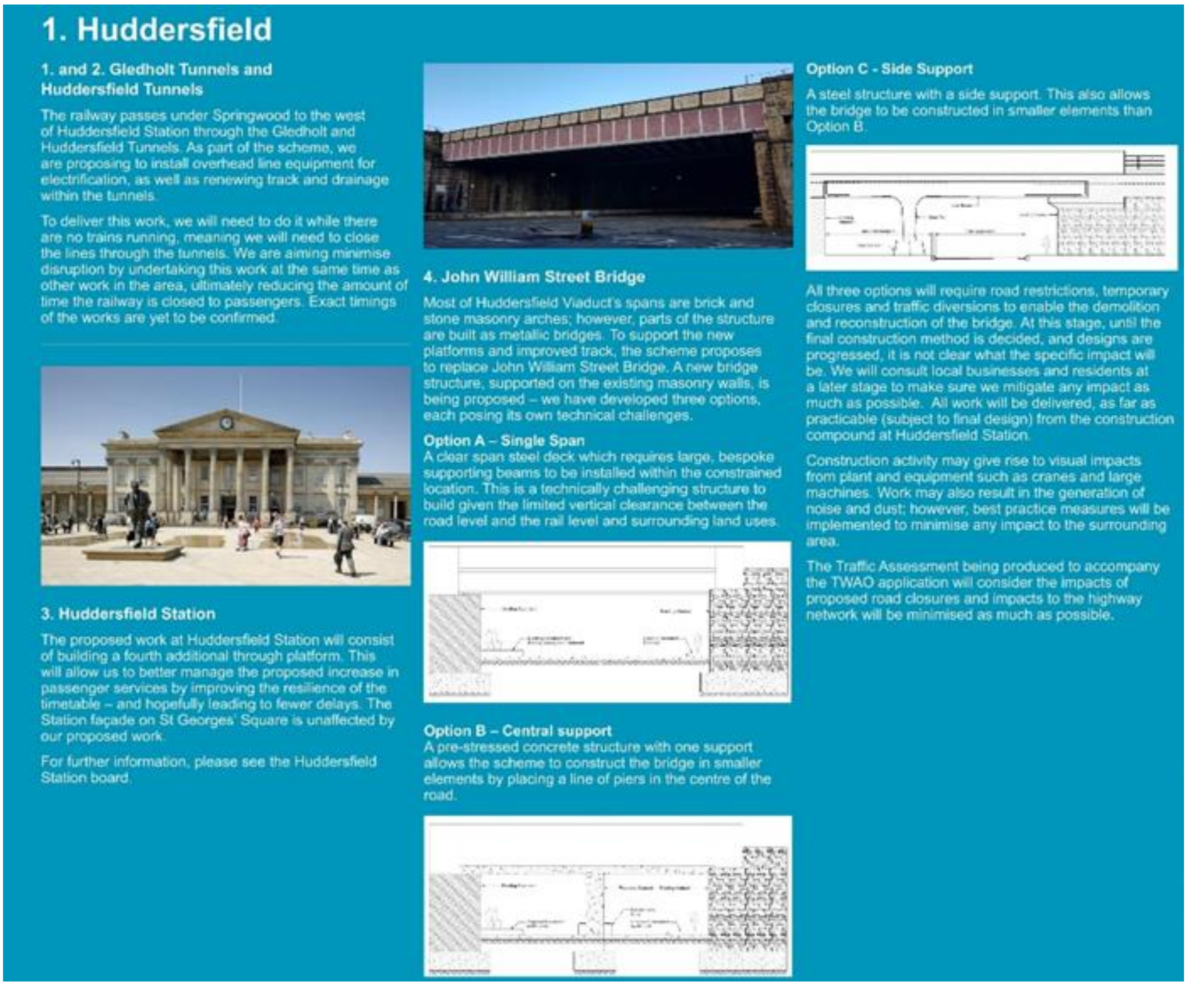
John William Street Bridge

3.2.9 The existing bridge is formed of three interlinked steel superstructures (decks) with girders that protrude above track level. The re-modelled track alignments clash with these girders and additional load capacity is required to carry platforms and increased ballast depths (existing sub-standard ballast depths are sub-standard). Therefore, the whole bridge deck requires replacement in a form that can accommodate the new track geometries and platforms.

3.2.10 The design of the replacement deck is being undertaken so that it can be installed in prefabricated components within a short timeframe. The demolition of the existing deck and erection of the new deck will take place within one or both main Huddersfield Station blockade periods. It is likely that works within these railway blockades will disturb the highway below for between one and two weeks, and during these periods we will work with the local highway authority to design suitable alternative diversion routes and facilitate access to businesses for sales/deliveries as far as it is reasonably practicable.

3.2.11 Alternative designs were considered for the bridge including a 2-span structure, which although more cost effective and simpler for the railway, would have had a more severe impact on the highway and resultant disturbance to local businesses. This was included in the stakeholder and public consultation, and a preference to maintain the existing clear span was noted and subsequently adopted as the preferred option.

Figure 3-21: John William Street Design Alternatives, Public Consultation Information



3.2.12 The longer platforms required at Huddersfield Station has meant that the new re-numbered platform 2 extends over the bridge, cantilevering over the highway. This requires some additional structural support on the northeast abutment corner, which limits headroom over the footway below. This requires some re-alignment of the existing highway kerb lines and installation of vehicle protection measures, which potentially impact the goods delivery entrance of a nearby supermarket. The highway works have therefore been designed to maintain delivery vehicle turning movements into the Supermarket, thereby mitigating effects to temporary disruption during construction. However, the design of this structure is being reviewed to address the headroom limitation which may negate the need for the highway works. This is subject to ongoing discussions with Kirklees Council.

Fitzwilliam Street Bridge

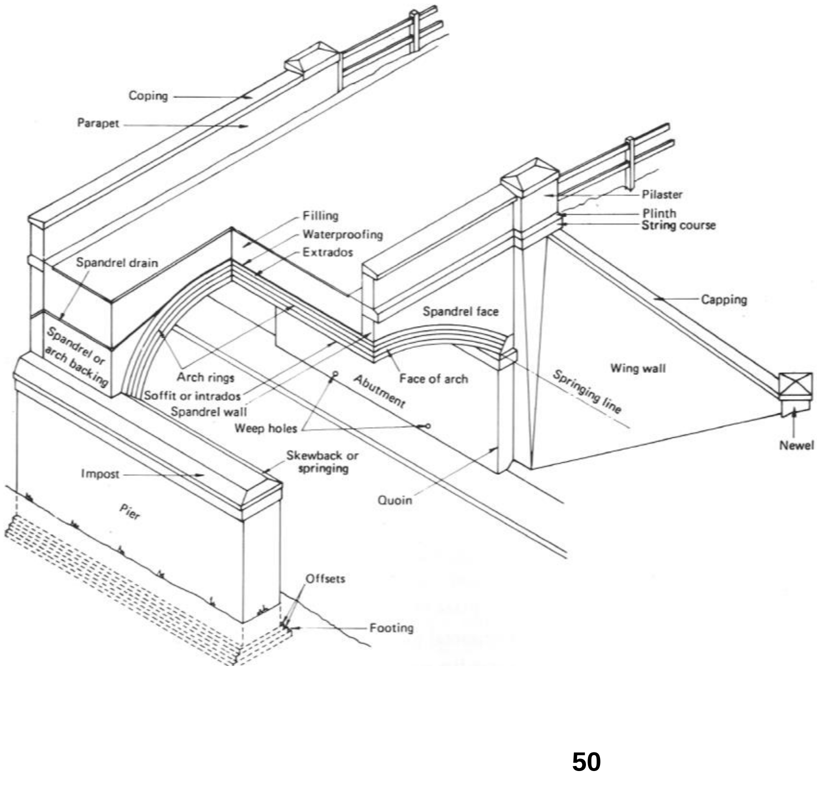
3.2.13 Works are required to strengthen some of existing steelwork components of Fitzwilliam Street Bridge. This is necessary due to re-alignment of track across the viaduct from the new platform 6, and to remedy some long-standing structural defects to the northeast corner of the existing bridge abutment.

3.2.14 These works will require access under the bridge deck and around the northeast abutment corner. This will affect the public highway as well as the access from the Castlegate Retail Park. The design will be developed to limit, as far as reasonably practical, the scale and duration of the works required. This will include advanced structural analysis techniques to minimise the steelwork strengthening and investigating construction methodologies so that some of the works may be carried out from above rather than impacting on the highway.

Spandrel/Parapet Strengthening and OLE Attachments

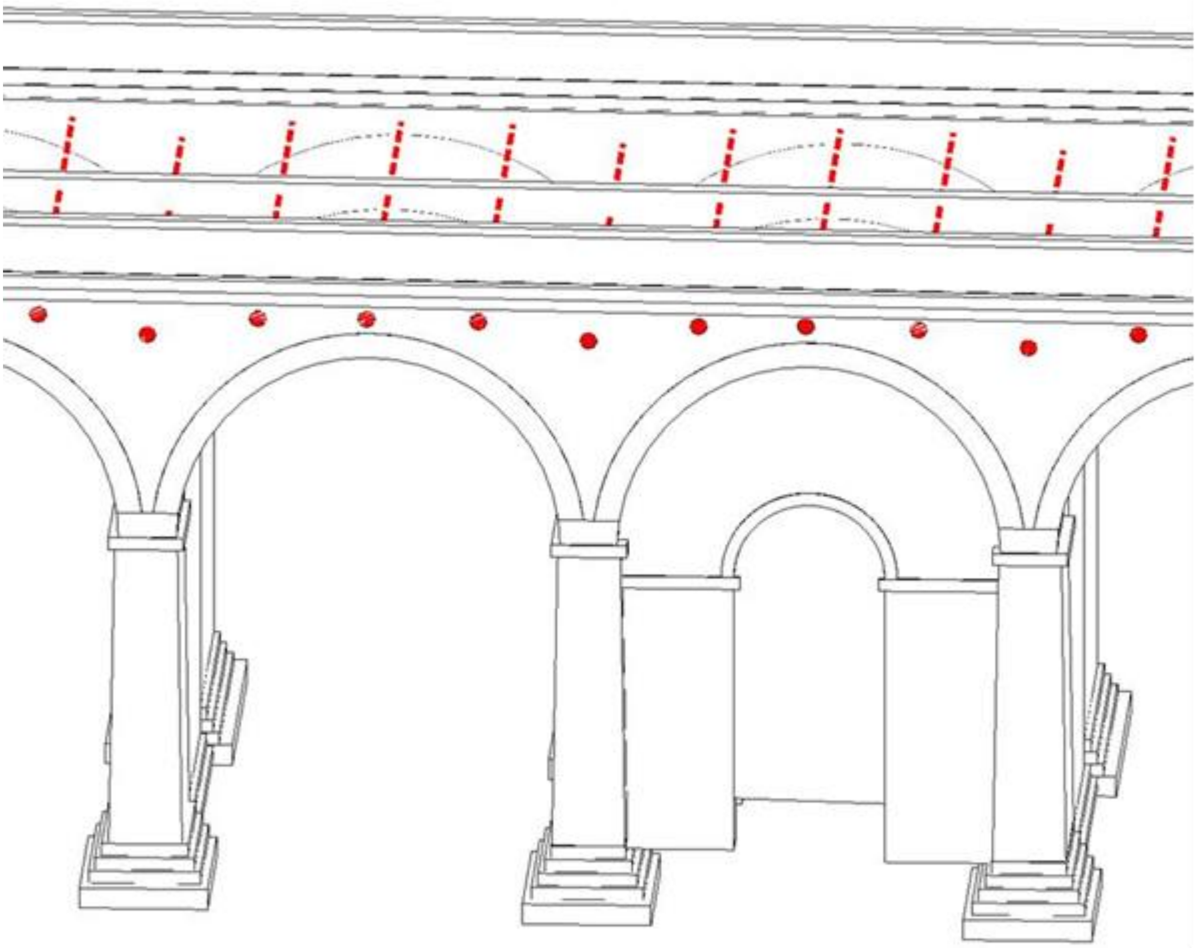
3.2.15 The re-introduction of 4-tracks across Huddersfield Viaduct (plus a short 5-track section at the station end) require works to edges of the viaduct. The new tracks will be much closer to the spandrel (arch side) walls thereby increasing loadings beyond the current situation. Structural assessment work has shown that these are understrength to modern standards.

Figure 3-22: Arch Structure Terminology



3.2.16 The strengthening works will generally be formed of tie-bars between adjacent walls and pattress plates fitted to the outside of the structure. At positions where OLE masts are to be attached; large concrete footings will be cast on the internal side of the viaduct walls with brackets then subsequently fixed through from the outside.

Figure 3-23: Huddersfield Viaduct, Spandrel wall strengthening with tie bars & pattress plates



3.2.17 The works have been designed so that are able to be carried out as far as reasonably practical from within the viaduct footprint or from equipment mounted on top of the viaduct. However, there will be occasions when some access is required from below to erect scaffold, deliver materials and equipment or other protective measures for the works above.

3.2.18 From a permanent works perspective effects have been minimised as far as reasonably practicable. However, there are some effects caused by temporary construction access, which cannot be fully mitigated. These effects are covered in the construction Methodology Proof.

Emerald Street Embankment

3.2.19 Emerald Street is a public highway located to the South side of an existing tall embankment, which carries the railway off the east end of Huddersfield Viaduct. The highway primarily provides access to a large re-cycling and recovery facility operated by SUEZ on behalf of Kirklees council. It also provides access to several other commercial/industrial properties.

3.2.20 The Scheme re-introduces 4-tracking through this area with new fast lines being constructed along the crest of the embankment as well as foundations for steel portal structures to carry the OLE equipment. The existing slope is very steep and has been assessed as being potentially unstable once the new tracks have been installed. It therefore requires strengthening to assure it long term performance and overall stability.

3.2.21 The preferred method of strengthening is by inserting a grid of soil nails over the face of the embankment. This is an established technique, which has been used extensively over the rail network, as a reliable and economic way to stabilise steep embankment or cutting slopes. The method involves drilling and inserting long steel rods or “nails” from the face of the slope and tensioning them to mobilise the soil mass within the embankment core behind any assessed failure plane.

Figure 3-24: Soil nailing, concept visualisation and installation example

3.2.22 There will be no permanent effects from the works, however, during construction the works will require soil nailing equipment, operatives, and machinery to access the embankment slope from Emerald Street and therefore may cause temporary disruption to the highway. These temporary effects are covered in Mike Pedley’s Construction Methodology evidence.

Deighton to Bradley Corridor

3.2.23 This part of the route is very constrained as it's a narrow curvaceous corridor fringed by existing private properties, retail, and industrial businesses. The SoC Appendix B section B5.20 describes the challenges within this route section and the design works undertaken to mitigate impacts to lineside neighbours. The potential impacts and design mitigations are as follows:

Deighton Station

3.2.24 Replacing Deighton Station at or near to its existing site is very challenging due to it being sited in a steep cutting overlooked by residential properties. During the option selection the existing site plus several alternative sites were studied to arrive at the optimum solution.

3.2.25 The conclusion of the option selection was that Deighton station could be retained very close to its existing location. The SoC Appendix B Section B.6.21 describes the work undertaken. There was always a residual concern with the existing site location that impacts on properties could not be fully mitigated and consequently one alternative site to the west of the existing station was also included in the public consultation exercise to test the preference for either a station move or to support the reconstruction at the existing site.

3.2.26 The feedback obtained from consultation favoured the existing station siting, however it echoed concerns about potential property acquisition. Subsequently the Scheme design was extensively developed, and innovative engineering techniques were deployed including top-down construction of the bridgeworks and soil nailed retaining slopes to confidently establish that all existing properties could be retained. Therefore, the preferred solution is to retain Deighton Station at its existing location and the engineering required to retain the existing properties is shown in the visualisation below.

