Environmental Statement

Volume 2i: Scheme-wide Assessment

Chapter 8: Noise and vibration

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8. NOISE AND VIBRATION

Summary of principal findings

This chapter presents the assessment of noise and vibration effects associated with the construction and operation of the Huddersfield to Westtown (Dewsbury) section of the Transpennine Route Upgrade (TRU) Programme. This chapter covers the assessment of the entirety of the Huddersfield to Westtown (Dewsbury) Route ('the Scheme').

The assessment of potential noise and vibration impacts during construction and operation of the Scheme has been undertaken in line with relevant policy, legislation, technical standards and guidance documents. In addition to measured noise and vibration levels, existing published sources have been used for describing the baseline environment in the study area. The suitability of the overall assessment methodology has been agreed with the local authority.

Potential effects

Without appropriate mitigation measures, there will be potential significant adverse effects from noise associated with construction activities at 46 noise sensitive receptors (NSR) along the route in relation to works during normal core daytime hours.

Night-time construction activities at the Hillhouse Compound have the potential to cause significant adverse effects at nearby NSR owing to the level of noise and the duration of works.

Additional night-time working would be required at some locations, predominantly overhead line equipment, track work, and structures such as bridges, but would not typically be of a sufficient duration to lead to significant adverse effects.

There are potential temporary significant adverse effects from construction traffic on 19 roads affecting approximately 1250 NSR.

There are no predicted significant adverse effects on people from construction vibration at residential NSR. There are potential significant effects on the operation of Dr Reddy's pharmaceutical plant, in terms of the use of precision equipment during vibratory construction works (such as compaction and piling). There is potential for cosmetic damage to 27 buildings located close to potential sources of construction vibration.

Assessments of operational noise have been undertaken at 5165 NSR identified in the study area. Without mitigation, it is shown that there would be potential significant adverse effects at 65 NSR during the day and 34 NSR at night (totalling 70 NSR).

There are no predicted significant adverse effects from noise from fixed mechanical plant or the public address systems at the new, temporary, or refurbished stations.

There are no predicted significant adverse ground-borne vibration or ground-borne noise effects from the operation of the Scheme.

There are predicted significant adverse effects due to the temporary and permanent operation of stabling sidings at the Hillhouse Compound, particularly due to idling trains during night-time periods.

There are significant adverse effects at two NSR, namely no. 24 & 26 Brooks Yard in relation to realignment of Thornhill Road which is required to facilitate the Scheme.

Mitigation

Mitigation measures set out in the Code of Construction Practice (CoCP) will be implemented to minimise noise and vibration impacts during construction. Temporary traffic diversions and traffic routes will be managed by a Construction Traffic Management Plan (CTMP).

To minimise impacts from the operation of the Scheme, mitigation measures will be implemented in the form of noise barriers at eight locations, subject to feasibility, and statutory noise insulation under the Noise Insulation (Railways and Other Guided Transport Systems) Regulations 1996 (NIRR). There are also a further 16 NSR experiencing significant adverse effects, but which are not expected to prove eligible for statutory noise insulation under the NIRR. Non-statutory noise insulation may be offered at these NSR, on a case-by-case basis, if reasonable acoustic conditions are not achievable with the existing glazing and ventilation provision, this will be subject to further assessment.

Significant adverse effects of noise from the operation of the temporary and permanent stabling sidings at the Hillhouse Compound will be mitigated by noise barriers, non-statutory noise insulation, and site management.

Residual effects

With the application of mitigation measures described in the ES, there are no predicted significant residual adverse noise and vibration effects from construction activities within the Scheme footprint. There are, however, temporary and short-term significant adverse effects in the wider study area due to construction traffic and temporary road diversions.

During the operation of the Scheme, with mitigation in place, significant adverse residual effects will be avoided at all NSR in terms of internal amenity. External amenity will also be maintained where noise barriers are introduced. Where barriers are not feasible, there will be residual significant effects in external amenity areas of 14 NSR.

8.1 Introduction

8.1.1 This chapter presents the assessment of noise and vibration effects associated with the construction and operation of the Huddersfield to Westtown (Dewsbury) section of the Transpennine Route Upgrade (TRU) Programme. This chapter covers the assessment of the entirety of the Huddersfield to Westtown (Dewsbury) Route (herein referred to as the 'Scheme'). The noise and vibration assessment is further broken down into six Route Section Assessments in Volume 2ii of this Environmental Statement (ES) which provide additional detail to this chapter.

8.1.2 This chapter is set out as follows:

- Legislative and policy context – relevant international, national and local policy requirements, legal requirements and guidance which have been used to define the assessment approach are outlined;
- Assessment methodology – the methodology the assessment follows is defined including the justification for the study area and the approach for determining significance of effects;
- Baseline – a summary of the noise and vibration baseline within the study area is provided;
- Potential effects – the potential impacts and effects (both beneficial and adverse) during construction and operation are characterised;
- Mitigation measures – agreed avoidance, mitigation, compensation and enhancement measures are described;
- Residual effects – the significance of residual effects (both beneficial and adverse) following the implementation of mitigation measures are assessed; and
- Cumulative effects - the potential likely significant cumulative effects of the Scheme are described.

8.1.3 A detailed description of the Scheme is provided in Chapter 2 (Scheme description) of this ES and all appendices and figures referred to in this chapter are provided in Volumes 3 and 4 of this ES respectively.

8.1.4 Receptors that are sensitive to noise and/or vibration include residential buildings, schools and educational facilities, hospital and medical facilities, community facilities, and places of worship. These are referred to as Noise and vibration Sensitive Receptors (NSR) within this chapter.

8.1.5 Noise and/or vibration related impacts on the historic environment, ecological receptors, Public Rights of Way (PRoW), and agricultural land are reported in Chapters 6 (Historic Environment), 9 (Biodiversity), 15 (Population and human health), and 19 (Agriculture) of the ES, respectively.

8.1.6 Construction related activities that have the potential to cause noise and/or vibration effects at NSR include:

- Setup of site compounds (short-term stationary);
- Operation of site compounds (long-term stationary);
- Construction or diversion of drainage and culverts (long-term and short-term stationary);
- Earthworks (including soil pinning) (long-term and short-term stationary);
- Retaining Walls (long-term and short-term stationary);
- Stations (long-term stationary);
- Structures (long-term and short-term stationary);
- Utilities and Distribution Network Operators (DNO) (long-term and short-term stationary);

- Track laying and top ballast laying (short-term linear); and
- Installation of Overhead Line equipment (OLE) (short-term linear).

8.1.7 Stationary works are those that would occur at a relatively fixed location for the duration of the specific activity, such as a structure or a compound, while linear works are those that will move along the track, with works at a specific location for a relatively short duration.

8.1.8 Activities related to the operation of the Scheme that have the potential to cause noise and/or vibration effects at NSR include:

- Changes in route capacity (i.e. increase or decrease in train movements);
- Changes in train speeds along the route;
- Realignment of tracks moving source closer to or further away from NSR;
- Changes in type of locomotive and rolling stock (including freight and passenger);
- Local track conditions (track type, points, crossings, curve squeal);
- Changes to station locations;
- Fixed mechanical plant and station Public Address (PA) equipment at new or upgraded stations;
- Operation of proposed stabling sidings; and
- Road realignments required by the Scheme.

8.1.9 Maintenance activities are an existing part of the operation of the railway. Noise impacts from such activities would therefore not fundamentally change due to the Scheme and are scoped out of the assessment.

8.2 Legislative and policy context

National policy

Overarching national policy guidance

National Planning Policy Framework

8.2.1 The National Planning Policy Framework (NPPF) was introduced by the Department of Communities and Local Government (DCLG) in March 2012 and subsequently revised in 2018 and 2019. The document sets out the Government's planning policies for England and how these are expected to be applied.

8.2.2 The NPPF includes statements relating to noise and the requirement to take it into account in the planning process. Section 170 of the NPPF indicates that the planning system should contribute to and enhance the natural and local environment by:

> *"preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability. Development should, wherever possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans."*

8.2.3 Section 180 is specifically related to noise and requires planning policy decisions to:

- "mitigate and reduce to a minimum, potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life"; and

- "identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason".

8.2.4 The terms 'adverse impacts' and 'significant adverse impacts' are defined within the explanatory note of the Noise Policy Statement for England, 2010 (NPSE).

Noise Policy Statement for England

8.2.5 The NPSE sets out the long-term vision of Government noise policy: to promote good health and a good quality of life through the effective management of noise within the context of Government policy on sustainable development.

8.2.6 The NPSE outlines three aims for the effective management and control of environmental, neighbour and neighbourhood noise:

- Avoid significant adverse impacts on health and quality of life;
- Mitigate and minimise adverse impacts on health and quality of life; and
- Where possible, contribute to the improvement of health and quality of life.

8.2.7 In its aims, the NPSE uses the key phrases 'significant adverse' and 'adverse'. The NPSE states in its explanatory note that there are two established concepts that are currently being applied to noise impacts, which are:

- NOEL – No Observed Effect Level. This is the level below which no effect can be detected; and
- LOAEL – Lowest Observed Adverse Effect Level. This is the level above which adverse effects on health and quality of life can be detected.

8.2.8 The NPSE then extends this concept to include:

- SOAEL – Significant Observed Adverse Effect Level. This is the level above which significant adverse effects on health and quality of life occur.

8.2.9 The NPSE notes that it is not possible to have a single objective noise-based measure that defines SOAEL that is applicable to all sources of noise in all situations. Consequently, the SOAEL is likely to vary for different noise sources, receptors and times. Relevant SOAELs have been identified for the Scheme taking account of the sources of exposure and receptors.

Planning Practice Guidance for Noise, 2014

8.2.10 The Planning Practice Guidance for Noise (PPGN) provides further detail about how the effects of noise can be categorised. The noise exposure hierarchy from PPGN is reproduced in Table 8-1.

Table 8-1 PPGN noise exposure hierarchy

Response	Example of outcomes	Increasing effect level	Action
Not present	No effect	No Observed Effect	No specific measures required
Present and not intrusive	Noise can be heard, but does not cause any change in behaviour, attitude or other physiological response.	No Observed Adverse Effect	No specific measures required

Response	Example of outcomes	Increasing effect level	Action
	Can slightly affect the acoustic character of the area but not such that there is a change in the quality of life.		
Lowest Observed Adverse Effect Level (LOAEL)			
Present and intrusive	Noise can be heard and causes small changes in behaviour, attitude or other physiological response, e.g. turning up volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance. Affects the acoustic character of the area such that there is a small actual or perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum
Significant Observed Adverse Effect Level (SOAEL)			
Present and disruptive	The noise causes a material change in behaviour, attitude or other physiological response, e.g. avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area.	Significant Observed Adverse Effect	Avoid
Present and very disruptive	Extensive and regular changes in behaviour, attitude or other physiological response and/or an inability to mitigate effect of noise leading to psychological stress, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory.	Unacceptable Adverse Effect	Prevent

National Policy Statement for National Networks

8.2.11 The National Policy Statement for National Networks (NPS), sets out government policies for nationally significant infrastructure rail and road projects. In England, the NPS may also be a material consideration in decision making for applications that fall under the Town and Country Planning Act 1990 or any successor legislation. Whilst the Scheme is seeking consent under the Transport and Works Act, given the nature of the Scheme as rail infrastructure it is considered appropriate that weight should be given to the principles set out in the NPS.