Figure 3-25: Visualisation of the Proposed Deighton Station

A62 Leeds Road

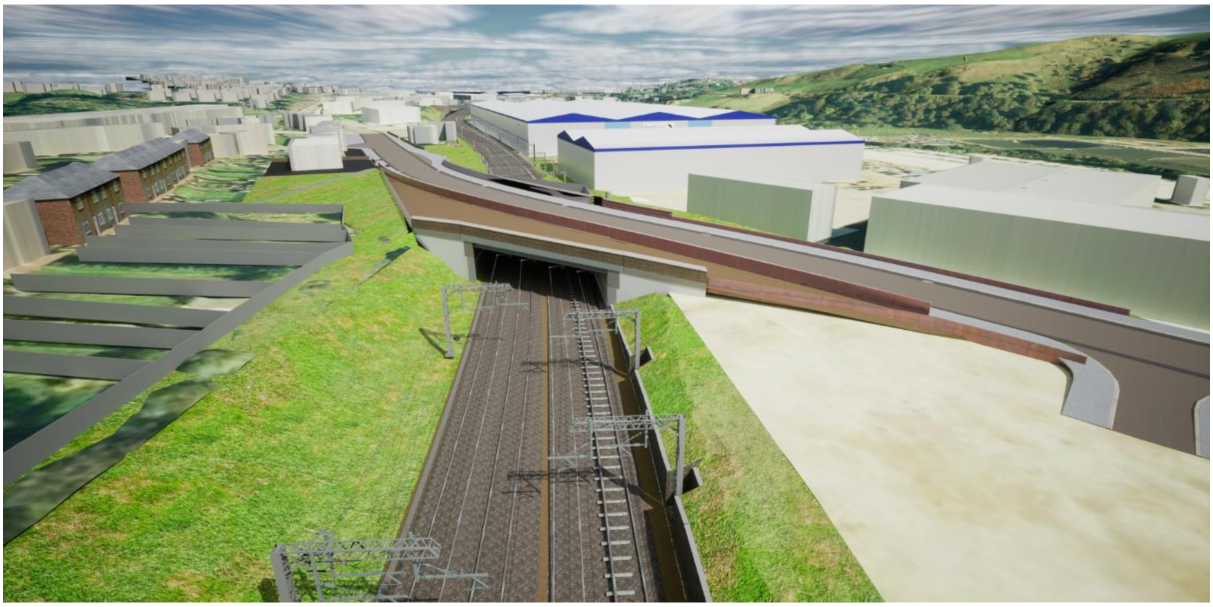
3.2.27 The A62 is a heavy trafficked and critical urban highway route joining Huddersfield town centre with the urban conurbations to the east and the M62 motorway. Many iterations of design rail alignments were trialled through this structure, but the plan geometry of the existing abutments and low existing headroom, which impedes overhead electrification, has resulted in the need to largely re-construct this bridge.

3.2.28 The solution proposed for the A62 bridge re-construction in combination with the narrow, constrained corridor to the east is the result of a lengthy and extremely complex design exercise. A prime consideration in the design development was the need to keep the A62 highway always open, except for very short periods when tie-in operations are required. This is to ensure that businesses and residents in the local as well as the wider Huddersfield area are as far as reasonably possible unaffected by the works.

3.2.29 This has been achieved by designing a temporary highway alignment to the northern side of the existing bridge and providing a bridge structure which can be built in two-halves to suit the staging of the works. For further information the reader should refer to the planning drawings submitted with the Order (NR13, specifically 9 No. drawings titled A62 Leeds Road Bridge MVL3-102), which show the temporary and permanent arrangements as well as the tie-ins to adjacent properties and land boundaries.

3.2.30 To facilitate the construction, parts of the existing bridge abutments and walls are retained within the new bridge, and the railway alignment below has been adjusted to provide the narrowest possible cross-section with all tracks placed at “6-Foot” centres. The visualisation of the bridge below depicts the widened structure to provide the temporary highway alignment and narrowed railway tracks leading towards the industrial properties beyond.

Figure 3-26: Visualisation of A62 Leeds Road Bridge



3.2.31 I defer to our Highways Expert Witness, Chris Williams, who will describe the development of the highway design in this location in his Evidence. He will also respond to specific objections from the local highway authority (Kirklees) in his Proof.

“Buy it Direct” and Volkswagen Gap

3.2.32 The visualisation in Figure 3-26 shows the very narrow corridor between the existing Buy it Direct warehouse and the Volkswagen car dealership immediately to the east of the A62 Leeds Road. In the very early stages of design development at GRIP2, it seemed unlikely that a 4-track electrified railway could be fitted through the space available, without severely impacting one or more of these properties.

3.2.33 However, by careful design of the track alignment in combination with resolving the A62 Leeds Road Bridge, it has been possible to squeeze the rail infrastructure within the available space. This has led to several compromises by Network Rail particularly in respect to the narrowed track centres through this area (albeit only a short length affected) and the implications this has on access and maintenance of track, OLE equipment and signals. The design is within acceptable standards; however, additional measures have been incorporated within the design proposals to ensure this piece of railway is safe to operate and maintain.

3.2.34 I have included further discussion on this topic in my response to specific objections from neighbouring business, see Section 4 for my responses to **OBJ 09, OBJ 10** and **OBJ 13**.

B6118 Colne Bridge Road

3.2.35 The existing Colne Bridge Road overbridge, which is grade II listed, must be demolished and replaced by the Scheme to accommodate the 4-track electrified railway. The SoC Appendix B Section B.6.2.5 describes the design work undertaken for this bridge replacement and associated highway re-alignment.

3.2.36 A key component of the chosen design solution was the need to minimise disruption to the highway and nearby business premises. Various options for on-line and off-line construction were tested through public consultation. The preferred approach from consultation was an off-line scheme constructed to the east of the existing alignment. This was assessed as the best compromise between business/traffic disruption versus some short-term impacts to the Mamas and Papas warehouse to the northeast of the bridge site.

3.2.37 I defer to our Highways Expert Witness, Chris Williams, who will describe the development of the highway design in this location in his Evidence. He will also respond to specific objections from neighbouring businesses and the local highway authority (Kirklees) in his Proof.

Heaton Lodge Corner

3.2.38 The SoC Appendix B Section B.5.23 describes the design development that has taken place at Heaton Lodge and the preferred scheme to construct a new off-line 100mph track alignment, which cuts the existing tight radius corner that otherwise restricts linespeeds through that area.

3.2.39 The preferred option was the result of intensive design development and testing of several alternatives to achieve the best balance between the overall strategic business case objectives for the railway and environmental impacts, including the compulsory purchase of land and property.

3.2.40 The Scheme submitted impacts on three residential properties, which lie just outside of the current Network Rail land boundary. These were former railway cottages built adjacent to historic coal sidings that are now removed.

All viable options studied for curved track alignments negatively impacted these cottages, and Network Rail therefore took an early decision to negotiate with the affected owners and purchase these properties in preference to compulsory acquisition through the Order. At the time of writing, I understand that two of the property purchases have been completed and the third is nearing completion.

<u>Calder Road Re-Alignment, Ravensthorpe</u>

3.2.41 The grade separation and associated works in the Ravensthorpe and Westtown area of Dewsbury require very significant civil engineering interventions. The large-scale nature of the works means that some disruption to the local area is unavoidable during construction as well as some permanent impacts. This section of my evidence plus following sections describes how the design has been developed and rationalised as far as reasonably possible to mitigate impacts.

3.2.42 The preferred Scheme for the grade separation is a Flyover option whereby the new fast lines rise vertically out of the existing (and widened) Ravensthorpe cutting to pass over the diverging lines towards Wakefield at Thornhill LNW junction. These works require the vertical and horizontal alignment of Calder Road, which is a well-used local highway link between Ravensthorpe town centre and Thornhill to the South.

3.2.43 All grade separation options studied in the Ravensthorpe area (the preferred Flyover option as well as the rejected Dive-under option) require the re-alignment of Calder Road and the off-line re-construction of the existing railway overbridge. The principal reasons for this are:

- The existing Calder Road Bridge provides approximately 4.4m vertical clearance to the railway. For overhead electrification, desirable minimum clearances are about 5.1m over plain line (however, these may be locally reduced depending on site factors e.g., structure type, maintenance restrictions, local contact wire heights, wire fixing arrangements, etc.). With Ravensthorpe station relocated near to Calder Road Bridge, the wire heights required through the platforms on the slow lines dictate headroom clearances of about 5.2m over the slow lines with reduced clearances potentially allowable on the fast lines as discussed above.
- The existing bridge (and adjacent pipe bridge) carry multiple utility connections include water, gas, electricity (low and high voltage), and telecoms including fibre optic cables. The diversion of these utilities is best carried out in an off-line replacement of the bridge to avoid multiple temporary utility diversions with associated cost and programme implications.

- The reconstruction of the bridge and associated highway and utility interfaces is complex with significant staging required to facilitate all works in the area. The overall programme for the highway and bridge re-construction is likely to span several years. If it were geometrically possible to construct back on-line, then a temporary off-line highway diversion would still be required to mitigate effects on local businesses and property owners during the construction period. This off-line diversion would have similar land and property impact as a permanent alignment.

Design Development and Optimisation

3.2.44 A substantial part of the design development carried out post GRIP3 (prior to TWAO submission) has concentrated on optimising the Calder Road works and minimising impacts on adjacent landowners, businesses as well as other stakeholders and interested parties. The key to this has been the rationalisation of the railway alignments and other associated works, which allow the Calder Road bridge to be re-built as close as reasonably possible to its original position, whilst maintaining the significant advantages of off-line construction.

3.2.45 To achieve this the slow line vertical alignments passing below the flyover structure have been designed to be as low as reasonably possible, and then the fast line vertical alignments passing over the same structure have been correspondingly optimised for them to remain as low as reasonably possible through the Calder Road area.

3.2.46 With respect to the design optimisations to the Slow Line track alignments, the Scheme proposed has:

- Lowered the diverging slow line alignment towards Wakefield, which passes beneath the flyover structure approximately 500mm below current levels, thereby lowering the critical intersection point that must be cleared by the fast lines. The achievable vertical alignment is limited by the tie-ins to the up and down slow lines chords extending from the new Baker Junction and achieving the track geometry required for the “switch-diamond” crossing within the structure, all within acceptable minimum rail standards.
- Combined parts of the remodelled Thornhill LNW junction switch and crossing arrangement (specifically the “switch-diamond” crossing) within the footprint of the intersection structure, and minimised the separation between track elements, such that the transverse span lengths of the structure above are as short as reasonably possible. The structural design of the flyover has correspondingly been compacted around this arrangement.

- Optimised the position of the OLE support equipment within the compacted structural arrangement for the Flyover. This equipment coincides with transverse beam locations, and associated wire heights within the track intersection have also been minimised to correspond with lowest acceptable standards.
- All tolerances have been minimised to a lowest practicable level consistent with the current design stage including construction tolerances, track placement and maintenance tolerances (vertically 50mm rather than the preferred 100mm), and electrification wire uplift and maintenance tolerances.

3.2.47 With respect to the design optimisations to the Fast Line track alignments the proposed Scheme has:

- Applied the steepest gradient permitted by Network Rail standards of 1 in 80 for the Down Fast line and exceeded the steepest gradient limit at 1 in 75 on the Up Fast line to accommodate the effects of cant (track super-elevation) and the relative levels between the adjacent lines.
- Projected the respective Down and Up gradients over the Flyover structure so that the peak elevation of the track is east of the structure. This achieves the vertical clearance at the key intersection point in the shortest and most efficient way as reasonably possible to optimise the Calder Road geometry to the west.
- Selected vertical curves to transition between rising and falling gradients at the tightest limit (and therefore shortest distance) permitted by the design standards.
- Positioned vertical curves that lead into the respective Down and Up gradients of 1 in 80 and 1 in 75 as far to the East as reasonably possible without them overlapping with the horizontal alignment transition curve geometry, and then taking this arrangement to the limit permitted by Network Rail Standards (for non-coincident vertical and horizontal alignment features). This study of coincident vertical and horizontal rail geometry (alongside all the other limiting geometry features) concluded that the minimum possible track gradient in this area was 1:75 as applied to the design of the Up Fast line.
- Optimised the position of the electrification support equipment and associated clearances at the Calder Road Bridge both for the fast lines and the slow lines (see previous text with respect to wire heights and location of Ravensthorpe Station platforms). This has resulted in minimum electrification clearances of 4.75m to the fast lines and 5.20m to the slow lines. It should be noted that the clearance to the fast lines has required a site-specific risk assessment in accordance with OLE design standards and is approximately 0.5m lower than normal desirable values for free running wire installations.
- Similarly, to the Slow Line exercise, tolerances have been minimised to a lowest practicable level consistent with the current design stage.

3.2.48 Within the design optimisation described above there are several significant compromises that have been accepted by both the operational divisions within Network Rail and by Train Operating Companies alike. These relate both to the application of minimum standards and acceptance of less-than-ideal maintenance arrangements.

3.2.49 With respect to application of standards, some of the track geometry developed falls into the "exceptional" category and has required substantial specialist technical advice to prove its viability. This includes computational analysis carried out by Huddersfield University to demonstrate:

- The performance of freight trains (that may use the fast line route) over the short steep gradients proposed, in combination with the signalling design and variability in weather conditions.
- The passenger comfort criteria (combination of acceleration and gravitational force effects) defined by standards are not exceeded for trains transiting the fast line alignment at maximum line speeds.

3.2.50 With respect to maintenance considerations, the proposed geometry of the re-modelled Thornhill LNW Junction has been subject to specialist wear rate modelling carried out by Network Rail technical services. In addition, there has been close consultation with the NR Route Engineering team to establish acceptable working practises and structural arrangements to allow efficient and safe maintenance of the "switch-diamond" crossing enclosed by the proposed Flyover structure.

3.2.51 Following on from the optimisation of the railway alignment there has been significant design development of the Calder Road highway itself to challenge the physical site constraints and highway design standards. The design development has considered the following items:

- The vertical alignment of the highway over the existing Calder River Bridge. The existing river bridge is an old railway structure, which has an almost flat vertical geometry. This produces a noticeable "kink" in the vertical highway alignment as it grades up to the railway crossing and is a severe limitation to optimising the geometry for the new highway alignment design. The through truss structural form has allowed us to consider a revised vertical highway alignment across the structure by raising the road levels and re-constructing the vehicle containment barriers to match. Structural assessment and survey works have been undertaken to prove the viability of this approach, and the Scheme design proposed allows for an approximate 0.5m raise in the vertical highway alignment at the southern edge of the bridge abutment.
- The structural layout of the new Calder Road Bridge over the widened railway corridor. The bridge geometry has been fine tuned to respond to the available vertical clearances to the optimised rail geometry and OLE

equipment below. This has resulted in the unusual 2-span arrangement of the bridge with a short side span opening over the fast lines with the structural slab thickness minimised to lower the road geometry above as far as reasonably possible. The resultant design has critical clearances over the fast lines with a longer span allowed over the slow lines.

- In combination with the above, the highway design itself has been optimised by consideration of gradients, sight lines and visibility, geometry of side road entrances/tie-ins, and provision of a roundabout on the southern approach to minimise earthworks.

3.2.52 I defer to our Highways expert witness Chris Williams who will describe the above design development points and others in his Proof of Evidence. He will also respond to specific objections from neighbouring businesses and the local highway authority in his Proof about the aspects that are directly affected by the highways design.

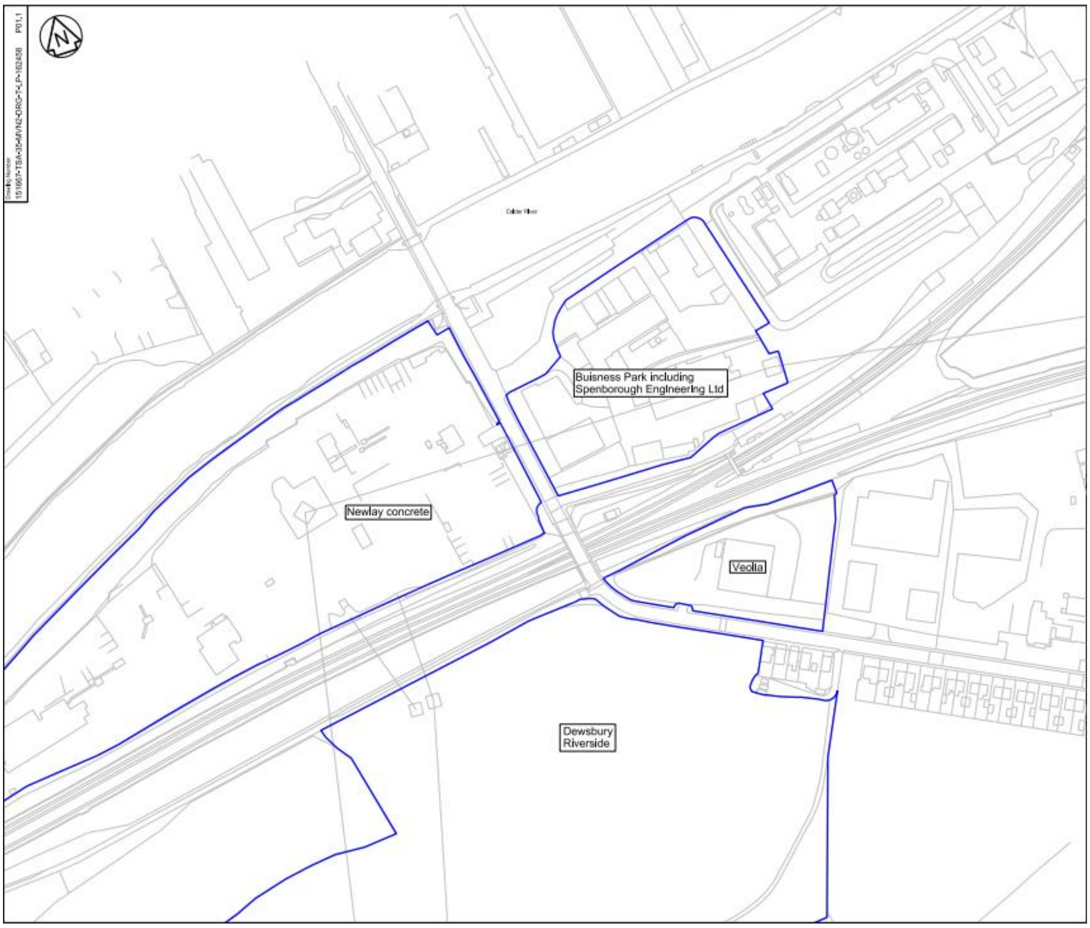
3.2.53 In summary, very significant design development has been undertaken by Network Rail and the design team, led by me, in proposing an optimised scheme for the Calder Road re-alignment. The Scheme as proposed accounts for the described design optimisations, as far as it reasonably practical, considering the stage of design development. It is recognised that there may be further small refinements possible during subsequent design phases, which may then further optimise the approach taken. However, any further refinements will not have a significant affect to the Scheme as presented within the limits of deviation shown.

Land and Property Impacts

3.2.54 The impacts to adjacent land and businesses due to the Calder Road re-alignment (including design optimisations described above) are as follows:

- **Newlay Concrete Ltd.** and associated businesses operating within the same site.
- Veolia Environmental Services Ltd.
- Dewsbury Riverside Developments Ltd.
- **Calder Road Business Park** (inc. Spenborough Engineering)

Figure 3-27: Ravensthorpe Area, land, and property plan



3.2.55 The following sections summarise the works that affect each of these businesses and further detail is given in my response to objections in Section 4.

Newlay Concrete

3.2.56 The proposed works affecting the Newlay site are:

- Permanent acquisition of a triangular portion of land on the SE corner of the site. This is required to build the new abutment for the Calder Road Overbridge and northern highway approach to tie-in to the existing alignment over the Calder River.
- The new highway alignment requires associated re-modelling of the existing site entrance, which itself requires temporary land to create an alternative temporary access whilst works are being undertaken
- In addition to the highway works, the Scheme proposes to decommission 132KV and 33KV high voltage overhead lines operated by Northern Power Grid and demolish a pylon tower within the site boundary. These works require temporary land to be made available within the site to enable site access for plant and equipment.

Veolia Environmental Services Ltd.

3.2.57 The proposed works affecting the Veolia site are:

- A high-pressure gas main diversion requires re-routing across the northern fringe of the Veolia site. This diversion is required to take the existing gas main away from the proposed Flyover grade separation structure. The works require temporary possession of land including a large area currently used for parking refuse vehicles. This requires temporary provision of land to provide alternative parking for Veolia vehicles. This has been designed and planned into the staging of the works and limits of deviation for the Scheme.
- Following the completion of the gas main diversion, the Veolia site is restored to its existing configuration whilst the main works to the Calder Road and adjacent bridge are carried out off-line. During this period new extended parking facilities will be constructed to facilitate the final configuration of the site.
- The design of the grade separation earthworks has been fully co-ordinated with the edge of the Veolia site (in plan position and level). During the later phases of the scheme the new fast line embankment earthworks will be constructed up to the Veolia boundary. During that time, some temporary construction access is required along the fringe of the site which will again affect refuse vehicle parking. This is facilitated by the extended parking works described above, which will ultimately be configured to their full extent once the earthworks have been completed and boundary fencing installed.

Dewsbury Riverside Ltd.

3.2.58 The proposed works affecting the Dewsbury Riverside site are:

- The realignment of Calder Road and Ravensthorpe Road and the construction of the new roundabout (also providing access to the new Ravensthorpe Station forecourt) requires the permanent acquisition of land within the area of the Dewsbury Riverside site allocation.
- The realignment of Ravensthorpe Road would affect the potential access to the 120 homes that are the subject of a planning application currently under consideration by Kirklees Council. This access would be re-provided onto the realigned Ravensthorpe Road, if required.
- The removal of the Ravensthorpe 132kv high voltage overhead lines through the area south of the railway and diversion of these underground would remove restrictions how the land beneath these could be developed. These works require temporary land to be made available within the site to enable site access for plant and equipment.

Calder Road Business Park (inc. Spenborough Engineering)

3.2.59 The proposed works affecting the Business Park are:

- Permanent acquisition of a small section of land parallel to the existing Calder Road alignment. This is required to build the highway and associated earthworks and the northern highway approach to tie-in to the existing alignment over the Calder River.
- The new highway alignment requires associated re-modelling of the existing access to the business park. Continued access during the works would be managed through the construction staging in this area.
- The removal of the Ravensthorpe 132kv high voltage overhead lines through the area south of the railway and diversion of these underground would remove restrictions how the land beneath these could be developed. These works require temporary land to be made available within the site to enable site access for plant and equipment.

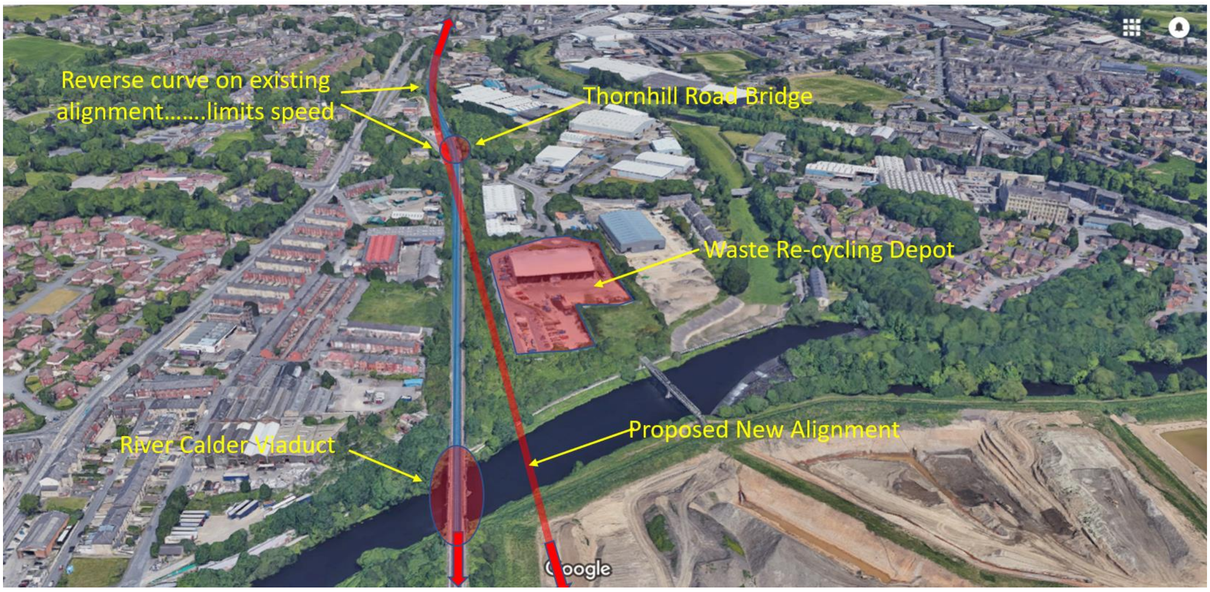
<u>Weaving Lane and Thornhill Road, Westtown</u>

3.2.60 The proposed works to the east of the River Calder including those around Thornhill Road affect several businesses and properties. As with other locations, the design has been extensively developed and rationalised in this area to minimise direct impacts and disturbance.

Weaving Lane Recycling Centre and Adjacent Businesses

3.2.61 Immediately to the east of the new Baker Viaduct, and the east bank of the River Calder, the new railway alignment passes close to the existing Weaving Lane Recycling centre. This centre is owned by Kirklees Council with a franchised waste operator, Suez Recycling and Recovery UK. Further to the east the same alignment passes close to the rear of two existing business units owned by Armley Chairworks Ltd. and Shackleton’s Ltd.

Figure 3-28: New Railway Alignment East of the River Calder



3.2.62 The track alignment at this location is a very important feature of the overall Ravensthorpe grade separation scheme. The chosen geometry enables the railway alignment to achieve the following critical aspects of the design:

- It eliminates an existing slow speed reverse curve to the east of Weaving Lane This reverse curve limits possible through line speeds to no more than 80mph (in accordance with standards), due to the short transition lengths between curved and straight elements.
- By eliminating the reverse curve, it also develops a long section of straight alignment on which to site the new Ravensthorpe East Junction high-speed turnouts (Note, this junction has been later re-named as Baker Junction).
- The straight-line bearing (direction) of the new alignment into the "Ravensthorpe Triangle" creates the grade separation geometry and the ability to construct most of the works off-line whilst maintaining the operational railway.
- It creates an overall fast line geometry to allow 110mph line speeds to be obtained in the Up direction, for trains accelerating out of Dewsbury towards Huddersfield (before they encounter the grade separation). Similarly, the alignment allows trains to de-accelerate safely from 110mph in the Down direction towards Dewsbury. The arrangement therefore maximises the JTI potential of this route section.
- This off-line alignment makes part of the existing mainline redundant where is passes over the grade II* listed viaducts over the River Calder and Hebble & Calder Navigation. These two historic structures are life expired and would need to be replaced if re-used by the TRU Project. The chosen alignment therefore preserves these two important

structures and also facilitates a future opportunity for others to create a new access through the area (e.g., a walking and/or cycling route).

- Lastly, it future-proofs potential for a continuation of a 4-track alignment towards the east through Dewsbury should this be promoted as part of a future railway enhancement scheme.

Figure 3-29: River Calder and Hebble & Calder Navigation Viaducts (Grade II* listed)

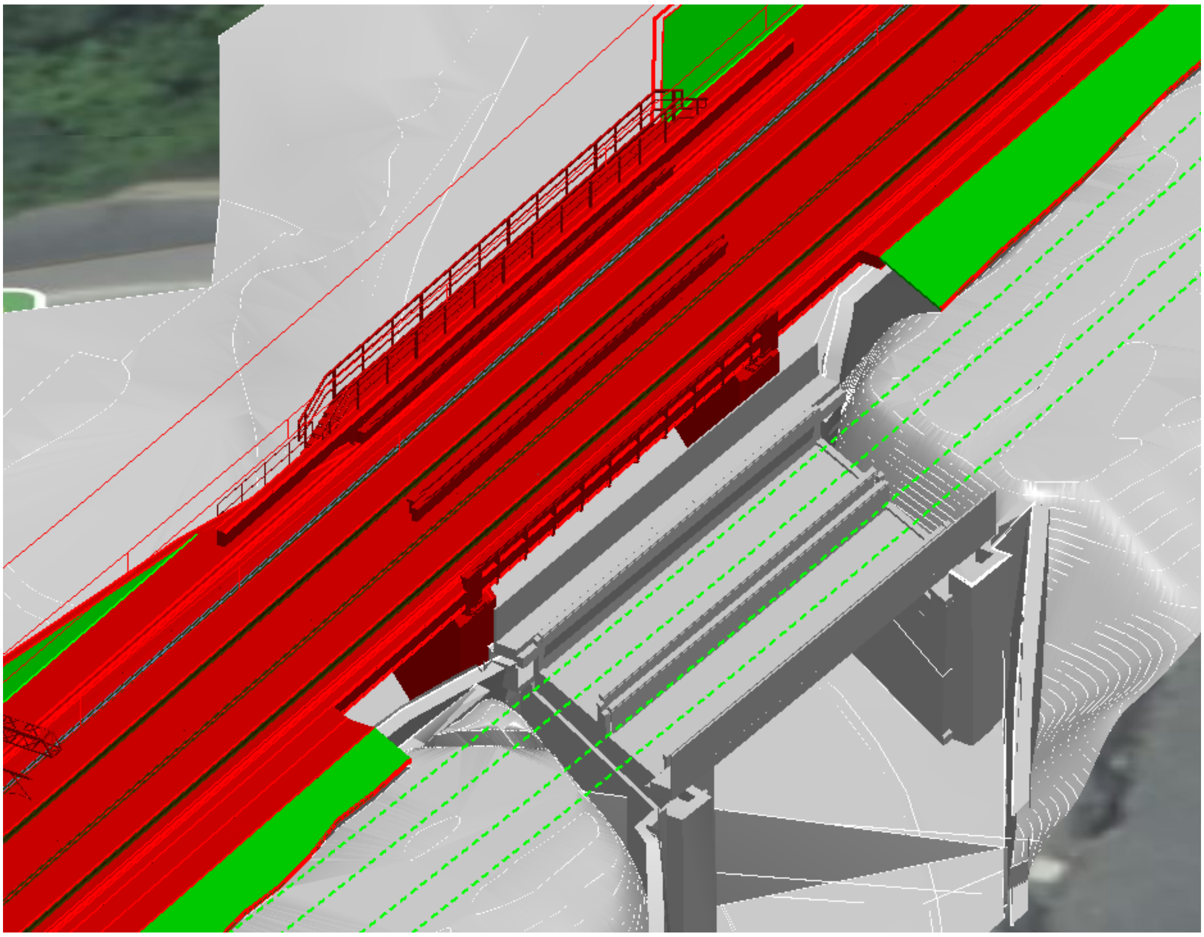
3.2.63 The new track alignment parallels the existing northern site boundary of the recycling centre with an offset that allows a retaining wall to be built whilst maintaining the existing site access in the permanent condition. During the development of the design, different wall construction options were investigated, and the preferred design is a reinforced earth solution, which has been selected to minimise temporary disturbance to the recycling centre, as it can be built “bottom up” in small modular layers. Refer to Evidence provided by Mike Pedley in his Proof with respect to the construction methodology for this wall and temporary construction impacts at the recycling centre.

3.2.64 The same retaining wall then extends on a steadily reducing profile behind the two adjacent business units to the east. The design has been developed so that the alignment of the wall gives sufficient space to construct behind the units with minimum disturbance to their current operations in both the permanent and temporary cases. Refer also to my response to **OBJ 07** in Section 4 of this document.

Thornhill Road and Fall Lane

3.2.65 The alignment described in the previous section cuts off the existing reverse curve in the railway in the vicinity of Thornhill Road. The new straight alignment emerging from the Ravensthorpe Area creates the geometry to tie-into an existing left-hand curve existing from Dewsbury to make a continues high speed alignment. The geometry has been carefully positioned so that a new bridge and embankment across Thornhill Road can be built off-line while trains continue to use the existing alignment during the construction works.