8.2.12 Paragraphs 5.191 and 5.193 of the NPS set out the following with regards to noise:

"...The prediction of road traffic noise should be based on the method described in Calculation of Road Traffic Noise. The prediction of noise from new railways should be based on the method described in Calculation of Railway Noise 1995. For the prediction, assessment and management of construction noise, reference should be made to any relevant British Standards and other guidance which also give examples of mitigation strategies..."

"...Developments must be undertaken in accordance with statutory requirements for noise. Due regard must have been given to the relevant sections of the Noise Policy Statement for England, National Planning Policy Framework and the Government's associated planning guidance on noise..."

Construction noise and vibration policy guidance

The Control of Pollution Act 1974

8.2.13 The Control of Pollution Act 1974 (CoPA) sets out the framework for the legislative control of construction noise and vibration on any given site. It also sets out the principle of 'best practicable means' (as defined in Section 72 of the Act) and how that should be applied to construction activity noise. The Act refers to approved Codes of Practice, which include British Standards 5228 Part 1 and Part 2, as being relevant for the purposes of determining the 'best practicable means'.

8.2.14 Section 61 of the Act states that consent may be sought from the relevant local authorities prior to the construction works commencing. If prior consent is sought, the relevant local authorities will need to be provided with information about the proposed construction works and how construction noise will be managed, including the use of 'best practicable means'.

Operational noise and vibration policy guidance

The Noise Insulation (Railways and Other Guided Transport Systems) (Amendments) Regulations 1996 (amended in 1998) (NIRR)

8.2.15 The NIRR provide a methodology for assessing whether residential properties are eligible for statutory sound insulation because of a new railway line or, under discretionary powers, alteration of an existing railway line. The duty to carry out insulation work or to make grants is determined by the following criteria:

- The relevant noise level is greater by at least 1 dB than the prevailing daytime or night-time noise level and is not less than the specified daytime or night-time noise level, defined below;
- The noise caused, or expected to be caused, by the movement of vehicles makes an effective contribution to the relevant noise level of at least 1 dB; and
- The dwelling is within 300m of the new and altered railway.

where:

- The relevant noise level is the noise level that is caused or is expected to be caused by the movement of vehicles using the new railway line or the altered railway line;
- The prevailing noise level is the level of noise caused by the movement of vehicles on the relevant system immediately before any construction or alteration works commence; and
- The specified level is 68 dB $L_{Aeq,T}$ and 63 dB $L_{Aeq,T}$ for daytime and night-time respectively.

8.2.16 The daytime period is defined as the period of 18 hours between 0600 hours and midnight. The night-time period is defined as the period of 6 hours between midnight and 0600 hours.

8.2.17 The relevant noise level is calculated using the methodology set-out in the Calculation of Railway Noise 1995 and its Supplement 1 and is based on traffic flows expected under normal operating conditions within a period of 15 years from opening of the new railway line or alteration.

8.2.18 Regulation 8 provides relevant authorities with discretionary powers to undertake or make a grant in respect of the cost of undertaking noise insulation work in or to eligible buildings with respect to construction noise. This is subject to meeting certain criteria given in the Regulation.

Noise Insulation Regulations 1975 (amended 1988) (NIR)

8.2.19 Schemes that make alterations to roads usually require an assessment under the NIR. These regulations give discretionary powers to provide statutory noise insulation to residential properties when certain criteria are met. The duty to carry out insulation work or to make grants is determined by the following criteria:

- The relevant noise level is greater by at least 1 dB than the prevailing noise level and is not less than the specified level, defined below; and
- The noise caused or expected to be caused by traffic using or expected to use that highway makes an effective contribution to the relevant noise level of at least 1 dB.

where:

- The relevant noise level is the noise level expected to be caused by traffic using or expected to use any highway;
- The prevailing noise level is the level of noise caused by traffic using any highway immediately before any construction or alteration works commence;
- The specified level is 68 dB L_{A10} for the 18-hour period 0600-0000; and
- The dwelling or building used for residential purposed is not more than 300 m from the closest point of the new or altered highway.

8.2.20 Night-time noise from roads is not specifically considered by the NIR, but consideration is given to all facades and windows in habitable spaces, including bedrooms.

Local policy

Local planning policy

8.2.21 The Scheme passes through one local authority area; Kirklees Council. Kirklees Local Plan was adopted in February 2019 and contains a number of policies relating to noise from proposed noise generating development.

8.2.22 Policy LP21 relates to highways and access and states:

"Proposals shall demonstrate that they can accommodate sustainable modes of transport and be accessed effectively and safely by all users…"

"…. Proposals shall demonstrate adequate information and mitigation measures to avoid a detrimental impact on highway safety and the local highway network. Proposals shall also consider any impacts on the Strategic Road Network.

All proposals shall:

"…c. be accompanied by a supporting Transport Assessment or Transport Statement where the development would generate significant trip generation, providing detail as to the impact

on highway safety, air quality, noise and light restrictions…"

8.2.23 Policy LP52 relates to the protection and improvement of environmental quality and states:

"Proposals which have the potential to increase pollution from noise, vibration, light, dust, odour, shadow flicker, chemicals and other forms of pollution or to increase pollution to soil or where environmentally sensitive development would be subject to significant levels of pollution, must be accompanied by evidence to show that the impacts have been evaluated and measures have been incorporated to prevent or reduce the pollution, so as to ensure it does not reduce the quality of life and well-being of people to an unacceptable level or have unacceptable impacts on the environment.

Such developments which cannot incorporate suitable and sustainable mitigation measures which reduce pollution levels to an acceptable level to protect the quality of life and well-being of people or protect the environment will not be permitted.

Where possible, all new development should improve the existing environment."

Technical guidance and standards

8.2.24 The following technical guidance and standards are used to inform the assessment. Details of technical guidance and standards are provided in Appendix 8-1.

- Overarching technical guidance and standards:
  - IEMA Guidelines for Environmental Noise Impact Assessment (2014); and
  - Transport Analysis Guidance (2015).
- Construction noise and vibration technical guidance and standards:
  - British Standard 5228-1:2009+A1:2014 – Code of practice for noise and vibration control on construction and open sites – Part 1: Noise (BS 5228-1); and
  - British Standard 5228-2:2009+A1:2014 – Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration (BS 5228-2).
- Operational noise and vibration technical guidance and standards:
  - Calculation of Railway Noise 1995 (CRN);
  - Additional railway noise source terms for "Calculation of Railway Noise 1995". A report produced for the Department for Environment, Food, & Rural Affairs (Defra) by AEAT, 2007 (Defra 2007);
  - Calculation of Road Traffic Noise (1988) (CRTN);
  - Design Manual for Roads and Bridges (DMRB) (2019);
  - British Standard 6472-1:2008 – Guide to evaluation of human exposure to vibration in buildings – Part 1: Vibration sources other than blasting (BS 6472-1);
  - British Standard 4142:2014+A1:2019 – Methods for rating and assessment industrial and commercial sound (BS 4142:2014);
  - British Standard 4142:1997 – Method for rating industrial noise affecting mixed residential and industrial areas (BS 4142:1997);
  - British Standard 8233:2014 – Guidance on sound insulation and noise reduction for buildings (BS 8233);

- World Health Organisation: Guidelines for Community Noise (2000) (WHO GfCN);
- WHO Night Noise Guidelines for Europe (2009) (WHO NNG);
- Professional Practice Guidance: Planning and Noise (2017) (ProPG);
- Building Bulletin 93: Acoustic Design of Schools: performance standards (2015) (BB93); and
- Health Technical Memorandum 08-01: Acoustics (2013) (HTM 08:01).

- Other technical guidance which have informed specific areas of the assessment as required:
  - British Standard 7445-1:2003 – Description and measurement of environmental noise – Part 1: Guide to quantities and procedures;
  - Association of Noise Consultants (ANC) Measurement and Assessment of Groundborne Noise and Vibration: ANC Guidelines (2020);
  - Transportation Noise Reference Book (1987) (TNRB);
  - Federal Transit Administration (FTA) Transit Noise and Vibration Impact Assessment (2018);
  - Transport and Road Research Laboratory Research Report RR 102 (1987);
  - BS ISO 14837- 1:2005 – Mechanical vibration – Ground-borne noise and vibration arising from rail systems – Part 1: General guidance;
  - BS 7385-2:1993 – Evaluation and measurement for vibration in buildings – Part 2: Guide to damage levels from ground borne vibration;
  - International Union of Railways report, 'Managing noise from parked trains' (2014);
  - 'The calculation of noise from railway bridges and viaducts', Bewes O.G., University of Southampton, 2005;
  - RIVAS Deliverable D3.6 entitled 'Description of the vibration generation mechanism of turnouts and the development of cost effective mitigation measures' (2013);
  - Atkins (2014). East West Rail: Phase 1 – Vibration from Switches and Crossings – Assessment and Mitigation, Doc. No. 5114534-ATK-VIB-RPT-80003[1];
  - Network Rail (2009). NR/L2/TEL/30134, Issue 2: Design and Installation Requirements for Public Announcements, Voice Alarm and Long Line Public Announcements Systems; and
  - British Standards Institution (2011). BS EN 60268-16:2011 Sound system equipment, Part 16: Objective rating of speech intelligibility by speech transmission index. London: BSI.

8.3 Assessment methodology

8.3.1 This section describes the study areas and data sources used to undertake noise and vibration assessments for the construction and operational phases of the Scheme, as well as

[1] https://planningregister.cherwell.gov.uk/Document/Download?module=PLA&recordNumber=47456&planId=1186657&imageId=9&isPlan=False&fileName=7440541.pdf [Accessed February 2021]

the methodologies used to calculate impacts, assign significance and determine the need for mitigation measures. A summary of stakeholder consultation undertaken to date is also provided.

Study area

8.3.2 Several study areas are used for the assessment of noise and vibration impacts. These cover defined distances from the Scheme depending on the specific noise and vibration aspect being assessed. The study areas are based on:

- The proposed construction footprint;
- The proposed construction traffic routes on the road network during the construction phase;
- The location of railway tracks proposed or modified by the Scheme;
- The location of roads realigned or introduced to accommodate the Scheme; and
- The location of railway stations proposed or modified by the Scheme where fixed mechanical plant and Public Address (PA) systems will be located.

Construction noise and vibration study areas

8.3.3 The study area for construction noise impacts considers the area typically within a 300 metre (m) distance from the physical works associated with the Scheme. This is based on guidance in BS 5228-1, which states that caution is needed when making construction noise prediction beyond 300m due to meteorological effects, particularly when soft ground correction factor has been applied. A 300m study area is also advocated by DMRB.