Figure 3-30: Thornhill Road, existing and proposed bridge works



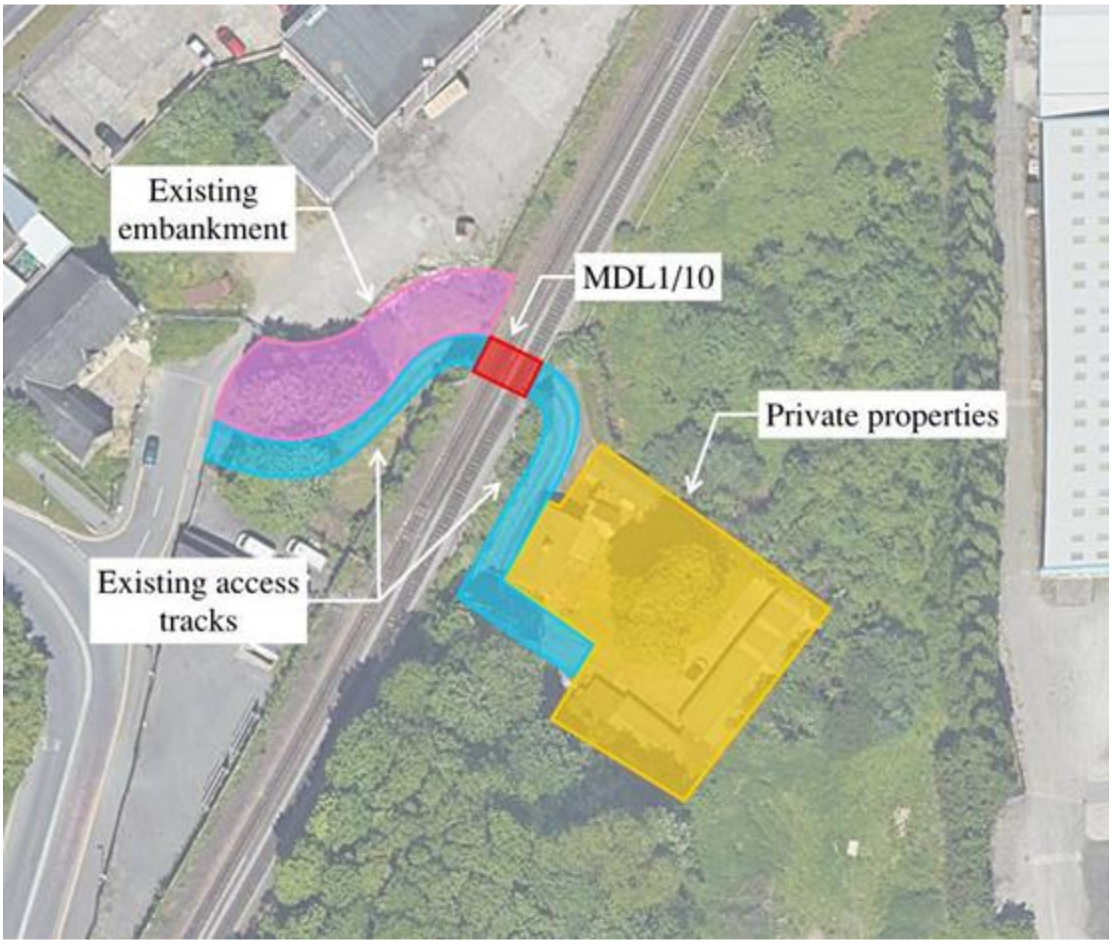
3.2.66 Considerable sub-option selection work was carried out at this site due the complex physical constraints, which includes a heavily sloped topography, an existing steep and constrained highway alignment, plus numerous utilities buried within the highway corridor. The resultant design has been carefully fitted around the existing bridge geometry and has preserved the existing functionality of the highway below including its junction with Fall Lane. In addition, private properties to the north of the existing bridge have been retained, albeit they are affected by the highway corridor being moved closer to their boundary.

3.2.67 I defer to Evidence provided by Mike Pedley in his Construction Methodology Proof about the temporary effects during construction.

Occupation Bridge

3.2.68 Occupation Underbridge is bypassed to the North by the new railway alignment exiting from the Thornhill Road area. The Scheme proposes to infill this structure, which currently provides highway access to a private property to the south of the railway from Thornhill Road.

Figure 3-31: Occupation structure location plan



3.2.69 An alternative access will be provided by the Scheme from Calder Bank Road, adjacent to the existing access to the Westex Carpet's property. The access will be segregated from the Westex operations and will be gated to match the existing provision at this property. Refer to the plan drawing 4 included in Appendix 1, which shows the new property access and interface with the Westex business.

3.3 Scheme Effects on Cycling and Walking and Accessibility

3.3.1 The design has recognised the importance of existing cycling and walking routes and facilities. When these are affected by the Scheme footprint, where reasonably practical, any routes or facilities have been at least re-provided on a like for like basis, or where justified, improvements made. Where new infrastructure is proposed such as re-constructed stations and highway diversions, where justified by standards, and within the remit of the Scheme, we have provided some enhancements over existing provisions. The principal locations affected are described in the following sections, or where indicated, as responses to specific objections in section 4 of this evidence.

3.3.2 I also defer to the evidence provided by Chris Williams in his Highways Proof about the application of standards and design guidance for cycling provisions at the various sites where the Scheme affects the existing cycling provision.

Huddersfield Station

3.3.3 There are no permanent effects of the scheme with respect to cycling or walking provisions around Huddersfield Station. Temporary effects due to construction are covered in the construction Methodology Proof. A specific objection OBJ 25 was received with respect to future provisions, which I have responded to in section 4 of this Proof.

Red Doles Road

3.3.4 Red Doles Road is an existing structure that provides vehicular and pedestrian access beneath the railway, including a public right of way (byway). A new bridge deck is required to span Red Doles Road, which will make use of the disused historic abutments. Access for vehicles, and users along the public right of way, will be retained.

Fieldhouse Overbridge

3.3.5 The existing Fieldhouse Overbridge, which carries a public right of way over the railway, will be replaced with a new footbridge structure. The raised level of the bridge deck requires stepped access onto the existing approach and as a result, an additional ramped access will be provided to aid persons with reduced mobility (PRM) to use the public right of way. Refer to the evidence provided by Chris Williams in Section 4 of his Proof including a response to **OBJ 33** Kirklees.

Ridings Underbridge

3.3.6 Riding’s underbridge carries the railway over a public right of way footpath. The existing 2-tracks will be realigned to the north of the existing corridor.

The existing metallic bridge deck on the north side is not wide enough to carry the realigned tracks and therefore, this section of the bridge will be demolished and replaced with a wider structure. The new structure will be formed with a simple concrete portal which will maintain the geometry and headroom of the adjacent stone arch. The public right of way will be maintained, and the works will improve its amenity by removing the dark and hidden recessed areas under the existing metallic bridge.

<u>Birkby Bradley Greenway & Deighton Station</u>

3.3.7 At Deighton, the proposed Scheme will deliver a new station in the same location with additional facilities including ticketing and improved security arrangements. Step-free access will be provided via a new station forecourt directly off Whitacre Street. The forecourt will include three blue badge parking bays and a passenger drop-off point with both platforms accessed from the forecourt level via a footbridge with stairs and lifts.

3.3.8 Due to the embankment works on the approach to Deighton Station, the Birkby Bradley Greenway (National Cycle Route 69) requires a minor realignment. The realignment will be approximately 10m to the north of the existing route over approximately 200m to the north-west of the station.

3.3.9 Due to the gradient of the earthworks, it would not be possible to provide a direct connection to Deighton Station from the Greenway, so cyclists on the Greenway would continue to access the station as they do now (via Whitacre Street).

<u>A62 Leeds Road</u>

3.3.10 As described in Section 3.2 of my Evidence, it is proposed to construct a new bridge slightly to the west of the existing bridge. The bridge will be constructed in two phases with a temporary highway alignment in operation to maintain connectivity for all users during the works.

3.3.11 I defer to our Highways expert witness Chris Williams who will describe the above design development points in his Proof of Evidence. He will also respond to specific objections points raised by **OBJ 33** Kirklees in his Proof.

<u>Wheatley's Overbridge</u>

3.3.12 Wheatley's Overbridge carries National Cycle Route 66 over the railway just to the west of Bradley Junction. It is proposed to demolish and construct a new single span bridge immediately adjacent to the existing structure, which will accommodate the cycle route. As the new bridge is being built parallel and off-line, there should be minimum disturbance during construction.

B6118 Colne Bridge Road

3.3.13 The B6118 Colne Bridge Road is a critical route within the local highway network. The existing road alignment is very substandard with narrow lanes and steep approach gradients over the bridge limiting forward visibility. A narrow footway is provided on the east side of the road only.

3.3.14 As described in Section 3.2 of my evidence, a new bridge is proposed to be constructed off-line to the east. The off-line solution limits the length of road closure required and therefore minimises the impact to all users of the bridge and surrounding businesses and communities during demolition of the structure.

3.3.15 Further details are provided in Section 4 of the Evidence provided by Chris Williams with respect to specific objections **OBJ 33** Kirklees.

Helm Lane PROW

3.3.16 An existing public right of way crosses the railway to the west of Battyeford, connecting the tow path of the Calder & Hebble Canal Battye Cut to Helm Lane. This path currently crosses over the railway via the Heaton Lodge Footbridge and under the Calder Valley lines via the Helm Lane Underpass.

3.3.17 The existing footbridge is life expired and does not provide adequate vertical clearance to accommodate OLE or safe parapets to protect users of the bridge from the electrical equipment. It is therefore proposed to replace the footbridge with a modern structure to maintain the public right of way and provide adequate protection to its users.

3.3.18 The existing underpass is very substandard being both low and narrow. Due to the alignment of the new fast lines, it is proposed to divert the footpath to the east by approximately 90m to a new crossing location. The new underpass will maintain the public right of way, providing full height and width to modern standards.

Mirfield Station

3.3.19 At Mirfield Station, the Scheme proposes to reconfigure the station to serve the slow lines from an extended island platform with no platforms on the through fast lines. Facilities to be provided within the station will include two new sheltered seating areas for waiting, improved train information and improved security arrangements.

3.3.20 The existing car park will be reconfigured to provide a drop off area, in addition to the existing three blue badge parking bays and car parking bays. The platform will be accessible from the drop off area and car park via a new footbridge with steps and a lift. The main station entrance will be moved to the eastern side of Station Road with steps and a lift providing access to the island platform.

3.3.21 As part of the works to Mirfield Station and the construction of a new eastern entrance, modifications to Station Road are required. This will include narrowing the lane widths under the Station Road underbridge to reduce speeds and provide more space directly outside the station entrance.

3.3.22 I also defer to our Highways expert witness Chris Williams who will describe the above highway design development points in his Proof of Evidence. He will also respond to specific objections points raised by **OBJ 33** Kirklees.

Ravensthorpe Cutting & Hunger Hill Overbridge

3.3.23 No works are proposed to Hunger Hill Overbridge as part of the Order. However, Bridleway DEW/3/10 to the south-east of Hunger Hill Overbridge will require diversion to accommodate the new railway alignment and associated earthwork cutting. The bridleway will be diverted to the south-east of the existing Ravensthorpe Road via the proposed new Ravensthorpe Station access.

Calder Road & Ravensthorpe Station

3.3.24 It is proposed to relocate Ravensthorpe Station approximately 200m to the west of the existing station. One island platform will be provided to serve the stopping services on the slow line. Additional facilities will be provided at the station including two new sheltered seating areas for waiting, improved train information and improved security arrangements.

3.3.25 The station will be accessed from the south via a new forecourt from a roundabout on the realigned Calder Road. The new forecourt will contain three blue badge accessible parking spaces, a maintenance parking bay, and a turning head. The island platform will be accessed via a footbridge with stairs and a lift down to platform level.

3.3.26 As described in Section 3.2 of my Evidence, Calder Road Overbridge requires reconstruction to the west of the exiting bridge. This will require modifications to the highway alignment including a slight steeping of the northern approach gradient to achieve clearances to the electrified railway. It is proposed to construct a footpath and cycleway to a shallower alignment gradient to suit non-motorised users and people with reduced mobility.

3.3.27 I defer to our Highways expert witness Chris Williams who will describe the above design development points in his Proof of Evidence. He will also respond to specific objections points with respect to the highway works raised by **OBJ 33** Kirklees.

Thornhill Road & Fall Lane

3.3.28 As described in Section 3.2 of my evidence, to achieve the required highway clearances beneath the proposed new bridge at Thornhill Road, the scheme proposes to realign the junction of Thornhill Road and Fall Lane. Provision for pedestrians and cyclists at this new junction will match the current situation, including the cycle lane provision.

3.4 Scheme Effects on Local Development Proposals

Introduction

3.4.1 From the beginning of the Scheme option selection and subsequent design development, I have always been very aware of the potential socio-economic impact of the Scheme, and the potential for supporting local development where appropriate within the boundaries of the Scheme remit.

3.4.2 The preferred Scheme touches on many geographies within its footprint where it could have a positive impact on existing and future development proposals. However, I will concentrate on the three main areas where the Scheme is considered to have a significant impact:

1. Huddersfield Station Area
2. Ravensthorpe Area
3. Local Stations (Deighton, Mirfield and Ravensthorpe)

Huddersfield Station Area

3.4.3 The Scheme once complete is designed to transform the passenger experience at Huddersfield Station:

- The availability of an increased choice of fast, frequent, and reliable train connections afforded by the TRU Programme upgrade, which is enabled by the Scheme.
- The re-modelled and expanded station will have improved passenger facilities including wayfinding, announcements, information points, seating and waiting rooms, as well as equal access provided by an additional footbridge and lifts. The project is also working with stakeholders to provide improved retail offerings.
- The heritage aspects of this important Grade I listed station will have been preserved and added to in a modern yet sympathetic manner to create a space, which can be enjoyed by the passenger and public alike.

3.4.4 It is my understanding that similar transformative station schemes in other areas of the country have acted as a catalyst to help support or even generate development proposals. I also understand that within Huddersfield there is significant development potential within the nearby town centre with its abundance of historic and listed buildings, and this is noted in the submitted Design and Access Statement **(NR15A).** Like many historic post-industrial towns in the Yorkshire region, Huddersfield is slowly re-inventing itself, and I would hope that this Scheme can make a positive impact on that.

3.4.5 Through background research for the option development at Huddersfield and through stakeholder interactions, I was made aware of several development proposals that could impinge on the design choices being made. These included:

- Proposals to create a new **Western Station Gateway**.
- Proposals to re-develop the **Grade II Listed Warehouse** and adjoining goods lift which abut the western boundary of the station site.

Western Station Gateway

3.4.6 Currently the only station access is from the existing frontage on the southeast side of the station. There are several proposals contained within various planning type documents produced by Kirklees, The Combined Authority, and other interested parties over several years. A summary list of documents considered is included in my response to specific objections in Section 4.

Figure 3-32: Huddersfield Station, illustrative proposal for a western gateway connection taken from "The Huddersfield Blueprint – A Decade of Ambition", Kirklees 2019

3.4.7 In the development of the design, we have taken cognisance of these proposals by future-proofing the cross-station accesses to allow them to be extended to meet such a future development. This includes:

- Designing the structure of the passenger subway, which extends the existing subway to serve the new island platform 5 and 6, to be able to be further extended under platform track 6 and into the western gateway site area.
- Designing the structure of the new footbridge which serves all platforms to be able to receive an additional span to extend towards the new western gateway site area.

3.4.8 I understand that the general extent of these works has been discussed with Kirklees Council and the project team is happy to work with Kirklees or other interested parties to further develop any adjoining proposals should they be put forward within the timescales of this Schemes delivery.

Grade II Listed Warehouse

3.4.9 I understand that various proposals and outline planning permissions have come forward for the site, again over several years, however, at the time of writing I am unaware of any firm proposals to take any of these plans forward.

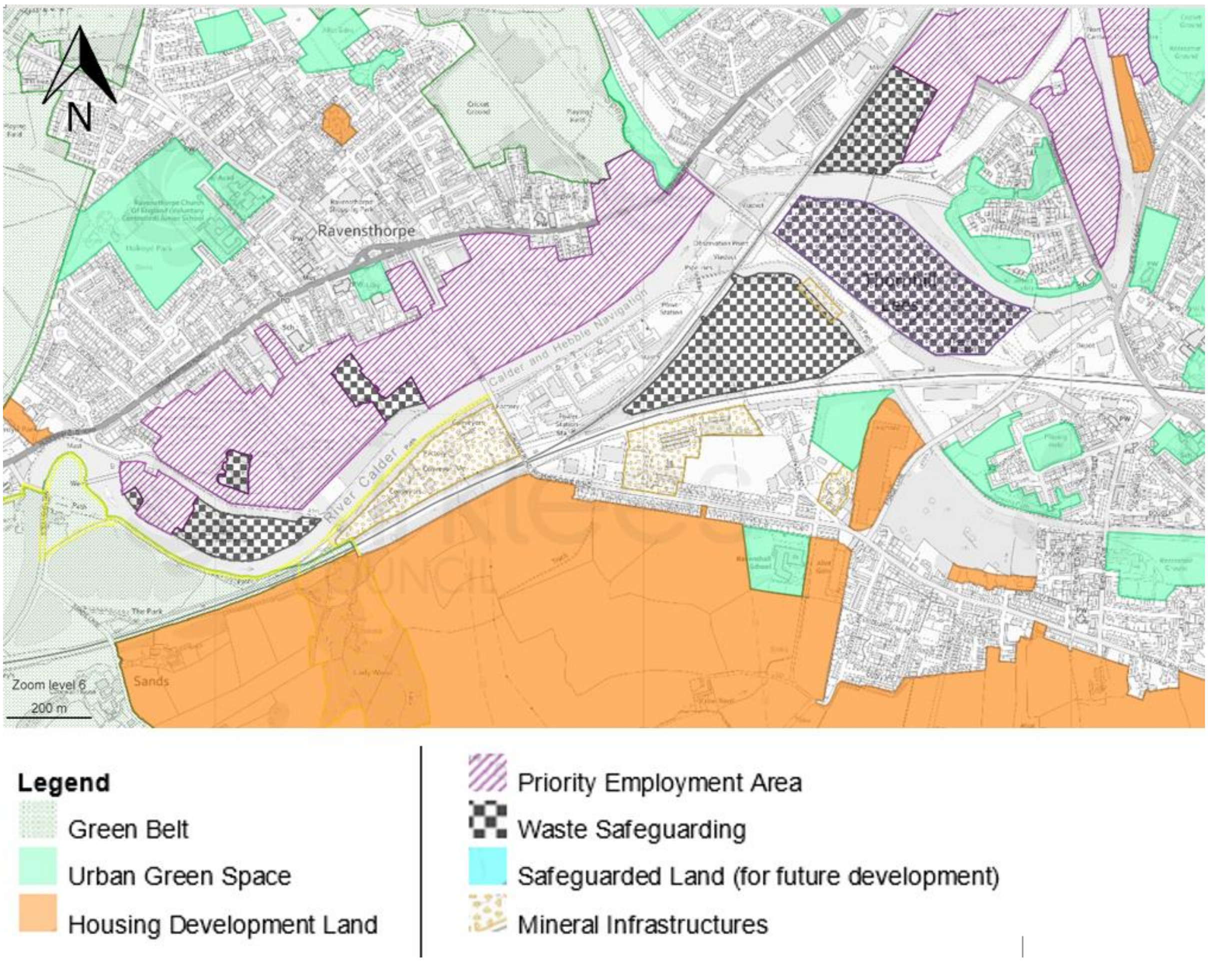
3.4.10 The design has taken cognisance of the existing situation and developed the proposals as far as reasonably possible, such that they do not have a permanent impact on the building and its future development. The exception to this is the requirement for the Scheme to impose some permanent restrictive effects to the Goods Lift, which is close to the new platform track 6 and its OLE equipment. The station western extents and position of track 6, are defined by the geometry of the preferred platform and track layout, and the very restrictive nature of the Huddersfield station site. Further commentary is provided in Section 4 in my response to specific objections about the western boundary position.

3.4.11 The Scheme requires temporary use of a large area of land immediately to the north of the warehouse to enable construction activities. I defer to evidence provided by Mike Pedley in his Construction Methodology Proof and evidence provided by Tony Rivero in his Planning Proof to discuss the requirements for the use of this land and any effects it might have with respect to future development proposals.

<u>Ravensthorpe Area</u>

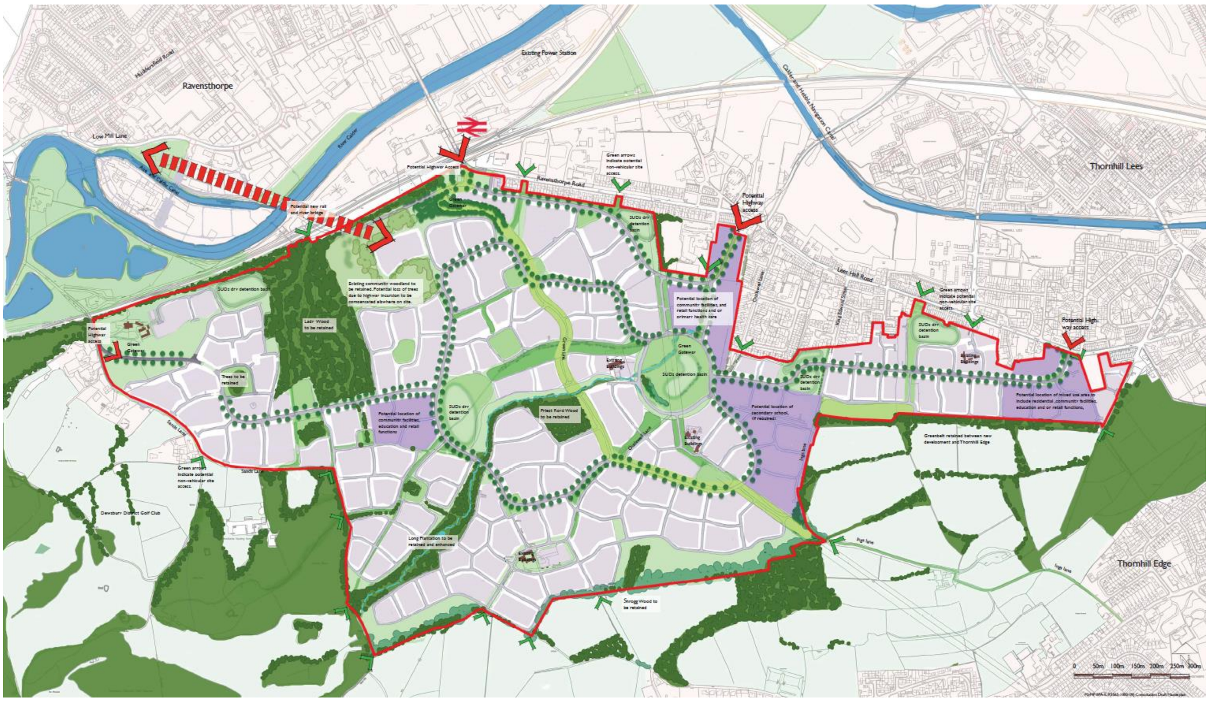
3.4.12 The Scheme proposes significant works in the Ravensthorpe area to create a new grade separated railway junction. The primary effect is predominantly with respect to allocated housing development land as shown in the figure below, which has been extracted from the adopted Kirklees Local Plan.

Figure 3-33: Ravensthorpe Area Land Allocations, extract from Kirklees Local Plan



3.4.13 The allocated housing land is more widely known as "Dewsbury Riverside" and is Kirklees largest housing allocation contained in their local plan and envisages 4000 new homes being built over a period of about 20 years. The master plan for the site is shown in the figure below. This master plan was the version under consideration at the time of the Schemes option development, although I am aware that Kirklees and other interested parties are continuing to develop these plans.

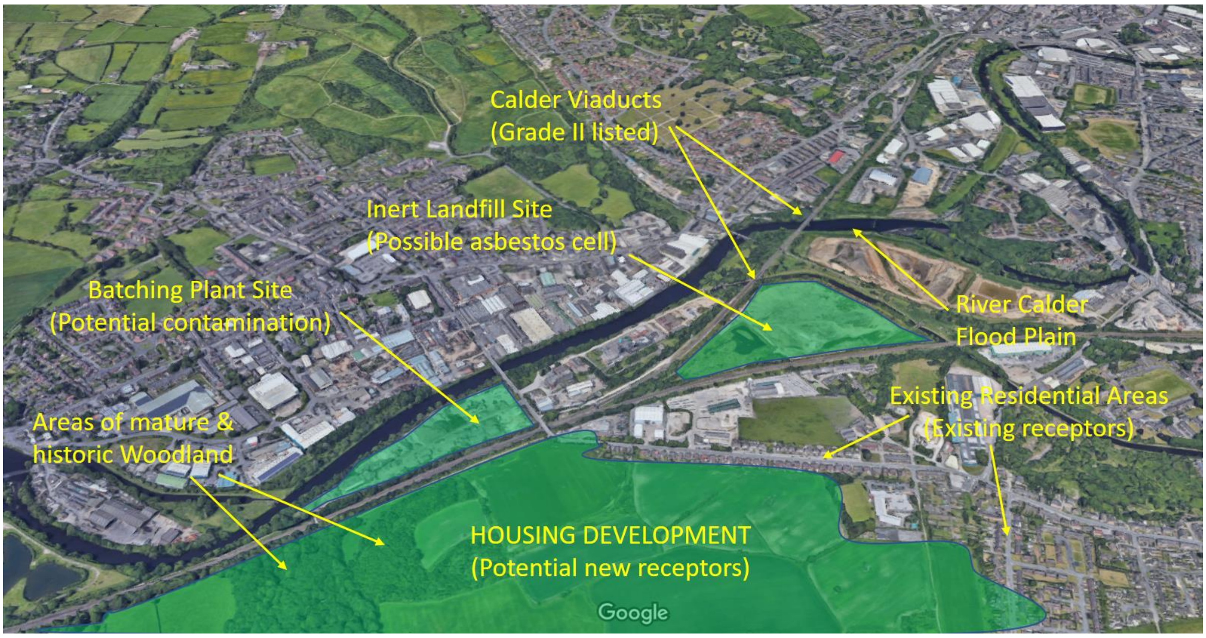
Figure 3-34: Dewsbury Riverside Master Plan c. 2017



3.4.14 During the option development for the railway scheme and considerations of grade separation alternatives at Ravensthorpe, due cognisance was taken of the land allocations within the Local Plan (which was still under consultation at that time), and the wider physical and environmental constraints. I have extracted some diagrams below, which are taken from the GRIP3 Option Selection Report. These show some of the constraint mapping that was carried out, which informed the engineering and design decisions that I made alongside considerations of local planning policy including land allocations.

Figure 3-35: Ravensthorpe Area, Physical Constraints

Figure 3-36: Ravensthorpe Area, Environmental Considerations



3.4.15 For wider reasons documented in previous sections of my evidence, the Ravensthorpe grade separation was chosen as part of the preferred operational layout for the Scheme. Of the grade separation sub-options studied, option1A a Flyover grade separation was selected to be the preferred Scheme as presented in the Order. The following sub-sections describe features of the Scheme, which have residual effects on local development proposals.

Ravensthorpe Station Re-location

3.4.16 The existing Ravensthorpe Station is connected to Calder Road via an informal access road with no drop-off or formal station car parking, with access to the platforms via a non-compliant ramped access and stepped footbridge. This uninviting arrangement with lack of facilities is reflected in the current low passenger numbers. This in stark comparison to adjacent stations (at Dewsbury and Mirfield) or local populous figures. In 2016/17, The Office of Rail and Road (ORR) records show that there was a total of about 42,000 trips (entries & exits) originating or terminating at Ravensthorpe. In comparison, this less than 10% of the total numbers recorded at Mirfield, which recorded 506,000 trips in the same year.

3.4.17 The land footprint required for the grade separation geometry (including linking chord lines) impacts on the existing station and therefore requires the station to be re-sited. The preferred Scheme re-locates the station to the west side of the re-modelled Thornhill LNW Junction. The re-siting choice allows for the off-line construction of the grade separation works whilst the existing station remains operational. This subsequently allows the commissioning of an “opened out” double junction track layout, which itself is enabled by splitting the slow lines around a new island platform forming the new station.

3.4.18 This re-siting of Ravensthorpe Station to the west of Thornhill LNW Junction strategically places the station in a much-improved position. It is closer to Calder Road in a much more visible location with land adjacent in which to form a new forecourt with disabled parking, passenger drop-off and bus turning facilities. From a railway operational perspective, it also opens new opportunities for future train services to call at Ravensthorpe and then towards Wakefield, which is understood to be an aspiration for external stakeholders including Kirklees Council and The Combined Authority.

3.4.19 The station re-location directly complements the Dewsbury Riverside master plan illustrated above and therefore fully supports the local area planning policy. It is located as conveniently as possible directly adjacent to the proposed development and provides a new station to current accessibility standards with an improved local rail service with linkages to wider destinations. If the development proposals are taken forward it is hoped that this will drive a greater modal shift from road to rail with patronage growth beyond those currently forecast (without the development). It is understood that this would be of considerable benefit to both the railway and the local community as well as supporting wider government aspirations for sustainable growth and carbon net zero targets.

Figure 3-37: Ravensthorpe Station, Visualisation of new proposed site location

Utilities Network Rationalisation

3.4.20 The grade separation Scheme and associated works to provide a traction power sub-station on the “Ravensthorpe Triangle” site requires a substantial re-organisation of major utilities routes in the area. Where possible these utility diversions have been co-ordinated to suit adjacent development.

3.4.21 Of note are diversions and associated rationalisation of the HV electricity network. Historically Ravensthorpe had a large coal fired power station which extended over a large site footprint north of the railway. Therefore, Ravensthorpe became the focus for a significant network of HV power cables with overhead 132KV lines crossing the area plus many 33KV connections both overground and underground.

3.4.22 The 132KV overhead cable network supplies power to the traction power site and this requires some modifications to existing tower locations. The overhead cables also clash with proposed embankment locations and required clearances to OLE equipment. Network Rail has worked together with Northern Power Grid (NpG) to plan as series of network rationalisations to achieve the most effective scheme for both parties, including decommissioning of redundant parts of the electricity network.

3.4.23 The Scheme put forward in the Order removes a large overhead section of 132KV cables. These currently span from a tower in the “Ravensthorpe Triangle” site over the Calder Road Business Park to a tower position in the

Newlay concrete site and then over the railway through the middle of the housing development site. This line in effects parallels another 132KV line and can be simply made redundant by a short diversion across land to the South of “Dewsbury Riverside”. In addition, NpG plan to decommission sections of 33KV overhead cable which pass over the railway from the housing development site and into the Newlay site as well as areas of redundant underground cabling within the Newlay site.

3.4.24 The diversions and rationalisations described above will be of direct benefit to the adjacent development land as well as existing affected businesses who will enjoy less restrictions to their current operations by the removal of HV overhead lines.

<u>Minor (Local) Stations</u>

3.4.25 The local stations on the Scheme, Deighton, Mirfield and Ravensthorpe are all impacted by the proposed 4-tracking and electrification works to the railway. In general, the Scheme proposes as a minimum to replicate existing facilities on a like for like basis, extend platforms to a minimum of 150m, and provide improvements to accessibility in line with the requirements of the Equality Act.

3.4.26 The local stations have been designed using a master planning approach to, where reasonably practicable, respond to known or not unduly prohibit future development proposals (which in turn may drive future patronage growth and requirements for extended station facilities). They have also been designed together to deliver a cohesive proposal in which each share an identity though the use of a consistent material pallet and asset forms.

4. ENGINEERING AND DESIGN RESPONSE TO OBJECTIONS

4.1 Huddersfield Area

4.1.1 This section covers all objections within the environs of Huddersfield Station including Huddersfield Viaduct. Objections (whole or part) addressed within this section include:

- **OBJ 14** Yorkshire Children's Centre
- **OBJ 15** Kinder Properties
- **OBJ 16** DP Realty Ltd.
- **OBJ 23** HD1 Developments
- **OBJ 25** Kirklees Cycling Campaign
- **OBJ 40** West Yorkshire Combined Authority
- **OBJ 43** CUBICO UK Ltd.
- **OBJ 45** R&D Yorkshire Ltd.

<u>Huddersfield Tunnels – effects on Bus Station and Highway Network</u>

In response to OBJ 40

4.1.2 The Huddersfield Tunnels and Westgate Bridge are to the south of Huddersfield Station. The scheme proposes to deliver new track works and OLE equipment within the tunnels and under Westgate Bridge.

4.1.3 The installation of new equipment within the tunnel envelope necessitates lowering of the existing track level to create additional space. Although surveys to investigate the construction form of the tunnel and its surrounding geology have been undertaken, it is difficult to achieve an accurate understanding of the relationship between the tunnel foundations and surrounding rock. For this reason, the project is seeking provision to install rock anchors in certain sections of the tunnels including beneath the Huddersfield Bus Station. These will be installed if the excavation required to deliver the track lowering results in instability of the tunnel structure. The project is continuing to develop survey works to further understand this relationship as the design develops.

4.1.4 An existing overhead sewer pipe runs over a beam structure suspended within the Westgate Bridge portal structure. Through the Scheme development there has been a considerable focus on investigating solutions around the sewer pipe to achieve a feasible OLE solution without incurring complex, costly, and potentially very disruptive works, including to the Westgate highway above. The Scheme design is still being developed in this area; however, I am confident that we are working towards a solution that will minimise impacts on the highway network above.

4.1.5 At the time of writing, it is the intention that the sewer remains in place and that rock anchors will not be required. However, there is a risk that some or all these works may be required as the design and construction methodologies develop into final detail. Therefore, NR wish to keep these protective provisions and temporary land access in the Order.