8.3.4 Noise from construction deliveries on the existing road network has been assessed for each affected route. The assessment principally takes into account the change in Basic Noise Level (BNL) at 10m from the road, calculated in line with the CRTN methodology, with a subsequent assessment of the impacts on NSR beyond 10m where significant effects are identified.

8.3.5 The study area for construction vibration impacts are identified with reference to the type of construction activities. Construction activities that may generate significant levels of vibration include piling and compaction. Threshold distances have been calculated within which vibration levels due to these construction activities may exceed the SOAEL or the threshold for potential cosmetic damage. The assessment has identified NSR that fall within these distances for each activity.

Rail traffic noise study area

8.3.6 Operational noise impacts from railway activities have been assessed within 300m of the outermost railway tracks. This is based on guidance given in CRN.

Rail traffic vibration and ground-borne noise study area

8.3.7 In the absence of specific guidance, operational vibration impacts have been assessed within 20m of the outermost railway tracks based on experience on the East West Rail 2 (EWR2) project where such impacts were observed at distances of less than 10m. To account for any variation between projects due to local factors, the 20m study area has been used to capture all potential significant adverse effects.

8.3.8 Ground borne noise impacts have been assessed within 50m of the outermost railway tracks. Based on experience of other similar projects, observable adverse effects would not be expected beyond this distance.

Road traffic noise study area

8.3.9 The calculation area has been defined based on the guidance set out in DMRB which indicates that the study area shall be defined to include NSR that are potentially affected by operational noise changes generated by the Scheme, either on the route of the Scheme or other roads not physically changed by the Scheme. DMRB states that a study area within 600m of new road links or road links physically changed or bypassed by a project and 50m of other road links with the potential to experience a short-term noise change of more than 1.0dB(A) as a result of a project can be sufficient for most projects, but variations in the study area can be defined for individual projects.

8.3.10 In relation to the Scheme, notable effects from road realignments were relatively localised due purely to the road realignments. There were no changes to traffic flows either locally or on the wider network as a result of the realignments. According to the guidance in DMRB, variations in the study area can be defined for individual projects. For relatively minor road realignments, where the impacts are shown to be limited to the immediate vicinity of the Scheme, the study area extends to 300m which was adequate to identify all significant adverse effects.

Fixed mechanical plant, industrial and commercial sources study area

8.3.11 Plant, industrial and commercial noise, including those associated with the stations (including PA systems), would be assessed at the nearby NSR, typically limited to 800m from the location of the plant based on the Building Research Establishment Environmental Assessment Method (BREEAM) assessment methodology.

Data sources

General

8.3.12 General data sources, such as Ordnance Survey terrain data, base mapping, receptor locations and address point data have been used throughout all of the assessments.

8.3.13 Baseline noise and vibration surveys have also been conducted for the Scheme. The methodology for which is detailed in Appendix 8-2 and 8-3 respectively.

Construction

8.3.14 With regards to the construction noise and vibration assessment, the following data has been used:

- Anticipated construction schedules;
- Works locations;
- Anticipated plant details;
- Anticipated percentage on-time;
- Construction traffic routes;
- Construction vehicle volumes; and
- Construction road diversion routes and associated traffic volumes.

8.3.15 Construction data used in the assessment are summarised in Appendix 8-4.

Operational

8.3.16 With regards to the operational noise and vibration assessment, the following data have been used:

- Opening year and future year without the Scheme (do-nothing (DN)) and with the Scheme (do-something (DS)) railway timetables;
- Details of existing and potential future freight activities;
- DN and DS rail speeds;
- DN and DS train/rolling stock information;
- DN and DS rail track alignments;
- DN and DS bridge, viaduct and barrier information;
- DN and DS topography and details of proposed earthworks;
- DN and DS station locations and layouts;
- Opening year and future year DN and DS road traffic and alignments;
- Details of proposed new and refurbished stations; and
- Details of the operation of proposed stabling sidings.

8.3.17 Data used in the assessment of operational rail noise, operational road traffic noise, and stabling sidings noise are summarised in Appendix 8-5, Appendix 8-6 and Appendix 8-7, respectively.

Assessment criteria

8.3.18 This section describes the assessment criteria for the construction and operational noise and vibration assessments.

Construction phase assessment criteria

Construction activity noise assessment criteria

8.3.19 Although there are no statutory construction noise limits, BS 5228-1 provides example criteria for deriving appropriate construction noise significance criteria. The standard explains that the assessor needs to consider other Scheme-specific factors, such as the number of receptors affected and the duration and character of the impact, to determine if there is a significant effect.

8.3.20 The SOAEL is considered to be exceeded where the threshold values stated in Table 8-2 are exceeded based on the example criteria provided in Table E.2 of BS 5228-1.

Table 8-2 Construction noise SOAEL values

Day	Time (hours)	Averaging period, T	SOAEL threshold, dB $L_{Aeq,T}$
Mondays to Fridays	0700 – 0800	1 hour	70
	0800 – 1800	10 hours	75
	1800 – 1900	1 hour	70
	1900 – 2200	1 hour	65
	2200 – 0700	1 hour	55
Saturdays	0700 – 0800	1 hour	70
	0800 – 1300	5 hours	75
	1300 – 1400	1 hour	70
	1400 – 2200	1 hour	65
	2200 – 0700	1 hour	55
Sundays and Public Holidays	0700 – 2100	1 hour	65
	2100 – 0700	1 hour	55

Day	Time (hours)	Averaging period, T	SOAEL threshold, dB $L_{Aeq,T}$
[A)] All noise levels are predicted or measured at a point 1m in front of the most exposed of any windows and doors in any façade of any eligible dwelling			

8.3.21 The total construction period of the Scheme is approximately four years. However, except for construction compounds that will be active at fixed locations throughout the construction phase, most other construction activities are intermittent and will take place over a relative short time period in any one place, due to the nature of the works. The following are considered significant time periods for SOAEL thresholds to be exceeded based on the guidance provided in BS 5228-1:

- A period of 10 or more days of working in any 15 consecutive days during construction; or
- For a total of 40 days or more in any 6 consecutive months during construction.

8.3.22 Significant adverse effects are deemed to occur at NSR where both the SOAEL, as detailed in Table 8-2, and temporal criteria stated above are exceeded.

8.3.23 Network Rail will offer noise insulation or temporary rehousing, as detailed in Section 8.6, if construction noise at NSR is expected to be significant, in accordance with the criteria detailed above, and all reasonable measures to reduce noise have been incorporated. Given the temporary nature of the majority of the works, the preferred approach would be to offer temporary rehousing in lieu of sound insulation where significant adverse effects will occur.

8.3.24 NSR considered for noise insulation or temporary rehousing will be regarded as ‘eligible’ NSR. Those NSR which are then deemed to be entitled to noise insulation or temporary rehousing, will be regarded as ‘qualifying’ NSR. Calculations have been conducted to predict construction noise levels at all NSR in the study area due to the works associated with the Scheme. NSR that may experience significant adverse effects and would therefore be eligible have been highlighted.

Construction activity vibration assessment criteria

8.3.25 Construction vibration levels have been calculated and assessed in accordance with the methodologies described in BS 5228-2. The assessment takes account of proposed plant items, construction methodologies, works programme, and work and receptor locations.

8.3.26 Construction vibration effect threshold levels, in terms of peak particle velocity (PPV), are shown Table 8-3.

Table 8-3 Construction vibration levels of significance at residential receptors

Vibration level, mm/s PPV	Effect
0.14	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration
0.3	Vibration might be just perceptible in residential environments
1.0	It is likely that vibration of this level in residential environments will cause complaint, but can be tolerated if prior warning and explanation has been given to residents
10	Vibration is likely to be intolerable for any more than a very brief exposure to this level in most building environments

8.3.27 The SOAEL is deemed to be exceeded for vibration levels at NSR above 1 mm/s PPV. Significant adverse effects are deemed to occur where construction vibration levels are expected to exceed to SOAEL for a period of 10 or more days or nights in any 15 consecutive days or nights, or a total number of days exceeding 40 in any six-month period, based on guidance provided by DMRB.

8.3.28 Additionally, vibration levels that have the potential to cause cosmetic damage to buildings have been assessed. Higher levels of vibration are required to cause damage to buildings compared to where vibration is just perceptible. BS 5228-2 indicates that the probability of damage tends towards zero at 12.5 mm/s PPV. This value refers to traditionally constructed buildings that are in a good state of repair; other buildings will require consideration on a case-by-case basis. There is no temporal criterion for potential cosmetic damage to buildings. Buildings which may experience vibration levels exceeding 12.5mm/s due to construction activities associated with the Scheme have been highlighted.

8.3.29 Vibration from traffic on the road network is scoped out of the latest version of DMRB. A maintained surface will be free of irregularities as part of Scheme design and under general maintenance. Proposed haul roads would be well maintained and to be free of irregularities as detailed in Part A of the Code of Construction Practice (CoCP) in Appendix 2-1. Vibration from construction traffic on the existing road network or proposed haul roads is therefore scoped out of further assessment.

8.3.30 BS 5228-2 also provides guidance on suitable vibration limits for sensitive equipment, such as microscopes and precision balances. The use of typical precision laboratory equipment may be disturbed by vibration levels exceeding approximately 25 µm/s RMS (root mean square). Lower criteria may apply depending on the precision of the equipment.

Assessment criteria for noise from construction traffic and temporary diversion noise on public highways

8.3.31 Noise due to construction traffic on public highways and temporary diversions has been calculated in accordance with CRTN and assessed in accordance with DMRB.

8.3.32 DMRB provides guidance on the impact magnitudes resulting from changes in the road traffic noise. The magnitude of noise impacts in terms of noise change in the short-term are provided in Table 8-4.

Table 8-4 Classification of impact magnitudes in terms of changes in noise level in the short-term

Magnitude of impact (adverse or beneficial)	Opening year/short-term noise change, dB
No change	0
Negligible	0.1 – 0.9
Minor	1.0 – 2.9
Moderate	3.0 – 4.9
Major	≥5.0

8.3.33 Significant adverse effects are deemed likely to occur where the short-term noise increase from construction traffic and/or temporary diversions is moderate or greater (≥3 dB) depending on context.

Operational phase assessment criteria

Railway noise assessment criteria

8.3.34 Calculations have been undertaken in accordance with CRN for determining equivalent continuous noise levels in dB $L_{Aeq,T}$. The calculation procedure also includes additional noise source terms provided Defra 2007. The predictions of dB $L_{Aeq,T}$ have been undertaken for the 18-hour daytime (0600 - 0000) and 6-hour night-time (0000-0600) periods separately.

8.3.35 The Scheme, assessed through this EIA, is an engineering programme of works which will result in increased line speed and the capability to run more trains, however the train operating companies are ultimately responsible for the services provided and therefore the options assessed are not a guarantee of future services.

8.3.36 The Scheme is proposed to accommodate a new long-term passenger timetable from 2026 (the opening year). As such, a foreseeable significant change in the timetable or train numbers between the opening and future year (2041) is not likely. Additionally, the number of freight paths is not expected to change as a result of the Scheme. Consequently, the predicted noise levels for the Scheme in opening and future years are expected to be the same. Therefore, DN and DS scenarios have been modelled and are applicable to both opening and future years.

8.3.37 The scenarios that have been modelled and compared are:

- DN – Scenario without the Scheme; and
- DS – Scenario with the Scheme.

8.3.38 The assessment of operational noise impacts considers both the absolute noise level and the change in noise level due to the Scheme. Conservative baseline ambient noise conditions from non-rail activity such as roads is also factored into the assessment. This serves to better represent the effect of the railway with increasing distance from the tracks as other sources become dominant.

8.3.39 With regards to absolute façade noise levels, the following criteria are applied:

- LOAEL:
  - 53 dB $L_{Aeq,16h}$ during daytime periods; and
  - 43 dB $L_{Aeq,8h}$ during night-time periods.
- SOAEL:
  - 68 dB $L_{Aeq,16h}$ during daytime periods; and
  - 53 dB $L_{Aeq,8h}$ during night-time periods.

8.3.40 With regards to noise change, DMRB provides guidance on the impact magnitudes resulting from changes in the road traffic noise. Although the guidance is specifically for road-based projects, Transport Appraisal Guidance (TAG) Unit A3 states that "*for other modes [of transport], the guidance in DMRB may provide a useful starting point*". The magnitude of noise impacts in terms of noise change in the long-term are provided in Table 8-5.

Table 8-5 Classification of impact magnitudes in terms of changes in noise level in the long-term

Magnitude of impact (adverse or beneficial)	Future year/long-term noise change, dB
No change	0
Negligible	0.1 – 2.9
Minor	3.0 – 4.9
Moderate	5.0 – 9.9
Major	≥10.0

8.3.41 As noted above, there is no expected change between the DS opening and DS future year noise levels from the Scheme and as such the magnitude of impact will be lower in the future year than the opening year (e.g. a 3dB increase is moderate in the opening year but minor in the future year). DMRB provides guidance on situations such as these, stating that where the long-term impact magnitude is predicted to be less than the short-term impact magnitude, it can be appropriate to conclude that a moderate or major change in the short-term is not significant. The significance of the effects of the Scheme are therefore assessed against the long-term noise change criteria. This is consistent with other similar projects, such as EWR2, and provides an indication of the likely long-term health effects.

8.3.42 The DN and DS scenarios have been compared and assessed against the following criteria:

- Significant adverse effects are deemed to occur where:
  - the DS absolute façade noise level is greater than the LOAEL; and
  - there is at least a moderate noise increase in the future year (≥5 dB).
- Adverse effects which are not significant are deemed to occur where:
  - the DS absolute façade noise level is greater than the LOAEL; and
  - there is a minor noise increase the future year (≥3 and <5 dB).

8.3.43 In addition, certain areas in the study area already have a designated status in terms of exposure to high levels of rail traffic noise (i.e. Noise Important Areas). Noise Important Areas (NIA) are determined via strategic noise maps and highlight the residential areas experiencing the highest 1% of noise levels. They are categorised into NIA designated for noise associated with the railway or with nearby roads. It is therefore considered appropriate to give greater weight to noise change where the existing baseline noise level is already high. This is reflected in the guidance in PPGN which states even a small increase in noise is significant where noise levels are already high. In these situations, the following criteria has been applied:

- Significant adverse effects are deemed to occur where:
  - the NSR is located within a designated NIA or the DS noise level exceeds the SOAEL; and
  - there is a ≥1 dB noise increase in the future year.

8.3.44 Effects are not significant where:

- the DS absolute noise level is below the LOAEL, irrespective of the increase in noise;
- the DS absolute noise level exceeds the LOAEL and the increase in noise is ≥5 dB; or
- the DS absolute noise level exceeds the SOAEL and the increase in noise is ≥1 dB.

Rail traffic vibration

8.3.45 Rail traffic vibration has been predicted within 20m of the railway track based on baseline vibration measurements from this Scheme and other similar projects. Vibration levels have been predicted as a function of distance from the railway lines to NSR.

8.3.46 BS 6472 provides guidance vibration effect levels in terms of Vibration Dose Value (VDV). The VDV thresholds are provided in Table 8-6.

Table 8-6 BS 6472 VDV Thresholds

Location and time period	VDV $ms^{-1.75}$		
	Low probability of adverse comment	Adverse comment possible	Adverse comment probable
Residential 16h day	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Residential 8h night	0.1 to 0.2	0.2 to 0.4	0.4 to 0.8
Office 16h day	0.4 to 0.8	0.8 to 1.6	1.6 to 3.2
Workshop 16h day	0.8 to 1.6	1.6 to 3.2	3.2 to 6.4

8.3.47 In instances where there are appreciable levels of vibration in the general environment, for example adjacent to an existing operational railway, the magnitude of impacts at residential receptors can be defined as shown in Table 8-7 based on the vibration guidance provided in the ANC Guidelines.

Table 8-7 Classification of impact magnitudes in terms of % change in VDV, $m/s^{1.75}$

Magnitude of impact (adverse or beneficial)	% change in VDV
No change	0
Negligible	<25%
Minor	>25% to 40%
Moderate	>40% to 100%
Major	>100%

8.3.48 The LOAEL is deemed to be exceeded at residential NSR for vibration levels above 0.4 $m/s^{1.75}$ VDV during the daytime period and 0.2 $m/s^{1.75}$ VDV during the night-time period.

8.3.49 The SOAEL is deemed to be exceeded for vibration levels above 0.8 $m/s^{1.75}$ VDV during the daytime period and 0.4 $m/s^{1.75}$ VDV during the night-time.

8.3.50 Significant adverse effects are deemed to occur where:

- DS operational railway vibration levels exceed the LOAEL with at least a Moderate increase in VDV (>40%) compared to DN; or
- DS operational railway vibration levels exceed the SOAEL with at least a Minor increase in VDV (>25%) compared to DN.

8.3.51 Where VDV values are present in more than one category in Table 8-6 and Table 8-7, a precautionary approach is taken with the more adverse outcome stated.

Rail traffic ground-borne noise

8.3.52 The FTA technical guidance provides details of the human responses to different levels of ground-borne noise. These guidance values are provided in Table 8-8.

Table 8-8 Ground-borne noise effect levels for permanent residential buildings

Ground-borne noise level, dB L_{ASmax}[2]	Human response
25	Approximate threshold of perception for many humans. Low-frequency sound usually inaudible.
35	Approximate dividing line between barely perceptible and distinctly perceptible. Low-frequency noise acceptable for sleeping areas.
45	Low-frequency noise annoying for sleeping areas.

8.3.53 The LOAEL is deemed to be exceeded for ground-borne noise levels above 35 dB L_{ASmax} and the SOAEL is deemed to be exceeded for ground-borne noise levels above 45 dB L_{ASmax}. Significant adverse effects are deemed likely to occur where the noise level exceeds the LOAEL, there is at least of moderate increase in ground borne noise (≥3dB), and the ground-borne noise level would not be masked by airborne noise.

Road traffic noise

8.3.54 The Scheme is not expected to cause a permanent change to operational traffic flows on the wider road network. There are, however, several locations where realignment of existing roads are required to facilitate the Scheme.

8.3.55 Noise due to changes in road traffic during the operational phase has been calculated in accordance with CRTN and assessed in accordance with DMRB.

Fixed mechanical plant, industrial and commercial sources

8.3.56 No fixed external plant is proposed as part of the Scheme. As such, noise from fixed plant is not considered further in this assessment.

PA System noise

8.3.57 With regards to PA systems at new, relocated and upgraded stations, the detailed design is outside the scope of this ES. However, indicative typical worst-case predictions have been conducted based on the Network Rail PA system specification NR/L2/TEL/30134[3] to assess if potential impacts are likely without additional mitigation in order to inform the design. Noise impacts from PA systems are outside the scope of BS 4142:2014 but are within the scope of BS 4142:1997. The guidance provided in BS 4142:1997 is provided in Table 8-9.

Table 8-9 BS 4142:1997 assessment criteria

Difference (background sound level - noise rating level)	Description of potential impacts from industrial and commercial sound (BS 4142:1997)
+10 dB or greater	Indication that complaints are likely
+5 dB	Marginal significance
-10 dB or less	Positive indication that complaints are unlikely

8.3.58 For PA systems:

[2] The maximum sound level with an A-weighted frequency response and slow time weighting (1 second)
[3] Network Rail (2009). NR/L2/TEL/30134, Issue 2: Design and Installation Requirements for Public Announcements, Voice Alarm and Long Line Public Announcements Systems.

- significant adverse effects are deemed likely to occur for rating levels exceeding the background noise level by at least 10 dB; and
- adverse effects are deemed likely to occur for rating levels exceeding the background noise level by at least 5 dB.

8.3.59 PA system noise has been raised as a particular concern by the local authority. As such, consideration will be given to achieving rating levels of at least 10 dB below background sound level where feasible, or otherwise as low as reasonably practicable.

Summary of assessment criteria

Sensitivity of receptors

8.3.60 The noise and vibration assessment criteria above are generally based on residential and other high sensitivity NSR. Sensitivity is therefore built into the assessment. However, additional consideration of sensitivity may be required in certain cases for other NSR. A summary of sensitivity to noise and vibration is provided in Table 8-10.

Table 8-10 Sensitivity of receptors to the Scheme

Sensitivity of receptor	Receptors sensitive to noise	Receptors sensitive to vibration
Very high	Not applicable	Listed buildings and non-earthwork Scheduled Monument that may be in a structurally unsound condition. Academic, research or commercial buildings housing vibration sensitive equipment.
High	Residential buildings, schools and education premises, hospitals, clinics, care homes, places of worship, community centres, libraries. Internationally or nationally designated nature conservation sites which are also known to contain noise sensitive species (i.e. noise may change breeding habits or threaten species in some other way).	Unreinforced or light framed structures.
Medium	Areas primarily used for leisure activities including Public Rights of Way (PRoW), sports facilities and sites of historic or cultural importance, camp sites, hotels, gardens, parks. Scheduled Monuments depending on their usage	Residential or light commercial buildings.
Low	Offices, cafes/bars with external areas. Scheduled Monuments depending on the usage	Reinforced or framed structures. Industrial, heavy commercial buildings and earthworks (Scheduled Monuments).
Non-sensitive	Industrial or retail premises	Not applicable

Summary of significance criteria

8.3.61 A summary of significance criteria is provided in Table 8-11.

Table 8-11 Summary of significance criteria

Assessment type	Time period	Potential significant adverse effect thresholds
Construction noise, including construction traffic on haul roads	Core daytime periods	Exceedance of 75 dB $L_{Aeq,T}$ Note-1
	Non-core daytime periods	Exceedance of 65 dB $L_{Aeq,T}$ Note-1
	Night-time	Exceedance of 55 dB $L_{Aeq,T}$ Note-1
Construction road traffic and temporary diversion noise (short-term)	All times	≥3 dB increase Note-2, Note-3
Construction vibration on people	All times	1 mm/s PPV Note-1
Construction vibration on structures	All times	12.5 mm/s PPV
Rail traffic noise (operational)	Day	≥5 dB increase Note-2,
	Night	≥5 dB increase Note-2, Note-3
Rail traffic vibration	All times	≥40% in VDV Note-2,Note-4
Rail traffic ground-borne noise	Night	>3 dB increase Note-2, Note-5
Operational road traffic noise due to road realignments	All times	≥5 dB increase Note-2, Note-3 (long-term)
Mechanical and fixed plant, and operation of stabling sidings	All times	Rating level ≥ L_{A90} + 10 dB
PA System Noise	All times	Rating level ≥ L_{A90} + 10 dB Note-6

Note-1: If exceeded for more than 10 days in 15 consecutive days, or 40 days in six consecutive months.
Note-2: Where DS absolute level is above the LOAEL
Note-3: Or 1dB where above SOAEL or in NIA
Note-4: Or >25% increase in where vibration levels already exceed the SOAEL
Note-5: Where not adequately masked by airborne noise
Note-6: Additionally, a target rating level of at least 10 dB below background for PA systems to be considered.