<u>Huddersfield Station – Future Passive Provision</u>

Future Connection to St George's Quarter

In response to OBJ 14, OBJ 23 and OBJ 25

4.1.6 The passenger subway extension structure is designed to facilitate removal of the end wall, and the proposed platform 5-6 stairs and lift within the passenger subway extension have been arranged in a manner which allows for a possible further extension into St George's Quarter. In addition, the new footbridge crossing the east end of the station is designed to enable its future extension by addition of a span to link to one or either of a future bay platform 7 or a building situated within St George's Quarter.

4.1.7 In the development of the Huddersfield Station scheme the following studies were considered:

- AECOM (2015) Huddersfield Station Gateway. Issue 1, May. Unpublished.
- Kirklees Council (2015) Kirklees Draft Local Plan.
- Kirklees Council (2016) Kirklees Draft Local Plan Map.
- Kirklees Council (2016a) Kirklees Draft Local Plan Map.
- Kirklees Council (2007) Kirklees Unitary Development Plan.
- West Yorkshire Combined Authority (WYCA) (no date) Huddersfield Station Gateway.
- WSP (2017) Huddersfield Railway Station Car Parking: Feasibility Study. Issue 1, 10 April. Unpublished.

Future Network/Operational Capability

In response to OBJ 40

4.1.8 **Additional Bay Platform**. Passive provision has been made for a second east facing bay platform (a future platform 7) at Huddersfield Station. This is in response to known aspirations from transport operators and authorities.

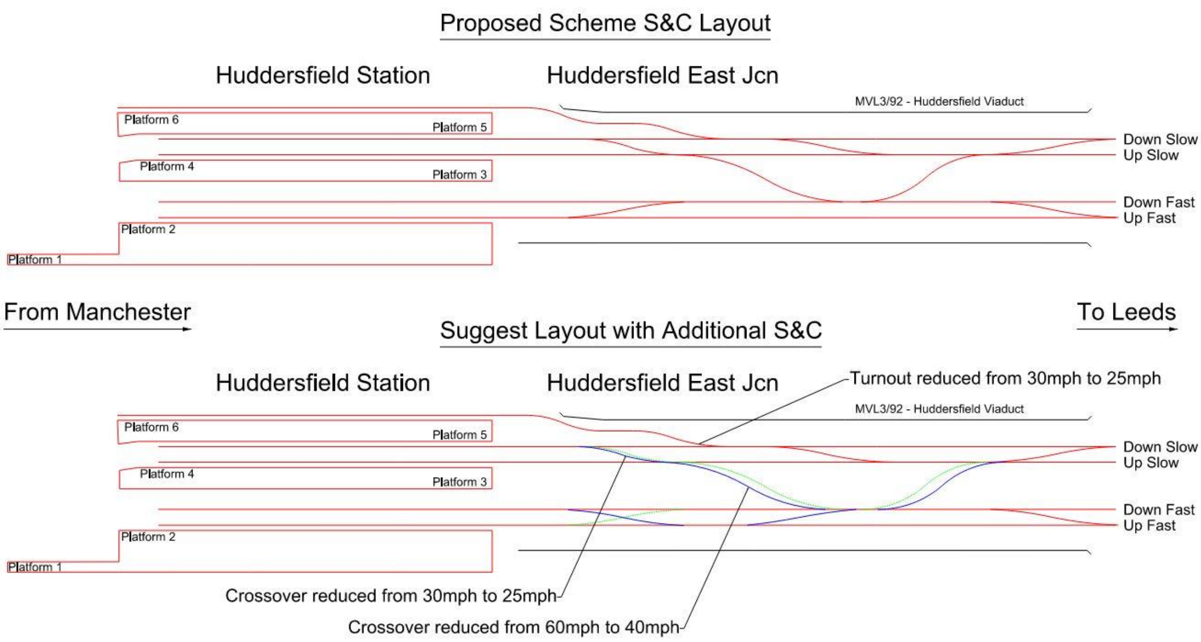
The additional platform footprint required, and any other future infrastructure modifications can be accommodated within the existing Network Rail land boundaries, although additional land may be required to facilitate construction.

4.1.9 Within the new infrastructure being provided by the Scheme this passive provision has been allowed for in the design of the new footbridge, the subway extension, cable containment routing within the station, lineside boundaries, and the replacement John William Street bridge deck. To deliver such a future scheme some modifications would be required to the operational extents of platform 6 together with new track and signalling installations.

4.1.10 It is understood that the Powers requested under the Order as submitted, and application for deemed planning consent, do not cover the provision of this future platform. It is therefore understood that the future promoter would therefore require separate planning consent including a listed building consent to deliver this scheme.

4.1.11 **Additional Track Crossover**. It is recognised that an additional track crossover could be provided at the Leeds end of the station between the fast and slow lines. This would allow a further parallel movement to occur between trains arriving simultaneously on the Up Fast and entering platform 3 and services exiting from platform 4 to join the Down fast. This is shown diagrammatically below.

Figure 4-1: Huddersfield East Junction, suggested additional track crossover



4.1.12 The operational modelling of the proposed Scheme does not require this crossover to achieve the capacity to satisfy the remitted ITSS or the target performance figures. There are also operational and physical infrastructure disadvantages of such a provision. This includes the reduction in speed capability at several locations within the layout including the proposed crossover from the Platform 4 to the Down Fast, which would need to be downrated from 60mph to 40mph to accommodate the additional switches required. This would inhibit linespeed of trains joining the Down Fast line and increase sectional running times. There may be other feasibility issues, such as provision of OLE equipment and associated wire runs, which have not been investigated.

4.1.13 Given the infrastructure cost of providing a crossover not required by the Scheme remit, increased whole life cost due to maintenance, and the noted performance disbenefits, it is not proposed to provide this crossover as part of this Scheme. It is noted that should future operational capacity be required above that provided by the TRU scheme, then this additional crossing could be provided as part of that future upgrade.

4.1.14 **Electrification Extents**. At the time of writing, the instructed TRU Programme scope includes electrification between Leeds and Huddersfield and between Stalybridge and Manchester. The current scope allows for electrified suburban passenger services to operate between Leeds and Huddersfield. Through Transpennine services would continue to be operated as the current situation with diesel-electric “bi-mode” stock or diesel only.

4.1.15 The OLE system design at Huddersfield has been developed to allow extension of the wiring towards the west as and when funding is made available. This has been achieved by fully wiring the Huddersfield and Gledholt tunnels (to the west of Huddersfield Station) as part of the W3 project. This takes the OLE system to a position where a simple wiring overlap can be made. In addition, the master power supply and feeding arrangements provided as part of the W3 and other TRU Programme projects, has also been designed to accommodate this future section of wiring and possible power demand from increased train services.

4.1.16 **W12 Gauge Clearance**. W12 gauge freight clearance is not part of the current TRU Programme scope. However, for this Scheme I can confirm that W12 gauge clearance can be generally achieved through the entire footprint due to the electrification and associated infrastructure works that are planned. The most constrained location on the Scheme is the Huddersfield Tunnel portal at the entrance into Huddersfield Station.

4.1.17 At this location there are two obstacles, one being an existing overhead sewer pipe within the Westgate Bridge portal structure, the other being the tunnel arch profile where it abuts the Westgate portal. As described previously, OLE delivery around these constraints has been a focus of design effort in this area. At the time of writing the Scheme design is still being developed, however, I am confident that the Scheme is working towards a solution that will safeguard W12 gauge clearance through the Huddersfield tunnels (and therefore the entire Scheme route).

<u>Huddersfield Station – Platform Facilities</u>

4.1.18 In response to OBJ 40

4.1.19 Additional platform facilities are to be provided by the Scheme as follows:

- Enclosed footbridge access to all island platforms in accordance with standards for PRM provision
- Waiting shelters on new island platform 5-6
- Weather protection screens on new island platform 5-6
- Canopy coverings to all island platforms
- Platform seating
- Compliant wayfinding and train information screens

<u>Huddersfield Station – Additional Cycling Facilities</u>

4.1.20 In response to OBJ 25 and OBJ 40

4.1.21 Passengers entering or leaving the station currently do so from St. George's Square via controlled gate lines in the main building entrance foyer. This is the only entrance/egress point into the station. The re-modelling proposals for the station do not change these entry/egress arrangements.

4.1.22 Cycling storage is currently provided at a dedicated facility situated at the Leeds end of platform 1 (to become re-numbered platform 2), which is a short walk from the existing gate line. This facility is provided by the current franchised Train Operating Company (TOC), and Network Rail are not aware of any proposals by the TOC to extend this facility, therefore it is considered adequate for its current or projected usage patterns.

4.1.23 Cyclists using the station can simply deposit their bicycle at the conveniently located platform 1 storage facility before traversing through the station to their required destination platform. For passengers wishing to take their bicycle on a train service, cross platform connections can be easily made via the lifts provided (or via the staircases) and then through the existing subway.

4.1.24 The design proposed for the re-modelled platforms provides additional cross platform access via a new footbridge situated at the Leeds end of the station. This new footbridge will be served by lifts and stairs to all platforms. It will provide a second means of access for cycle users as well as other passengers requiring lifts. As stated in response above, the existing subway will also be extended to serve the new island platform with lift and stair access.

4.1.25 The entrance to the new footbridge lifts and stairs is very close to the existing cycle storage facility, and therefore this is a substantial improvement over the current arrangements for cyclists.

4.1.26 Network Rail recognise that if a future scheme comes forward to connect the station to the proposed St. Georges Quarter (as described in the response above), then there should be consideration of additional cycle storage and general access arrangements as part of that scheme. Network Rail would welcome to discuss such arrangements with the future schemes promotors and recognise the importance of high-quality cycle provision at its stations.

<u>Huddersfield Station - Western Boundary Line</u>

4.1.27 In response to OBJ 14 and OBJ 23

4.1.28 The preferred option for the station re-modelling described in section 3 of this document requires 4-through platforms and a new northwest Leeds facing bay platform, each of which should provide a minimum operational length of 200m in accordance with the project requirements.

4.1.29 The Tea Rooms are retained and repositioned on the existing island platform, which is to be reduced in width. The Scheme provides minimum clearance from the corners of the Tea Rooms to the platform edge. The radius of proposed track 4, the distance between proposed tracks 4 and 5, and the width of the proposed new island platforms 5 & 6 are all the minimum required for operational safety and to satisfy NTSN mandatory requirements. The sum of these minimum requirements defines the position of track 5 adjacent to the eastern façades of Brian Jackson House, and the position of track 6 adjacent to the columns supporting the Wagon Lift structure, and therefore defines the line of the western boundary. The existing and proposed layout is shown in the long section in Figure 3-18, in section 3.

4.1.30 The fence line can be modified to provide a suitable turning head for Network Rail vehicle use. This would be suitable for Yorkshire Children's Centre use subject to access agreement between Yorkshire Children's Centre and HD1 Developments Ltd.

Huddersfield Station - Impacts on Brian Jackson House

In response to OBJ 14

Fire Access

4.1.31 The proposal does not prevent emergency egress from the northern gable end of Brian Jackson House.

Vehicle Access to Eastern & Southern Façades

4.1.32 In accordance with the logic presented in above, it is not possible to relocate track 5 any further from the eastern façade. This prohibits vehicular access to the eastern and southern facades.

Eastern Façade Windows

4.1.33 The proposed railway works are sufficiently distant from the eastern façade of Brain Jackson House such that the occupants can open the existing windows for ventilation purposes. Any future works to the eastern façade, include replacement of windows, would be subject to discussions with Network Rail regarding the extent of opening and materials.

Huddersfield Viaduct - Impacts on Castlegate Retail Park

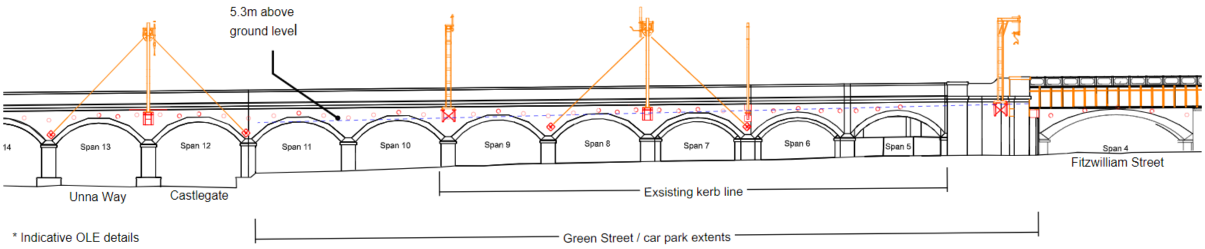
In response to OBJ 15, OBJ 16, OBJ 43 and OBJ 45

4.1.34 The works required by the Scheme to Huddersfield Viaduct, specifically bridges over John William Street, Fitzwilliam Street, and attachment of OLE stanchions, are described in section 3 of this document.

Details of Vehicle Protection Measures to OLE Stanchion

4.1.35 In the area adjacent to the Castlegate Retail Park, the Scheme proposes to install four steel stanchions that support the OLE equipment for the railway. These stanchions are to be fixed into the walls of the existing masonry arches of the viaduct structure. The levels of the supporting brackets have been raised as far as reasonably practicable as shown on the elevation sketch below.

Figure 4-2: Huddersfield Viaduct Elevation from Castlegate Retail Park



4.1.36 The brackets will not achieve full headroom clearances required by highway standards over the car park extents. Network Rail will carry out a risk assessment and either, approve a derogation from standards (if the risk is assessed as acceptably low), or install additional protective measures at road level. These may entail high sided "Trief" type kerbs (or other similar measures) in discrete locations around the stanchion locations.

Disturbance and Loss of Car Parking during Construction

4.1.37 The works to repair Fitzwilliam Street Bridge, reconstruct the deck of John William Street Bridge and the installation of OLE support brackets will all require some access and disturbance to the Castlegate Retail Park. I defer to evidence provided by Mike Pedley in his Construction Methodology Proof regarding any construction arrangements that may affect the Retail Park.

4.2 Ravensthorpe Area

4.2.1 This section covers my response to objections within the environs of Ravensthorpe including the railway grade separation proposed in that area. My response will relate to the overall option selection and development of the Scheme with respect to the railway works only and how these works have been refined to minimise impacts in the local area. I defer to our Highways Expert Witness, Chris Williams, to respond to matters raised with respect to highway design, specifically Calder Road, which is to be diverted as part of the grade separation.

4.2.2 Objections (whole or part) addressed in my evidence include:

- **OBJ 07** Shackleton's Ltd.
- **OBJ's 18 to 22** Hargreaves (GB) Ltd, Newlay Asphalt Ltd, Newlay Readymix Lt, Newlay Concrete Ltd, Dewsbury Sand and Gravel Ltd.
- **OBJ 29** Wakefield Sand and Gravel
- **OBJ 42** Veolia

4.2.3 At the outset I refer to and rely on the information that has already been deposited with the Order and the preceding Chapters 3.1 and 3.2 of this document:

- Design and Access Statement **(NR15)**
- Planning Drawings **(NR13)**
- Network Rail SoC **(NR28)** Section 6 and Appendix B

Option Selection and Design Development

In response to OBJ's 18 to 22 and OBJ 29

4.2.4 The proposed layout of the Scheme, and therefore resultant impacts in the Ravensthorpe area, was driven by the key decision points described in sub-sections below. These decisions were made during a carefully planned option selection and design development process, the basis of which has been consistently applied across the TRU Programme.

Option Selection and Design Development Process

4.2.5 The whole Engineering and Design option selection process, which I have led through GRIP3 to date, is explained in SoC Appendix B Section B.4. I have summarised that process in earlier sections of this Proof of Evidence. It is useful to initially review the overall timeline of decision making as follows:

- **GRIP3 Phase 1, Initial Option Selection**. This phase beginning in April 2017 covered the initial selection of a preferred scheme to support the TRU initial business case submission made to the Department of Transport (DfT) by Network Rail in December 2017.
- **GRIP3 Phase 2, Preferred Option Validation**. This phase was used to challenge and test the preferred option (including the re-evaluation where necessary of discarded or new alternatives) to confirm the single option selection. This phase began in January 2018 and concluded in November 2019 and included the initial consultation events held in September 2019. The GRIP3 stage-gate meeting was subsequently held in early December 2019.
- **GRIP4, Option Development (for TWAO)**. This early part of GRIP4 was used to further develop the preferred Scheme option and refine sub-alternatives for individual assets or specific localised interventions. This was to develop sufficient engineering and design detail to prepare a TWA Order. This phase began in January 2020 and concluded in June 2020 and included the second phase of consultation held in March 2020.
- **TWAO Preparation**, to prepare all necessary documentation required for an Order submission. From a design perspective this included Land and Works plans, Planning/Listed Building Drawings, and Design and

Access Statements to support the applications for deemed planning permission and listed building consents.