Scoping and consultation

8.3.62 Consultation was undertaken with Kirklees Council as part of scoping for the EIA. Environmental Protection Officers were invited to comment on the methodology proposed for the baseline noise and vibration surveys and the assessment of construction and operational noise and vibration impacts. Additionally, a meeting was held with Environmental Protection Officers from Kirklees Council to discuss the noise and vibration assessment on 31 July 2019.

8.3.63 Overall, Kirklees Council found the proposed assessment methodology to be acceptable. However, two comments were raised, as detailed in Table 8-12.

Table 8-12 Summary of consultation

Scoping/consultation comment	Response
The proposals for providing insulation or temporary rehousing, being at Network Rail's discretion are of concern, it would be preferable for a determination for eligibility for this to be made on an objective basis and not at the discretion of Network Rail.	This was discussed with Kirklees Council during the meeting on 31/07/2019. Network Rail (NR) explained the process and the reasoning for the wording and that NR will apply the guidance as per BS 5228 as the last tier of mitigation. Kirklees team are keen to see the criteria that would be applied, and this is to be the subject of future discussions. The criteria for qualification for noise insulation or temporary rehousing is presented in this Assessment.
It is acknowledged that BS 4142:2014 specifically excludes noise from public address systems but the proposed use of BS 4142:1997 for this instead is not considered ideal because of the nature of noise from this source is likely to be more intrusive than other industrial noise at a similar level. Ideally the objective should be for public address systems within the Scheme to be designed, installed and operated in accordance with best practical means so that they are not audible at noise sensitive locations.	The use of BS 4142:1997 represents industry practice and allows for greater protection than the 2014 version. Where feasible, the target limit would be for the noise rating level from PA systems to be 10 dB below the background sound level at nearby NSR, representative of NOEL. The rating level incorporates an allowance to take account of the intrusive nature of PA system noise. NR would refrain from using terms such as "audible" and "inaudible" as these are subjective. The PA systems would be required to achieve Network Rail requirements, particularly with regards to safety. The design of the PA systems is outside the scope of this ES but indicative limits have been set based on baseline noise survey data against which the systems would be designed. An indicative high-level assessment has been undertaken based on typical worst-case assumptions and comment has been provided on whether the limit is likely to be readily achieved without additional mitigation measures being considered at detailed design stage.

Cumulative effects

8.3.64 Cumulative effects can include Intra-Scheme impacts and Inter-Scheme impacts. Intra-Scheme impacts are where in-combination impacts arise from the Scheme. Inter-Scheme impacts occur due to impacts from more than one scheme.

Intra-Scheme cumulative effects

8.3.65 Intra-Scheme cumulative effects are the combination of multiple activities associated with the Scheme itself. With regards to construction, cumulative effects would include multiple construction activities occurring simultaneously at or close to the same location. With regards to the operation of Scheme, cumulative effects would include multiple sources affecting the same location, such as trains, road realignments and PA systems.

8.3.66 Owing to the variations in assessment methodology and criteria, particularly for operational noise effects, intra-scheme cumulative effects have been considered using professional judgement and additional mitigation has been considered, where applicable.

Inter-Scheme cumulative effects

8.3.67 Reasonably Foreseeable Future Projects (RFFP) that have the potential to affect or be

affected by the Scheme are detailed in Chapter 22 (Cumulative effects) of this ES.

8.3.68 The potential construction and operational inter-Scheme cumulative effects have been assessed based on available information and professional judgement and additional mitigation has been considered, where applicable.

Assumptions and limitations

8.3.69 The assessment of noise and vibration impacts includes a number of assumptions. Where required, assumptions have been made based on the precautionary principle providing a typical worst-case result. Assumptions used in calculations, modelling and assessments are stated in Appendices 8-4 to 8-11, together with limitations.

8.4 Baseline

8.4.1 Baseline noise and vibration levels have been determined via a combination of desk-based assessments, including reviewing Defra strategic noise maps[4], and field surveys at key locations along the route representative of nearby NSR. The results of the baseline assessment have been used in the assessment of potential construction and operational noise and vibration impacts at NSR. Noise and vibration monitoring locations were agreed with Kirklees Council.

8.4.2 The results of the baseline noise and vibration surveys are presented in Appendices 8-2 and 8-3, respectively. The results are also summarised in this Chapter and in the individual Route Section Assessments. Further baseline information which has been used to inform the assessments is shown in Figures 8-1 and 8-2.

Noise baseline

8.4.3 Given the varied land uses along the route, the existing noise climate also varies. However, as the Scheme is an upgrade to the existing railway, railway noise is an existing part of the noise climate along the route.

8.4.4 Other sources of noise include local roads (there are a number of A-roads in proximity to the Scheme, particularly the A62 and A644), industrial and commercial facilities, and canal activities at certain sections of the route. Specific details are provided in the individual Route Section Assessments.

8.4.5 There are several built up residential areas along the route, including (from west to east):

- Huddersfield;
- Hillhouse;
- Fartown;
- Deighton;
- Bradley;
- Battyeford;
- Lower Hopton;
- Mirfield;
- Ravensthorpe; and
- Westtown (Dewsbury).

[4] https://www.gov.uk/government/publications/open-data-strategic-noise-mapping

8.4.6 Residential house-boat moorings have also been identified in the vicinity of Wood Lane, Mirfield, and Station Road, Mirfield. Both sites are located within residential areas which have been assessed as part of this ES.

8.4.7 Non-residential NSR, such as schools, religious buildings, and healthcare facilities, have also been assessed with regards to noise and vibration.

8.4.8 There are three Railway NIA along the route, as follows:

- RI_528 – Topaz Close, Huddersfield;
- RI_519 – Station Road, Bradley; and
- RI_518 – Calder View, Mirfield.

8.4.9 There are also 16 Road NIA within 300m of the route, as follows:

- IA_3228 – Trinity Street and Castlegate, Huddersfield;
- IA_3177 – Castlegate, Huddersfield;
- IA_10488 – Southgate and Leeds Road, Huddersfield;
- IA_10487 – Bradford Road, Huddersfield;
- IA_3194, IA 3193, IA_3192, IA_3191, IA_10454 – Leeds Road, Huddersfield/Bradley;
- IA_3126, IA_3127, IA10450 – Huddersfield Road, Mirfield;
- IA_10449 – Huddersfield Road, Ravensthorpe;
- IA_3132 – A644, Westtown;
- IA_3139 – Halifax Road, Dewsbury; and
- IA_10446 – Bradford Road, Dewsbury.

Noise monitoring

8.4.10 Nineteen long duration and four short duration noise surveys have been conducted key locations along the route, representative of nearby NSR, as summarised in Table 8-13. Full noise survey details are provided in Appendix 8-2.

Table 8-13 Noise survey summary

ID	Monitoring location	Time period	Average $L_{Aeq,15min}$, dB[5]	Typical $L_{AFmax,15min}$, dB[6]	Typical $L_{A10,15min}$, dB[7]	Typical L_{A90min}, dB[8]
L00**	Springwood Street, Huddersfield (E/N: 414012/X416484	Day	60	70 - 80	62	51
L01**	Fitzwilliam Street, Huddersfield (E/N: 414243/417077)	Day	62	70 - 77	65	56
L03	Hammond Street, Huddersfield (E/N: 414823/418222)	Day	60	70	59	52
		Night	49	59	52	40
L04	Topaz Close, Fartown (E/N: 415278/418519)	Day	55	78	48	41
		Night	53	74	38	35
L05	Whitacre Street, Deighton (E/N: 416463/419150)	Day	59	79	62	49
		Night	54	80*	45	39
L06	Glen Field Avenue, Deighton (E/N: 416720/419399)	Day	56	67	58	51
		Night	52	68	52	40
L08	Station Road, Deighton (E/N: 417208/420017)	Day	60	83	53	47
		Night	57	82	47	43
L09	Paul Lane, Kirkheaton (E/N: 418253/420380)	Day	52	62	53	49
		Night	49	61	49	44
L10	Waterside Walk, Mirfield (E/N: 418656/420502)	Day	57	82	51	43
		Night	55	82	42	39
L11	Calder View, Mirfield (E/N: 419723/419741)	Day	56	76	49	43
		Night	53	77	41	37
L12	Chadwick Hall Gardens, Mirfield (E/N: 419718/419652)	Day	50	67	51	44
		Night	47	67	42	38
L13	Calder View/Chadwick Fold Lane, Mirfield	Day	54	71	53	44
		Night	51	76	45	44

[5] $L_{Aeq,15min}$ is the 'equivalent continuous sound level' over a 15-minute period. This is equal to the average sound energy experienced during the 15-minute period, smoothing out the natural fluctuations in the sound level over time. This is sometimes referred to as the 'ambient sound level'.
[6] $L_{Amax,15min}$ is the maximum sound level that is experienced during the 15-minute period.
[7] $L_{A10,15min}$ is the sound level that is exceeded for 10% of the 15-minute measurement period (i.e. the noisiest 90 seconds in a 15-minute period are louder than this level).
[8] $L_{A90,15min}$ is the sound level that is exceeded for 90% of the 15-minute measurement period (i.e. the quietest 90 seconds in a 15-minute period are quieter than this level). This is sometimes referred to as the 'background sound level'.