GRIP3 Phase 1, Initial Option Selection

4.2.6 The key decision taken during this early part of GRIP3 was the selection of the preferred "end to end" operational layout. Four layout options were presented at an "Expert Panel" meeting held on 25th August 2017. The options presented at that meeting comprised of:

Table 4-1: Operational Options taken forward to "Expert Panel" review at GRIP3

Option	Description
1A	Operational Layout 1 with a Flyover grade separation at Ravensthorpe
1B	Operational Layout 1 with a Dive-under grade separation at Ravensthorpe
5A	Operational Layout 5 with a Flyover grade separation at Heaton Lodge
5B	Operational Layout 5 with a Dive-under grade separation at Heaton Lodge

4.2.7 The recommendation made by the Expert Panel was that Options 1A and 1B were to be taken forward into GRIP3 design development and Options 5A and 5B were to be deferred. Further to the above, option 1A was the preferred Single Development Option choice for the DfT Interim GRIP3 business case submission.

4.2.8 Operational Layout 1 has new fast lines constructed to the South side of the existing railway corridor with the existing lines slewed and/or re-used as required to form the proposed slow lines. This operational layout requires a grade separation in the Ravensthorpe area in the vicinity of the existing Thornhill LNW Junction, where the new proposed fast lines can cross the Wakefield lines as they diverge from the Transpennine route.

4.2.9 The recommendations made by this panel were subsequently presented to the TRU Development Steering Group on 22nd September 2017 and the decision endorsed in a TRU Programme Delivery Group (PDG) Paper. Appendix 2 "Ravensthorpe Option Selection Evidence" contains documentation from the Expert Panel review and PDG as follows:

- 4 No. General Arrangements Drawings for the Ravensthorpe and Heaton Lodge areas for Operational Layouts 1A, 1B, 5A and 5B showing the different grade separation options considered. These are as presented at the Expert Panel Meeting in August 2017.

- The PDG paper which endorses and summarises the decision making from the Expert Panel Meeting. This paper references the Option Selection Report (OSR) Appendix A "Option Capture Summary".
- OSR Appendix A, which documents all the option selection carried out including summary descriptions for "end to end" operational layouts 1A, 1B, 5A and 5B and sub-option selections within those layouts. It also contains summary scoring matrices recording the Expert Panel views against the TRU option evaluation criteria.

GRIP3 Phase 2, Preferred Option Validation

4.2.10 During the early part of this second phase of GRIP3, engineering and design development of the two grade separation options at Ravensthorpe (1A, Flyover and 1B Dive-under) was carried out, to develop them into viable schemes with a sufficient level of detail to conduct an option validation appraisal. During this period the TRU PDG requested that the previously discarded option 5A was to be included within this validation exercise, and this option was therefore also developed to a similar level of detail.

4.2.11 An Option Validation Panel meeting was held on 18th April 2018 (VP2), with a follow up meeting held on 13th June 2018 (VP3) to close out remaining actions from the VP2 meeting. The outcome from those meetings was that option 5A was to be deferred (validating the previous 2017 decision) and both Options 1A and 1B were to be retained for further design development. Appendix 2 contains documentation from the VP2 & VP3 Meetings as follows:

- VP2 Option Selection Scoring Matrix (which was completed following outstanding actions reviewed at the VP3 meeting)

4.2.12 There then followed an intensive period (spanning approximately 12 months) of GRIP3 design development across the whole W3 scheme, including both Ravensthorpe grade separation options. The aim was to achieve a level of design certainty, including potential impacts on third party land and property, that could be put forward for external consultation as part of the TWA Order process.

4.2.13 As part of the above development phase a further engineering appraisal of the Ravensthorpe options was held on 21st June 2019. This was to assess if there was sufficient evidence, based on the additional engineering development, to select one option, or to continue with two options. This result of this review was a firm recommendation to the Scheme Sponsor, that both options should be included in the first stage consultation (which was then programmed for September 2019), and also to be taken forward into the GRIP3 Stage Gate process. This recommendation was endorsed, and consequently both Ravensthorpe grade separation options were presented during the Consultation event in September 2019 and associated affected 3rd party meetings held around that time. Appendix 2 contains documentation from the June 2019 review as follows:

- 2 No. GA Drawings for the developed schemes at Ravensthorpe for options 1A (Flyover) and 1B (Dive-under). These drawings represent the options as presented for the following GRIP3 engineering assurance and stage-gate process.
- Engineering Appraisal Scoring Matrix
- Engineering Appraisal Meeting Minutes

4.2.14 The Ravensthorpe options presented in June 2019 were then passed through the full GRIP3 engineering assurance process including Network Rail interdisciplinary design co-ordination (IDC) and review (IDR) plus Network Rail Route Asset Manager (RAM) endorsement. This was in preparation for the GRIP3 Stage-gate due to be held in late 2019

4.2.15 A pre-stage gate meeting was held on 27th November 2019 to understand the outstanding risks around the preferred option of the Flyover prior to the GRIP 3 Stage-gate. Additionally, the endorsement of the Flyover option from key Network Rail stakeholders (Route Asset Management team and the Operations and Maintenance teams) was re-confirmed. The meeting was attended by the sponsor, designers, engineering assurance reps, consents reps and the construction team. At this meeting it was agreed that the Flyover would be progressed for further GRIP4 development as the preferred option, whilst the Dive-under would be paused. This meant that no further GRIP Stage 4 asset level engineering design was to be undertaken on the Dive-under scheme as a sufficient level of development already existed to aid further comparison once the Flyover scheme had been developed further.

4.2.16 As part of the GRIP3 Stage-gate meeting held on 11th December 2019, the options approach described above was reviewed and endorsed and passed for further engineering development during GRIP4. Appendix 2 contains documentation from the GRIP3 Stage-gate and Pre-Stage-gate meetings as follows:

- Pre-Stage-gate meeting minutes
- GRIP3 Stage-gate certificate
- GRIP3 Stage-gate minutes and actions

GRIP4 Option Development (For TWAO)

4.2.17 During the early part of GRIP4 (January to April 2020), further design development was carried out on the Flyover option. This included the development of detailed construction methodologies (including track access planning), delivery programme and cost estimates. A similar detailed construction assessment, programme and costs were carried out for the Dive-under option against the design that had been frozen at GRIP3. The option development included many refinements to the Flyover grade separation track alignments, OLE clearances and related infrastructure optimisations, and these are described in Section 3.2 of my Evidence This process led to a final Option Validation Panel meeting held on 7th April 2020. The outcome of this panel meeting was a firm recommendation and endorsement of the Flyover option as the single preferred option, and as subsequently presented in the Scheme TWA documentation. Appendix 2 contains documentation from this final validation meeting as follows:

- A developed GA drawing for the Flyover Option (note the Dive-under GA was frozen at GRIP3)
- Validation review meeting minutes

Option Selection Summary

4.2.18 In summary, I have demonstrated that the option selection and design development of the Ravensthorpe grade separation scheme has followed a comprehensive, objective, and auditable process, which spanned a period of approximately 3 years from original identification of options to final option selection.

4.2.19 The overarching reasons for selecting the Flyover option over the Dive-under option is included within my previous evidence in Section 3, the SoC and other documents submitted in Appendix 2. However, I have summarised the main differentiating Engineering and Design reasons below:

- **Cost**. A detailed cost estimate built up using base quantities and construction methodology was used to compare both options. This showed that the Capital Cost (direct costs and overheads) difference between the two options was approximately £32m in favour of the Flyover option. A Life Cycle Cost analysis over 100 years lifespan of the assets showed a cost difference of approximately £21m again favour of the Flyover option. Therefore, the total Whole Life Cost difference (before any allocation of risk) was more than £50m in favour of the Flyover option. This evaluation did not include a cost risk analysis which would likely show a greater difference

- **Schedule**. The detailed evaluation of the project schedule including railway access (possessions and blockades) demonstrated that the Dive-under scheme would delay the Entry into Service date by at least 9 months. This evaluation did not include a schedule risk analysis which would likely show a greater difference.
- **3rd Party Land impacts**. Evaluation of temporary impacts on 3rd party land and property showed that both options had a similar impact. The Dive-under Scheme had the greatest permanent impact on the Veolia site, whilst for the Flyover Scheme, the permanent impact on the Newlay site was smaller and could be mitigated. Also refer to the following sub-section, which details this issue further
- **Risk**. Although a quantitative risk analysis was not carried out, a simple qualitative assessment favoured the Flyover option. Principal items which may drive risk to cost, or schedule include - ground engineering (inc. shallow mining and mine remediation); excavation and disposal of contaminated materials; and flooding during construction or in operation.
- **Carbon Costs**. The Fly-over option has less than 50% of the volume of structural concrete than the dive-under scheme and a similar amount of structural steelwork. The Dive-under scheme has much greater operational carbon costs mainly due to the running and maintenance of a rainwater pumping system. This is also reflected in the life cycle cost referred to above.
- **Flooding**. This could affect construction or the operational end state. The site of the Dive-under construction would be close to a major flood plain which has experienced recent flood events. Although mitigation measures can be designed, there will always be a significant risk during construction due to overland or ground water flooding. During operation, the greatest risk is due to failure of the pumping system.
- **Operational Safety**. The Dive-under option contains a great deal of operational infrastructure which would require maintenance requiring railway possessions or working close to live lines. The drainage and pumping system would require regular maintenance in enclosed spaces.
- **Environmental**. The eastern end of the Dive-under construction passes through a recent landfill site where there are known cells of asbestos contamination. The general construction techniques to build the Wall, Box and Trough structures below ground would require the excavation of a large amount of material, which may therefore be contaminated. In addition, temporary pumping for excavations may require contaminated ground water to be disposed of.
- **Engineering complexity.** The design and engineering of a large below ground structure within variable ground conditions including shallow mine working is complex as described in the risk commentary above. The viaduct structure over the Calder and Hebble Navigation would need a split-level section which also drives further engineering complexity.

This degree of complexity may drive further cost and schedule risks that have not been accounted for.

4.2.20 With respect to the above points, I also defer to the evidence provided by other expert witnesses: Mike Pedley regarding Construction Methodology, Nigel Billingsley regarding Land & Property and Jim Pearson regarding Environment.

<u>Design Development to Minimise Land, Property and Business Impacts</u>

In response to OBJ's 18 to 22, OBJ 29, OBJ 36 and OBJ 42

4.2.21 I have demonstrated through my evidence above and within Section 3.2, that a crucial part of the option selection and associated design development of the proposed railway works, has been to minimise land, property, and business impacts. Any impacts have been justified through the evaluation of the option selection criteria used, and therefore set against the needs case of the Scheme.

4.2.22 I have previously explained in Section 3.2 that both the Flyover and Dive-under options evaluated at Ravensthorpe require the off-line reconstruction of Calder Road railway overbridge with the consequential re-alignment of Calder Road itself. Both options evaluated had quite different temporary and permanent impacts on land and businesses surrounding Calder Road, which are summarised in the sub-sections below. This was an important aspect that was accounted for in the option selection decision making process.

Calder Road, Land and Property Impacts for the Flyover Scheme

4.2.23 For the preferred Flyover scheme, the summary of effects is shown in the plan below and described in Table 4-2:

Figure 4-3: Flyover scheme, Calder Road

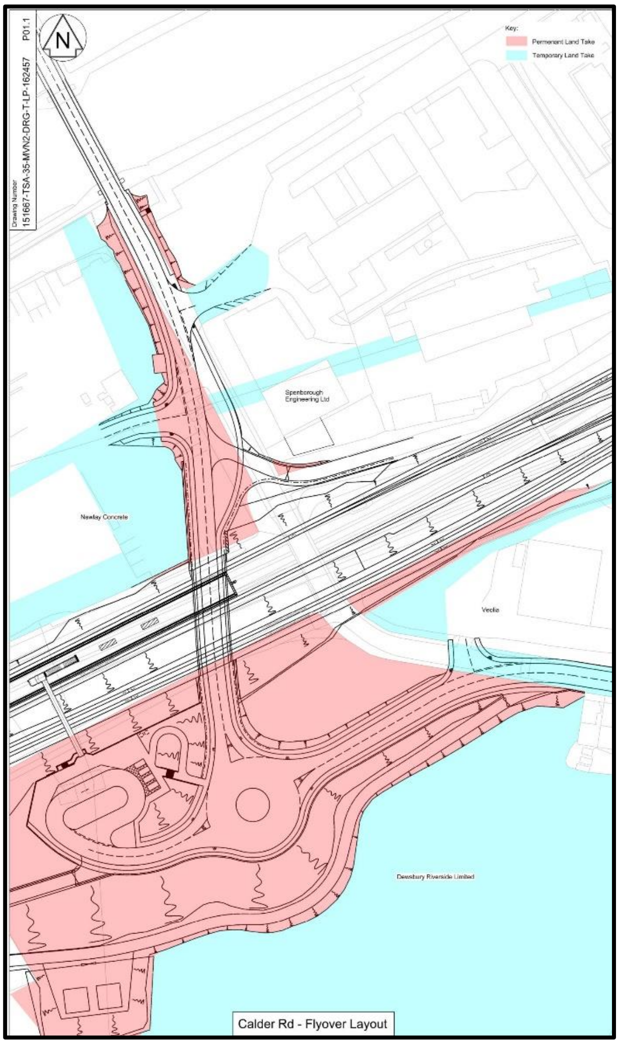


Table 4-2: Ravensthorpe, Flyover land and property impacts

Land Interest	Permanent Effect	Temporary Effect
Newlay	Acquisition of a small triangular plot of land on the SE corner of the site which currently houses part of a ready-mix concrete batching plant and associated materials storage.	Temporary acquisition of land to carry out HV utility diversions including 132KV overhead line and de-commissioning and re-routing of 33KV underground cables (quantum judged to be similar in both options).
Business Park inc. Spenborough Engineering		Acquisition of land to re-configure the highway access onto Calder Road.

Land Interest	Permanent Effect	Temporary Effect
		Acquisition of land to carry out HV utility diversions including 132KV overhead line de-commissioning (quantum judged to be similar for both options)
Veolia	Acquisition of a thin strip of land on the northern boundary of the site for earthworks and to establish a new fenced boundary.	Acquisition of land along the northern boundary to carry out gas main diversions Acquisition of land on the southwest corner of the site for construction vehicle access to carry out earthworks for the grade separation
Dewsbury Riverside Developments	Acquisition of land for an earthwork cutting to accommodate the railway works, the station works, the Calder Road works, and the utility diversion works (quantum judged to be similar for both options).	Acquisition of land for construction access and to carry out the HV utility diversions (quantum judged to be similar for both options)
Newlay	Acquisition of a small triangular plot of land on the SE corner of the site which currently houses part of a ready-mix concrete batching plant and associated materials storage.	Temporary acquisition of land to carry out HV utility diversions including 132KV overhead line and de-commissioning and re-routing of 33KV underground cables (works judged to be similar in both options).

4.2.24 I also defer to the Evidence provided by others on the above as follows:

- Chris Williams with respect to the development of the Highway design of Calder Road.

- Mike Pedley with respect to temporary effects due to Construction Methodology.
- Nigel Billingsley with respect to Property impact.