ID	Monitoring location	Time period	Average $L_{Aeq,15min}$, dB[5]	Typical $L_{AFmax,15min}$, dB[6]	Typical $L_{A10,15min}$, dB[7]	Typical L_{A90min}, dB[8]
	(E/N: 419997/419596)					
L14**	Back Station Road, Mirfield (E/N: 420431/419444)	Day	62	79	61	46
L15	Brewery Wharf, Mirfield (E/N: 420341/419583)	Day	51	65	50	41
		Night	46	64	39	35
L16	Steanard Lane, Mirfield (E/N: 421313/419271)	Day	50	64	53	44
		Night	45	64	49	33
L17	Sands Lane, Mirfield (E/N: 421826/419461)	Day	56	72	55	50
		Night	52	69	48	45
L18	Ravensthorpe Road, Dewsbury (E/N: 422806/419838)	Day	67	78	71	43
		Night	60	78	61	39
L19	Lees Hall Road, Dewsbury (E/N: 423377/420028)	Day	49	66	47	37
		Night	48	66*	50	34
L20	Mavis Avenue, Dewsbury (E/N: 423393/420614)	Day	53	64	51	53
		Night	48	59	51	47
L21**	West Value, Dewsbury (E/N:)	Day	48	55-65	49	46
L22	Brooks Yard, Dewsbury (E/N: 423684/421026)	Day	62	79	59	52
		Night	54	79	51	46
L23	Off Thornhill Road, Dewsbury (E/N: 423781/421096)	Day	54	76	48	44
		Night	49	75	42	38

**excluding anomalous non-railway activity maximums*
***Short duration – daytime only.*

Strategic noise maps

8.4.11 In addition to noise survey data, reference is made to strategic noise map data[9] which predicts noise levels from major railways and major roads. This data is useful for corroborating noise survey data and for evaluating baseline noise levels at locations where noise monitoring was not feasible.

8.4.12 Reference to strategic noise maps is made at Alder Street, Huddersfield which are adjacent to the railway, albeit with the railway at a raised elevation above the roof line of the properties. Strategic noise map data indicates that noise levels due to road and rail sources would be in the order of 50 to 60 dB $L_{Aeq,16h}$ during daytime periods and 45 to 55 dB $L_{Aeq,8h}$ during night-time periods.

8.4.13 Reference is also made in the assessment to strategic noise mapping data in relation to context and the appraisal of significant impacts.

Vibration baseline

Vibration monitoring

8.4.14 Baseline vibration surveys have been conducted at seven locations, representative of the closest receptors to the route, namely:

- L00 Springwood Street, Huddersfield;
- L04 Topaz Close, Fartown;
- L05 Whitacre Street, Deighton;
- L08 Station Road, Deighton;
- L10 Waterside Walk, Mirfield;
- L11 Calder View, Mirfield; and
- L24 Dr Reddy, Mirfield.

8.4.15 Full vibration survey details and results are provided in Appendix 8-3.

8.5 Potential effects

8.5.1 This Section describes the potential noise and vibration effects likely to arise during the construction and operational phase of the Scheme. The assessment has been undertaken in accordance with the methodology detailed in Section 8.3.

Potential construction noise and vibration effects

Construction noise

8.5.2 There are a number of sources of construction noise along the Scheme. The nature and duration of works varies with a combination of long-term and short-term stationary works, and intermittent linear works. Stationary works are those that would occur at a relatively fixed location for the duration of the specific activity, such as a structure or a compound. Linear works are those that will move along the track, such as track laying and installation of Overhead Line equipment (OLE), with works at a specific location for a relatively short duration.

[9] https://www.gov.uk/government/publications/open-data-strategic-noise-mapping

8.5.3 Long-term construction activities are those that may affect any one receptor for at least ten days in any 15 consecutive days, or 40 days in any consecutive six months, based on the guidance of BS 5228-1. Short-term construction activities are those which occur for durations shorter than those detailed above.

8.5.4 Anticipated works are as follows, together with an indication of their likely nature:

- Setup of site compounds (short-term stationary);
- Operation of site compounds (long-term stationary);
- Drainage and culverts (long-term and short-term stationary);
- Earthworks (long-term and short-term stationary);
- Retaining Walls (long-term and short-term stationary);
- Stations (long-term stationary);
- Structures (long-term and short-term stationary);
- Utilities and Distribution Network Operators (DNO) (long-term and short-term stationary);
- Track laying and top ballast laying (short-term linear);
- Installation of OLE (short-term linear); and
- Construction of noise barriers (short-term stationary).

8.5.5 Details of the noise levels expected from these activities are provided in Appendix 8-4. These show how noise levels reduce with increasing distance from activities, together with distances within which SOAELs would be expected to be exceeded. These distances have been used to determine the number of properties which may exceed the threshold construction noise values for the onset of adverse and significant effects. Consideration is also given to the expected duration of construction activities in determining whether the effects are likely to be significant.

Daytime construction noise

8.5.6 Significant adverse effects are deemed to occur during daytime periods where the construction noise level during the day is likely to exceed 75 dB $L_{Aeq,10h}$ at any NSR during core daytime periods for at least 10 days in any 15 consecutive days or 40 days in any consecutive six months. Adverse impacts are deemed to occur where the construction noise level during the day is likely to exceed 65 dB $L_{Aeq,10h}$.

8.5.7 Table 8-14 summarises the NSR which may experience significant adverse effects from construction activities during daytime periods. NSR which may potentially experience significant adverse effects from construction activities are also shown in Figure 8-3. Results of the assessments for individual construction activities are provided in the Route Section Assessments.

Table 8-14 Construction noise assessment summary

Route Section	Construction activity	Site location	Number and location of significantly affected NSR
1 – Huddersfield	Setup of site compounds	Longroyd Lane (Bow Street)	(1) No. 6 Longroyd Lane
	Operation of site compounds	Cross Church Street	(1) No. 23 Mark Street
	Stations	Huddersfield Station	(2) National Children's Centre to southwest of station, and Platform 1 Men's Community Group

Route Section	Construction activity	Site location	Number and location of significantly affected NSR
	Utilities and DNO	Gledholt MPTSC[10]	(5) No. 22 & 24 Cross Church Street, and No. 25, 27 & 29 Mark Street
2 – Hillhouse and Fartown	Setup of site compounds	Hillhouse Compound	(1) Brighouse motorcycle training centre, Alder Street
		Hillhouse Lane	(2) No. 35 & 37 Willow Lane East
3 – Deighton and Bradley	Setup of site compounds	Deighton Station	(5) No. 11 & 12 Lilac Court; and No. 11, 13 & 15 Whitacre Street
	Earthworks	E8 Bradley Junction Industrial units	(1) No. 4 Station Road
	Structures	Whitacre Street (MVL3/101)	(3) No. 12 Lilac Court; and No. 13 &15 Whitacre Street
	Drainage and Culverts	Deighton Station drainage	(17) No. 1 - 12 Lilac Court; and No. 13, 15,17,19 & 21 Whitacre Street
4 – Colne Bridge and Battyeford	-	-	No significant adverse effects
5 – Mirfield and Lower Hopton	Structures	Mirfield Viaduct (Steel Spans) (MVN2/192A)	(8) No. 2 & 2A-G Chadwick Lane (multiple apartments)
6 – Ravensthorpe and Westtown	Setup of site compounds	Thornhill Road	(5) No. 24, 26, 28 & 30 Brooks Yard; and Living accommodation at The Shepherds Boy public house
	Structures	B6117 Fall Lane, Thornhill Road (MDL1/9)	(2) No. 24 & 26 Brooks Yard
	Highway works	Thornhill Road	(2) No. 24 & 26 Brooks Yard

8.5.8 The results indicate that 47 NSR may be significantly adversely affected by construction noise during daytime periods due to the Scheme (noting that some NSR are affected by more than one activity).

8.5.9 Additionally, adverse impacts would be expected to occur at approximately 2000 NSR during daytime periods, but these would not be significant for EIA purposes.

8.5.10 It should be noted that the assessment of construction noise at this stage represents a typical foreseeable worst-case scenario in terms of both overall noise level and duration of each activity and does not take account of mitigation, such as screening. All construction works (both during the day and night) will be managed via Section 61 applications for prior consent under the CoPA with Best Practicable Means (BPM) to reduce noise levels, in discussion with the local authority. The effects of construction will, in principle, be no greater than those detailed above. Should all other mitigation not be sufficient to mitigate significant adverse

[10] Mid-point track sectioning cabinet

effects from construction noise at individual NSR, noise insulation or temporary rehousing would be offered (see section 8.3.23).

Night-time construction noise

8.5.11 There are proposed construction activities that will require night-time works, some of which under rail possession[11]. This may arise, for example, where the structure is over a section of an operational railway. Details of specific activities which would be expected to require night-time working are provided in the Route Section Assessments (Volume 2ii Chapter 8).

8.5.12 Additionally, the Hillhouse Compound will be a main construction hub with potential 24-hour activity for periods of the construction programme. Potential night-time construction activities at the Hillhouse Compound will include:

- The loading of materials, including ballast, onto carriages; and
- Crane activity lifting track sections onto carriages.

8.5.13 At the Hillhouse Compound, night-time construction activities will cause significant adverse effects at nearby NSR, particularly those to the north on Hammond Street which currently have a direct line of sight of the Hillhouse Compound area.

8.5.14 Track laying and OLE installation (i.e. short-term linear works) are not expected to cause significant adverse effects, in isolation, due to the short duration of these works (approximately one week) at any one location (notwithstanding potential cumulative effects, as discussed below).

8.5.15 At this stage of the assessment, likely night-time construction activities are known but a detailed schedule for night-time construction activities has not been finalised. Typical worst-case assumptions have been made on the length of the possessions and night-time working based on information from the construction team. The night-time construction noise SOAEL of 55 dB $L_{Aeq,1hour}$ would be expected to be exceeded at NSR within approximately 200m to 300m of works without specific noise mitigation measures in place. This will depend upon the specific night-time construction activities, locations, and plant, which will vary throughout the construction programme. Significant adverse effects would be caused at NSR if the construction noise SOAEL is exceeded for at least ten nights in any 15 consecutive nights, or 40 nights in any consecutive six months.

8.5.16 In lieu of specific detailed information regarding night-time construction activities, in order to assess a worst-case scenario, it is considered that all night-time constructions works at stations and structures (i.e. long-term stationary works) will cause potential significant adverse effects at NSR within 300m of the sites without mitigation being put in place.

8.5.17 All construction works (both during the day and night) will be managed via Section 61 applications for prior consent under the CoPA with best practicable means (BPM) to reduce noise levels, in discussion with the local authority. Night-time construction noise impacts will be reassessed as part of the Section 61 process, when sufficient detail on specific night-time construction activities and scheduling becomes available. This will also take account of the cumulative effects of multiple construction activities occurring simultaneously within the same area (including track laying and OLE installation). Further details of the process through which construction noise impacts will be managed is provided in Section 8.6.

[11] When a section of track is required for maintenance / construction work and trains cannot run, it is handed over by the operators to the engineers, who take “possession”. Special protective measures are used to prevent access by unauthorised trains.

Construction vibration

8.5.18 The majority of construction activities are not expected to generate significant levels of vibration. However, activities that may generate significant levels of vibration include:

- Ground compaction; and
- Percussive piling.

8.5.19 Details of the vibration levels expected from these activities are provided in Appendix 8-4. Appendix 8-4 shows how vibration levels reduce with increasing distance from activities and includes distances within which SOAELs would be expected to be exceeded.

8.5.20 The specific piling methods for each activity have not been determined at the time of the assessment. As such, the assessment considers the effects of percussive piling which would typically be a worst-case. Similar to noise, vibration generating construction activities will also be managed via Section 61 prior consent applications in discussion with the local authority. Further details of the process through which construction vibration impacts will be managed is provided in Section 8.6.

Construction vibration effects on people within buildings (nuisance)

8.5.21 The SOAEL for construction vibration effects on people within buildings is 1.0mm/s PPV where it is likely that vibration may cause complaint in a residential environment but can be tolerated if prior warning and explanation has been given to residents. Consideration is also given to the expected duration of construction activities in determining whether the effects are likely to be significant. Significant effects are deemed to occur where the SOAEL is exceeded for at least ten days in any 15 consecutive days or 40 days in any consecutive six months.

8.5.22 Results of the assessments for individual construction activities are provided in the Route Section Assessments (Volume 2ii Chapter 8).

8.5.23 The results indicate that that although some activities may cause vibration levels in excess of the SOAEL at NSR, the duration of activities is not expected to exceed at least 10 days in any 15 consecutive days or 40 days in any consecutive six months at any individual residential NSR. As such, there are no significant effects expected from construction vibration at residential NSR.

8.5.24 There are also potential adverse effects at approximately 1000 NSR due to compaction activities and approximately 2200 NSR due to piling activities although these are not significant for EIA purposes. Potentially adversely affected NSR will be notified of works, in line with best practice.

Construction vibration effects on sensitive commercial receptors

8.5.25 Dr Reddy's is a pharmaceutical facility which may contain vibration sensitive equipment such as microscopes and precision balances. Discussions held during the site surveys indicated that the facility does have laboratories within the facility. The use of any sensitive equipment may be disturbed by vibration levels exceeding approximately 25 µm/s RMS (or lower, depending on the processes). Construction vibration has the potential to exceed this level. As such, Dr Reddy's will be consulted prior to the start of works and advised of any potential vibration generating construction activities which may affect the use of sensitive equipment during periods of construction works. An External Communications Programme will be produced under Part B of the CoCP, as detailed in paragraphs 8.6.3 to 8.6.15, which will set out the procedure for engagement.

Construction vibration effects on structures (potential cosmetic damage)

8.5.26 Consideration has been given to locations where vibration levels may be high enough to cause cosmetic damage to buildings. This would occur at vibration levels much higher than the level at which vibration would be just perceptible. Cosmetic damage is not likely to occur at vibration levels below 12.5 mm/s PPV but may occur above this level. It should be noted that levels of vibration two to four times higher would be required to cause potential structural damage. Locations where the 12.5 mm/s PPV level may be exceeded are detailed in Table 8-15 and are also shown visually in Figure 8-4.

Table 8-15 Buildings which may experience vibration levels >12.5mm/s PPV

Vibration source	Route Section	Construction activity	Site location	Potentially affected locations
Compaction	1 – Huddersfield	Setup of site compounds	Longroyd Lane (Bow Street)	Derelict building on Longroyd Lane to the east of the site location.
	2 – Hillhouse and Fartown	-	-	-
	3 – Deighton and Bradley	Compound setup	Deighton Station	No. 11, 13, 21, Whitacre Street
		Drainage and culverts	Deighton Station drainage	No. 12 Lilac Court
	4 – Colne Bridge and Battyeford	Compound setup	Bradley Junction	Mamas & Papas Factory, Colne Bridge Road
		Track and ballast	Section wide	Derelict buildings next to track at Colne Bridge Mills
	5 – Mirfield and Lower Hopton	-	-	-
	6 – Ravensthorpe and Westtown	Compound setup	Ravensthorpe area	No. 153 Ravensthorpe Road
		Track and ballast	Section wide	Sparkes carwash, Webster Hill
Piling	1 – Huddersfield	Structures	MVL3/92(9) Huddersfield Viaduct (Span 29)	Halfords Autocentre (Bradford Road) to the west and Perry's Citroen (Northgate) to the east
	2 – Hillhouse and Fartown	OLE base installation	Section wide	Peace Pit depot (depending on location of OLE piling location)
				No. 8 & 15 Topaz Close
		Construction of noise barriers	Hillhouse Compound	No. 120 Alder Street
	3 – Deighton and Bradley	Structures	MVL3/101 Whitacre Street	No. 12 Lilac Court
			MVL3/102 A62 Leeds Road	Huddersfield Audi, Leeds Road
		OLE base installation	Section wide	Sicame Electrical Developments, No. 843-855 Leeds Road; Trackside industrial units at Neptune Way; and Volkswagen Huddersfield, Leeds Road; No .4 Station Road
	4 – Colne Bridge and Battyeford	OLE base installation	Section wide	Aspin House, Station Road; and Derelict buildings and industrial units next to track at Colne Bridge Mills

Vibration source	Route Section	Construction activity	Site location	Potentially affected locations
	5 – Mirfield and Lower Hopton	-	-	-
	6 – Ravensthorpe and Westtown	Structures	MDL1/9 B6117 Fall Lane, Thornhill Road	Brooks Yard
		Construction of noise barriers	Mavis Street/Avenue	No. 22 & 23 Mavis Avenue; and No. 22 Mavis Street

8.5.27 The effects of construction vibration at the locations above may be significant without mitigation measures put in place, subject to further detailed assessment and surveys prior to construction works. Details of mitigation of construction vibration are provided in Section 8.6.

Construction traffic noise

8.5.28 During construction, there will be additional heavy vehicle traffic on the local road network, travelling to and from the construction compounds, as well as changes in traffic due to temporary diversions. The sections of road that may experience at least a moderate temporary impact (those with greater than 3 dB noise increase in the short-term) during construction are provided in Table 8-16. The results are also shown visually in Figure 8-5. Results of the assessments for individual construction activities are provided in the Route Section Assessments.

Table 8-16 Construction traffic noise assessment

Route Section	Road location	Impact
1 – Huddersfield	Alder Street	Major (>5 dB increase)
2 – Hillhouse and Fartown	Alder Street (South of Hillhouse Compound)	Moderate (4.6 dB increase)
	Alder Street (North of Hillhouse Compound)	Major (>5 dB increase)
	Woodhouse Hill	Moderate (4.5 dB increase)
3 – Deighton and Bradley	Sheepridge Road/Deighton Road up to Keldregate	Moderate (4.2 dB increase)
	Keldregate	Moderate (3.0 dB increase)
	Deighton Road between Keldregate and Whitacre Street	Major (>5 dB increase)
	Whitacre Street	Major (>5 dB increase)
	Deighton Road between Whitacre Street and Leeds Road	Major (>5 dB increase)
4 – Colne Bridge and Battyeford	Dalton Bank Road	Moderate (3.4 dB increase)
5 – Mirfield and Lower Hopton	Station Road	Moderate (3.5 dB increase)
	Hopton New Road	Moderate (4.4 dB increase)
	Back Station Road	Major (>5 dB increase)
	Granny Lane	Moderate (3.8 dB increase)
	Hopton Lane/Hopton Hall Lane (down to Upper Hopton and Liley Lane)	Moderate (3.3 dB increase)
	Calder Road	Major (>5 dB increase)
	Newgate	Major (>5 dB increase)
6 – Ravensthorpe and Westtown	Forge Lane	Moderate (3.1 dB increase)

Route Section	Road location	Impact
	Warren Street	Moderate (3.5 dB increase)

8.5.29 There are temporary significant adverse impacts at approximately 1250 NSR associated with construction traffic and temporary diversions on the above mentioned 19 roads. Specific details are provided in the individual Route Section Assessments.

Potential temporary operational noise effects during construction phase

8.5.30 During the construction phase of the Scheme, the Hillhouse Compound will be used principally as a construction compound. However, the site will also serve as a temporary platform while Huddersfield Station is being refurbished. Such activity is expected to occur for approximately 14 months between Christmas 2023 and April 2025.

8.5.31 Additionally, three temporary sidings will be constructed at the Hillhouse Compound for the stabling of trains during night-time periods, because of the loss of provision at Huddersfield Station. Permanent sidings will subsequently be constructed at the Hillhouse Compound as part of the Scheme.

Bus replacement service at Hillhouse Compound

8.5.32 The compound will be served by construction traffic, and the temporary station will be served by a bus replacement service. Details of the number of bus services are not currently available. As a reasonable worst-case scenario, it is assumed that, on average, there will be up to approximately five buses per hour serving the temporary station during core daytime periods. The resulting noise level at the nearest NSR approximately 20m from bus movements on the proposed access road will be in the order of 60 dB $L_{Aeq,1h}$. Based on this assessment, there will be no significant effects during the day.

8.5.33 The number of bus services would be expected to be lower during the evening and early morning, with no services during the core night-time period when the station will not be operational (approximately midnight to 05:30). There are potential significant adverse impacts at NSR on Hammond Street and Abbey Road to the north during the evening and early morning.

Train movements and activity in stabling siding

8.5.34 During the temporary construction phase, a temporary stabling siding will be established at Hillhouse Compound due to the loss of provision at Huddersfield station due to the Scheme. There is expected to be provision for five 3-car diesel trains to be stabled overnight. The location of the siding is anticipated to be similar to the permanent sidings which are assessed below and have a slightly greater provision, although trains may also be stabled at the temporary station. The potential noise impact of the temporary sidings would be expected to be no worse than the permanent sidings. Reference should therefore be made to the assessment of noise from the permanent sidings detailed in paragraphs 8.5.66 to 8.5.75.

Temporary PA system

8.5.35 The Temporary Hillhouse Compound Station will be served by a temporary PA system. The assessment of noise impacts associated with the temporary PA system is provided in paragraphs 8.5.59 to 8.5.63.

Potential operational noise and vibration effects

Rail traffic noise

8.5.36 There are potential operational noise impacts due to changes in both the number and type of trains operating along the Route, changes in train length, changes in line speed, and changes to the track alignment. Details of the noise modelling methodology are provided in Appendix 8-6.

8.5.37 Noise calculations have been undertaken at 5029 residential and 136 non-residential NSR identified within the study area.

8.5.38 The assessment considers both the absolute noise level and the magnitude of the change in noise due to the Scheme. Conservative baseline ambient noise conditions from non-rail activity such as roads is also factored into the assessment. This serves to better reflect the effect of the railway with increasing distance from the tracks as other sources become dominant. Significant effects are deemed to occur where either:

- the DS façade noise level is above the LOAEL and there is an increase in noise level of at least 5 dB in the long-term (2041) due to the Scheme compared to the DN façade noise levels in the opening year (2026); and
- the DS façade noise level is above the SOAEL, or the NSR is within a NIA, and there is an increase in noise level of at least 1 dB due to the Scheme.