Calder Road, Land and Property Impacts for the Dive-under Scheme

For the discounted Dive-under, the summary of effects that were understood at the point of option selection* are shown in the plan below and described in Table 4-3 (* However, if this design had been developed further, some additional land impacts may have been identified):

Figure 4-4: Dive-under scheme, Calder Road

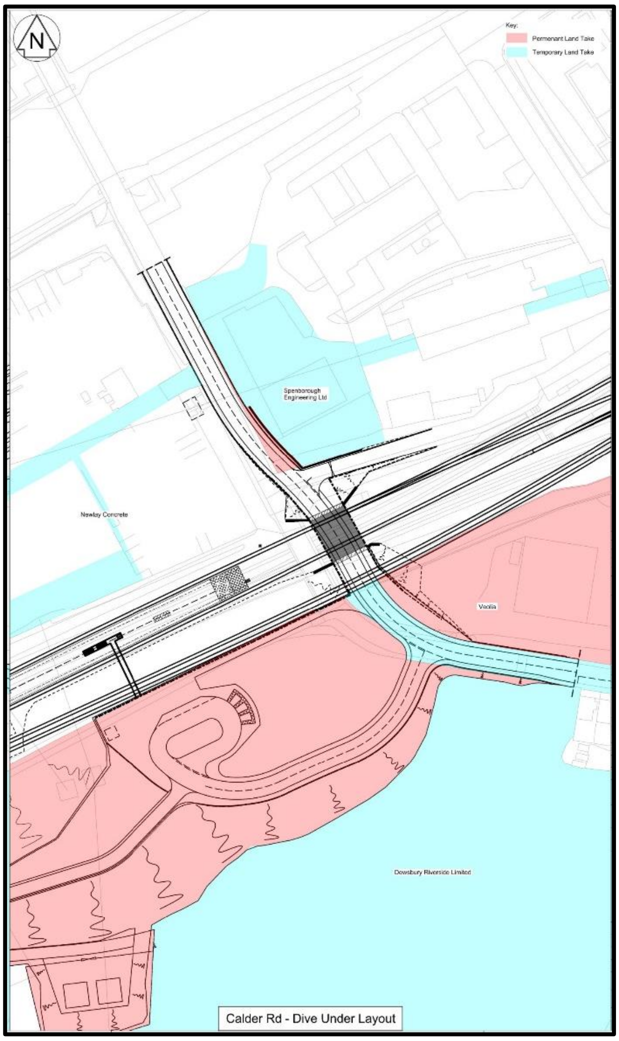


Table 4-3: Ravensthorpe, Dive-under land, and property impacts

Land Interest	Permanent Effect	Temporary Effect
Newlay	None identified *	Temporary acquisition of land to carry out HV utility

Land Interest	Permanent Effect	Temporary Effect
		diversions including 132KV overhead line and de-commissioning and re-routing of 33KV underground cables (quantum judged to be similar in both options). Acquisition of land around the site entrance to re-model the tie-in into the new Calder Road highway alignment.
Business Park inc. Spenborough Engineering	Acquisition of a small triangular portion of land in the southwest corner of the site to construct the re-aligned highway and supporting retaining wall	Acquisition of land to carry out HV utility diversions including 132KV overhead line de-commissioning (quantum judged to be similar for both options) Temporary rights to monitor buildings and equipment within buildings and carry out repair works as necessary.
Veolia	Acquisition of a small triangular section of land in the northwest corner to construct the re-aligned highway and to construct the dive-under retaining walls	Acquisition of the whole of the site to enable construction of the dive-under retaining structures and nearby highway works.
Dewsbury Riverside Developments	Acquisition of land for an earthwork cutting to accommodate the railway works, the station works, and the utility diversion works (quantum judged to be similar for both options)	Acquisition of land for construction access and to carry out the HV utility diversions (quantum judged to be similar for both options)

4.2.25 I also defer to the Evidence provided by others on the above as follows:

- Chris Williams with respect to the development of the Highway design of Calder Road.
- Mike Pedley with respect to temporary effects due to Construction Methodology.
- Nigel Billingsley with respect to Property impact.

Design Development to Minimise Scheme Impacts on the Newlay Site

In response to OBJ's 18 to 22 and OBJ 29

4.2.26 In the above sections I have demonstrated the process by which the preferred Scheme option was evaluated and selected. As a result of the selected Flyover option, there are both permanent and temporary impacts to the Newlay Site, which was recognised as part of the option selection process.

4.2.27 I understand that an important part of the evaluation was the ability of the Scheme to minimise such impacts with the aim to keep the Newlay site and associated businesses operating as viable concerns, both during the temporary construction phases and in the new permanent condition.

4.2.28 I have previously described in section 3.2 how the design development of the railway works was refined and optimised to limit the effects on the Calder Road re-alignment for the preferred Flyover scheme.

4.2.29 I defer to the Evidence provided by others on the above as follows:

- Chris Williams with respect to the development of the Highway design of Calder Road.
- Mike Pedley with respect to temporary effects due to Construction Methodology.
- Nigel Billingsley with respect to Property impact.

Design Development to Minimise Scheme Impacts at Weaving Lane

In response to OBJ 07

4.2.30 The works to the rear (north-west) of the Shackleton's building form part of the construction of the new Weaving Lane retaining wall. This extends from the abutment of new viaduct over the River Calder (Baker Viaduct), behind the Suez recycling centre and then behind the Shackleton's building.

4.2.31 The retaining wall, which be greater than 2m in height and reducing in height from south-west to north-east behind the building (to no lower than 2m), is proposed to be offset from the main building by at least 5m and would be at least 2m clear of a small building which houses a compressor unit. Due to the height of the wall, it will form the boundary to the railway and the existing palisade fence will be removed. An area of up to 2m in width in front (on the building side) will be retained by Network Rail for periodic access to inspect and maintain the wall.

4.2.32 At the north end of the retaining wall, a new palisade fence with a minimum height of 1.8m will tie into the front of the retaining wall, forming the secure boundary to the railway at this location.

4.2.33 The wall has been designed so that there are no permanent impacts to the Shackleton's building. I defer to the evidence provided by Mike Pedley in his Construction Methodology Proof to describe the temporary impacts due to the wall construction.

4.3 Deighton and Bradley Area

4.3.1 This section covers all objections within the railway corridor in and around the environs of Deighton Station and the A62 Leeds Road. Objections (whole or part) addressed in this section include:

- **OBJ 09** Bramall properties Ltd.
- **OBJ 10** WPC REIT
- **OBJ 13** JJIG Ltd and Buy it Direct Ltd.

<u>Vehicle Restraint and Fence Line Works at Volkswagen Garage</u>

In response to OBJ 09

4.3.2 The works affecting Bramall Properties (the Volkswagen garage) include the installation of vehicle restraint systems (VRS) and to replacement of the fence line along the railway boundary. These works are required to protect the railway from errant vehicles, to prevent unauthorised access onto the railway, and to generally protect the employees or customers using the garage site from the adjacent 4-track electrified railway corridor.

4.3.3 The VRS works will be limited to the area on upper deck of car park opposite the vehicle entrance from the A62 Leeds Road for the protection of the railway (replacement or upgrade of the current provision) as well as the area opposite the ramp to the lower deck of the garage's operation, again for the protection of the railway.

4.3.4 The fence line works will be required along the entire boundary (including to the rear of the VRS works opposite the ramp) and will not require the relocation of the fence line any closer to the building than the current fence line. This will not interfere with key elements of the property including the air conditioning units, external staircase, fire exits and vehicle turning areas.

4.3.5 I defer to the evidence provided by Mike Pedley in his Construction Methodology Proof to describe the temporary effects due to construction.

Proximity of Railway and OLE Equipment to Adjacent Businesses

In response to OBJ 10 and OBJ 13

4.3.6 This section of the scheme is very narrow and has provided significant challenges, which have been overcome by careful engineering and design including narrowing of the railway corridor by reducing the track centres.

4.3.7 For the large Buy-it-Direct warehouse **(OBJ 10)**, the railway will be supported by a retaining wall which will be no less 3.5m from the building (in line with the Limit of Deviation for Work No. 5). The fence line will sit upon the retaining wall, which will reduce and move further from the building towards moving north along the building. There will be no impact on the ability to use any of the emergency doors which are located to the rear of the building.

4.3.8 In this location, the OLE will be sufficiently clear of the building so that there will be no requirement for an isolation (of the OLE equipment) or possession of the railway while the occupiers of the warehouse are undertaking routine maintenance of the buildings (subject to them not oversailing the boundary fence) or conducting security patrols.

4.3.9 At the north of the large warehouse, works are proposed to Bradley Culvert, MVL3/102A. The culvert is not proposed to be extended on the east side of the railway and any works to the culvert and permanent land acquisition associated with it in this location would be outside of the ownership of the objector. Access and occupation of the land would be required on a temporary basis.

4.3.10 Immediately to the rear of the new Buy-it-Direct warehouse **(OBJ 13)**, the railway will also be supported by a retaining wall, upon which the fence line will be provided. This wall and fence will be positioned such that it will not reduce the available width to the rear of the building or access to the three fire escape doors on this side of the building.

4.3.11 Here, the OLE is also sufficiently clear of the building that there would be no requirement for a possession or isolation on the railway during routine maintenance of their building (subject to them not oversailing the boundary fence), or regular security patrols.

4.3.12 I defer to the evidence provided by Mike Pedley in his Construction Methodology Proof to describe the temporary effects due to construction.

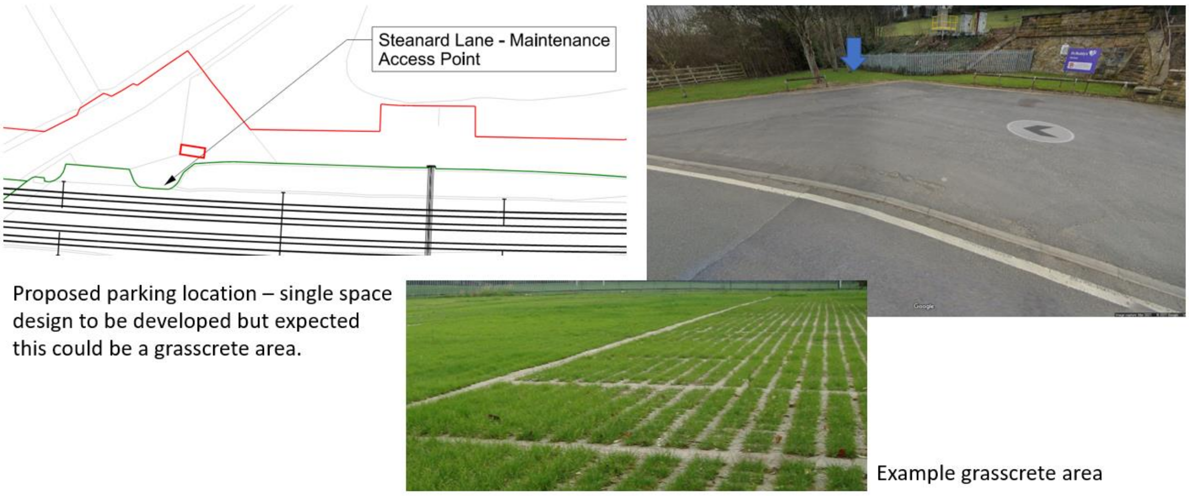
<u>A62 Leeds Road Bridge Highway Re-Alignment</u>

4.3.13 I defer to our Highways expert witness Chris Williams who will describe the design development points and response to an objection from the local highway authority (Kirklees) in his Proof of Evidence.

4.4 OBJ 26 - Dr Reddy's

4.4.1 It is proposed to provide a maintenance access point to the railway to the east of Steanard Lane Underbridge, with access gained from the land adjacent to the turning circle that is used to gain access to Dr Reddy's Mirfield facility. A "grass-crete" area will be provided on the grass verge, clear of the turning circle so that access to the turning circle will not be restricted.

Figure 4-5: Dr Reddy's maintenance access point



4.4.2 The works have been designed so that there are no permanent impacts to the Dr Reddy's access. I defer to the evidence provided by Mike Pedley in his Construction Methodology Proof to describe any temporary impacts during construction of all planned works in the vicinity of Dr Reddy's.

4.5 OBJ 35 - Canal & River Trust

4.5.1 The scheme has been consulted extensively with Canal and Rivers Trust throughout the design development stages and I have taken feedback onboard and incorporated this into design where reasonably practicable.

<u>Canal Overbridges, Design development to protect the waterway</u>

Existing Underbridge MVL/108S

4.5.2 Huddersfield Broad Canal Bridge is a 19.5m span half-through wrought iron structure. The structure is currently fenced off due to extensive corrosion in the deck plate, whilst the other half has a concrete slab and is used as an access track. The access track has a 3T weight limit sign. The existing structure houses a 200mm diameter Yorkshire Water sewer.

4.5.3 It is proposed to install a modified Network Rail standard design bridge deck on the existing substructure to accommodate the new Fast Lines. The existing Yorkshire Water sludge main will be diverted onto a new adjacent pipe bridge structure. The pipe bridge is designed to be visually similar to the adjacent railway bridge structure following feedback from Canal and Rivers Trust.

Figure 4-6: Huddersfield Broad Canal Underbridge, Visualisation from the canal

4.5.4 The soffits of proposed railway underbridge and pipe bridge will match that of the existing structure and will therefore maintain the existing headroom over the canal. The existing abutments are reused to minimise disturbance to the canal.

4.5.5 During construction the waterway will be protected. For further information, refer to evidence provided by Mike Pedley in his Proof on Construction Methodology.

New Structure "Baker Viaduct"

4.5.6 The Scheme passes over the Calder and Hebble Navigation and River Calder on a new structure, the Baker Viaduct. Significant optioneering was undertaken to deliver a solution which provided the required functionally for the operational railway whilst also promoting a design which respects its place in the landscape.

4.5.7 The height of the viaduct as it passes over the Calder and Hebble Navigation is dictated by the vertical geometry of the grade separated junction to the west, and existing railway alignment to the east. This results in a headroom of approximately 6m. The form and span of the structure over the canal was developed in consultation with the Canal and River Trust. Design elements included coordination of the piers to the canal, use of a bank seat support to the west to reduce the visual impact, and careful consideration of materials.

4.5.8 Once constructed, the Baker Viaduct will allow the canal and tow path to operate as it does today. I defer to Mike Pedley' s Proof of Evidence regarding the construction phase.

Figure 4-7: Visualisation of the Baker Viaduct

Acquisition of Land leading to Colne Bridge Lock

4.5.9 There are several reasons why the land leading to the Colne Bridge lock (Colne Bridge Lock 2) is required as part of the permanent scheme, which are described in the following sub-sections:

Road Rail Plant Access Point (RRAP)

4.5.10 There is a Network Rail requirement for a RRAP in the Colne Bridge area:

- The current RRAP, located to the west of Colne Bridge Road, needs to be re-located due to the four-tracking of the railway. The access point provides access to both Bradley Junction and the western side of Heaton Lodge. The four-tracking makes this access point and associated RRAP essential as vehicular access is lost (currently vans can drive from here to Bradley Junction and towards Heaton Lodge on the old track beds, but this facility will be lost).
- The next nearest RRAPs will be Hillhouse to the west, and Mirfield to the east. Hillhouse's main purpose is to serve Huddersfield station and Mirfield's is to serve the Mirfield Corridor (Heaton Lodge East to Ravensthorpe). As such, these two are likely to be busy access points so putting additional pressure on them to serve the Bradley Junction area is not a good practice, particularly as other disciplines maintenance activities will increase, and it will also be electrified. The possession Blocking Points & Earthing Points may not enable this in any case.

- Station Road (at Bradley) was considered but deemed unsuitable due to the restricted access for HGVs.
- The other two RRAPs noted above are accessed from the Down-line side, whereas Colne Road is accessed from the Up-line side. Given that most possession opportunities are likely to be two lines only (fasts lines or slows lines), the Scheme needs RRAP for access flexibility.

Signalling Power, Auxiliary Supply Point (ASP)

4.5.11 The position of the proposed key signalling equipment (Auxiliary Supply Point, ASP) (replacement of the Principal Supply Point (PSP) due to 4-tracting) is key in mimicking the current signalling power network, and support of equipment along the Bradley – Bradley Wood corridor. The proposed ASP will reuse the DNO connection currently agreed between the DNO and NR.

4.5.12 A new access from the realigned Colne Bridge Road is required. To provide a compliant access, which can be gated, supporting earthworks are required due to the level differences from the realigned highway. Access for HGVs is required to the RRAP. The layout of the facility provides a hammer head for turning to minimise the spatial requirements.

Maintenance and Welfare Facilities

4.5.13 Maintenance parking and welfare facilities are proposed at this location which are required by Network Rail due to the other facilities being provided. There are no other suitable welfare facilities in the vicinity.

4.5.14 There is also a requirement to maintain access for the Canal and River Trust to the Bradley lock. The design needs to accommodate access for the Trust and the requirements (in terms of vehicles sizes) have been requested. Further to this requirement, there will be a need to segregate the operational railway elements from the areas the Trust.

5. WITNESS DECLARATION

5.1 Statement of declaration

5.1.1 This Proof of Evidence includes the facts which I regard as being relevant to the opinions which I have expressed, and the Inquiry's attention has been drawn to any matter which would affect the validity of that opinion.

5.1.2 I believe the facts which I have stated in this PoE are true and that the opinions expressed are correct, and,

5.1.3 I understand my duty to the Inquiry to help it with the matters within my expertise and I believe I have complied with that duty.