Magnitude of impacts

8.5.39 The magnitudes of the long-term change in noise levels at NSR without mitigation is summarised in Table 8-17.

Table 8-17 Operational railway noise impact magnitude assessment summary

Increase or decrease	Magnitude of change in noise level	Number of NSR affected			
		Residential		Non-residential	
		Day	Night	Day	Night
Increase	Major	0	0	0	0
	Moderate	22	7	0	0
	Minor	535	30	8	0
	Negligible	4174	1654	100	28
Neither	No Change	292	1603	28	56
Decrease	Negligible	6	1732	0	51
	Minor	0	2	0	1
	Moderate	0	1	0	0
	Major	0	0	0	0

8.5.40 In the long-term there are no major increases in noise but there are moderate increases in noise at 22 residential NSR during daytime periods and seven residential NSR during night-time periods. All other long-term impacts are, at worst, minor.

Significance of effects

8.5.41 The summary of potential significant effects without mitigation, taking account of absolute noise level and long-term noise change, is shown for residential NSR in Table 8-18.

Table 8-18 Operational railway noise significance assessment summary

Assessment criteria	Residential NSR			
	Daytime noise levels		Night-time noise levels	
	≥LOAEL-<SOAEL[12]	≥SOAEL[13]	≥LOAEL-<SOAEL[14]	≥SOAEL[15]
No. of NSR above threshold without Scheme (DN 2026)	2179	7	3103	332
No. of NSR above threshold with Scheme (DS 2041)	2795	44	3077	340
Change in no. of NSR within effect level band	616	37	-26	8
No. of NSR with adverse effects[16]	478	-	21	-
No. of NSR with significant adverse effects[17]	21	44	3	31
Total no. of NSR with significant adverse effects	65		34	

8.5.42 With regards to residential NSR, the assessment indicates that there are significant adverse effects at 65 residential NSR during daytime periods and 34 residential NSR during night-time periods.

8.5.43 The summary of potential significant effects without mitigation, taking account of absolute noise level and long-term noise change, is shown for non-residential NSR in Table 8-19.

Table 8-19 Summary of operational railway noise effects at non-residential NSR

Assessment criteria	Non-residential NSR			
	Daytime noise levels		Night-time noise levels	
	≥LOAEL-<SOAEL	≥SOAEL	≥LOAEL-<SOAEL	≥SOAEL
No. of NSR above threshold without Scheme (DN 2026)	74	0	83	10
No. of NSR above threshold with Scheme (DS 2041)	85	0	83	9
Change in no. of NSR within effect level band	11	0	0	-1
No. of NSR with adverse effects	8	-	0	-
No. of NSR with significant adverse effects	0	0	0	1
Total no. of NSR with significant adverse effects	0		1	

8.5.44 The results also indicate no significant adverse effects at non-residential NSR during daytime periods but one during night-time periods; namely, Kingdom Hall of Jehovah's Witnesses, Mirfield. However, such a space would be usually be unoccupied during night-time periods

[12] Resultant daytime façade noise level between 53 dB $L_{Aeq,18h}$ and 67.9 dB $L_{Aeq,18h}$
[13] Resultant daytime façade noise level greater than 68 dB $L_{Aeq,18h}$
[14] Resultant night-time façade noise level between 43 dB $L_{Aeq,6h}$ and 52.9 dB $L_{Aeq,6h}$
[15] Resultant night-time façade noise level greater than 53 dB $L_{Aeq,6h}$
[16] Noise level between LOAEL and SOAEL with an increase in noise of between 3.0 and 4.9 dB is an adverse effect
[17] Noise level above LOAEL with an increase in noise of at least 5 dB, or above SOAEL with an increase in noise of at least 1 dB are significant adverse effects

and effects would therefore not be significant.

8.5.45 Details of the significantly affected NSR are provided in Table 8-20.

Table 8-20 Details of receptors potentially significantly affected by railway noise

Route Section	Potentially affected residential NSR	
	Daytime	Night-time
1 – Huddersfield	No significant adverse effects	No significant adverse effects
2 – Hillhouse and Fartown	Abbey Place Nursing Home; No. 54 Red Doles Road; No. 10 Sapphire Close; No. 6, 7, 8, 9, 11 & 15 Topaz Close; No. 14 & 22 Jade Place	No significant adverse effects
3 – Deighton and Bradley	No. 11 & 13 Whitacre Street; No. 11 & 12 Lilac Court; No. 682 & 684 Leeds Road; No. 1 - 4 Station Road; No. 43, 45, 47, 49, 51 & 54 Whitacre Close.	No. 49 & 51 Whitacre Close; No. 1 - 4 Station Road
4 – Colne Bridge and Battyeford	The Old Smithy, Helm Lane; No. 1 Wheatley Terrace, Helm Lane.	The Old Smithy, Helm Lane
5 – Mirfield and Lower Hopton	Hopton Cottage Care Home; 12 - 32 Woodend Road; 2 & 2A-G Chadwick Road (multiple apartments); No. 1A, 1B & 1C Calder Road No. 2, 4 & 6 Huddleston Court Ledgard Wharf (multiple flats)	Hopton Care Cottages (multiple apartments) No. 30 Woodend Road No. 1, 2, 4, 6, 8, 19 & 23 Huddleston Court (multiple apartments) Tyke (marina), Station Road
6 – Ravensthorpe and Westtown	No. 19, 20, 21 Mavis Avenue; No. 6, 8, 12, 14, 16, 18, 20 & 22 Mavis Street; No. 24 & 26 Brooks Yard	No. 6, 8, 10, 12, 14, 16, 18, 20 & 22 Mavis Street; No. 18, 20, 21 & 22 Mavis Avenue

8.5.46 Additionally, there are several locations where there are predicted reductions in noise levels; namely:

- Waterside Walk, Mirfield where fewer trains will be operating on the closest tracks to these NSR due to the proposed fast line located on the far side of the tracks. However, the reduction is negligible (<1dB reduction); and
- 41 Thornhill Road where the realignment will move the track further from this NSR. The increase in rail traffic offsets this benefit somewhat during the day leading to a negligible reduction, but there is a minor benefit (>3dB reduction) during night-time periods.

Operational railway noise effects on PRoW and recreational canal users

8.5.47 There are PRoW and canals which are used by recreational users adjacent to and crossing the railway[18]. The use of these locations is transient and would typically be for a short duration as users pass through the area.

[18] Note: Residential houseboat moorings are assessed as residential NSR.

8.5.48 Close to the railway line the magnitude of the increase in average noise levels over the course of a day due to the Scheme is typically minor, which reduces with increased distance from the railway. However, noise levels over short periods will be driven by individual train movements, similar to the existing situation.

8.5.49 In the area of the Ravensthorpe Viaduct, the train line will be realigned over the Calder and Hebble Navigation. Noise levels will therefore increase in the area below the proposed viaduct and reduce in the area below the existing viaduct. Given the relative proximity of the existing and proposed viaducts the effects of the realignment are, on balance, negligible on transient recreational users of the canal, and the net magnitude of the increase in noise is minor.

8.5.50 The magnitude of impacts on PRoW and recreational canal users is, at worst, minor and their sensitivity is medium. The effects are for a short duration as transient users pass through the areas close to the railway. The effects of operational railway noise on PRoW and recreational canal users are therefore not significant.

Wheel squeal

8.5.51 Another potential source of noise from the railway is wheel squeal. This has the potential to occur where there are sharp bends with small radii. Typically, wheel squeal has the potential to occur where the radius of a bend is less than 100 times the wheelbase of the train (the distance between the wheels in each bogie[19]), or approximately 300m. The tightest curve along the route is at Heaton Lodge between Bradley Junction and Heaton Lodge Junction which has a radius greater than 1000m. The wheelbase of the Class 802 is approximately 2.7m which is approximately 400 times the radius of the Heaton Lodge curve. Wheel squeal noise is therefore not expected at the Heaton Lodge curve, nor anywhere along the route.

Rail traffic vibration and ground-borne noise

8.5.52 An assessment of railway vibration and ground-borne noise is presented in Appendices 8-8 and 8-9 respectively. In summary, there will be no significant adverse effects from operational railway vibration or ground-borne noise along the entire route.

Operational vibration effects at commercial NSR

8.5.53 Vibration levels due to the operation of the railway are expected to reduce slightly at the aforementioned Dr Reddy's pharmaceutical facility as a result of the Scheme. This is due to train services moving to the fast line which is a greater distance from the facility than the existing line.

Road traffic noise

8.5.54 The Scheme is not expected to cause a permanent change to traffic on the wider road network. There are, however, four locations where road realignments would be required due to the Scheme. There is the potential for noise impacts due to the realignments moving the roads closer to NSR. These proposed road realignments are located at:

- A62 Leeds Road Overbridge (Route Section 3) (Drawing Ref 151667-TSA-32-MVL3-DRG-T-LP-162215.P01.2);
- B6118 Colne Bridge Road Overbridge (Route Section 4) (Drawing Ref: 151667-TSA-32-MVL3-DRG-T-LP-163404.P01.3);
- Ravensthorpe Road (Route Section 6) (Drawing Refs 151667-TSA-35-MVN2-DRG-T-LP-162438. P01.2, 151667-TSA-35-MVN2-DRG-T-LP-162439.P01.2 and 151667-TSA-35-MVN2-DRG-T-LP-162440); and

[19] A wheeled undercarriage pivoted below the end of a rail vehicle

- Thornhill Road (Route Section 6) (Drawing Ref 151667-TSA-35-MVN2-DRG-T-LP-162513.P01.2).

8.5.55 The assessment of potential noise impacts from the road realignments is described in Appendix 8-6 and in the respective Noise and Vibration Route Section Assessment in Volume 2ii, as detailed in the above bullet points. The realignments are also shown in the planning drawings which accompany the TWAO, references are provided above.

8.5.56 There are significant adverse effects at two residential NSR due to the realignment of Thornhill Road; namely, No. 24 & 26 Brooks Yard.

8.5.57 There are no adverse or significant adverse effects associated with the realignments of the A62 Leeds Road Overbridge, the Colne Bridge Road Overbridge or Ravensthorpe Road.

Fixed mechanical plant

8.5.58 No fixed external plant is proposed as part of the Scheme. As such, noise from fixed plant is not considered further in this assessment.

Public Address systems

8.5.59 A noise assessment has been undertaken to determine potential impact from PA systems associated with the proposed works at Huddersfield, temporary platform at Hillhouse construction compound, Deighton, Mirfield and Ravensthorpe Stations. The assessment is described in Appendix 8-10.

8.5.60 Details of the system designs are not currently available and the assessment of noise impacts from the PA system on the neighbouring NSR has been carried out based on generic system specification in line with the requirements of the Network Rail standard NR/L2/TEL/30134. In the absence of loudspeaker type and directivity information, the loudspeakers have been modelled as point sources, which represents the worst case in terms of acoustic impact at the neighbouring receptors.

8.5.61 Sound rating level thresholds for PA systems for each station are provided in Table 8-21.

Table 8-21 PA system thresholds for sound rating level at the likely worst-affected NSRs.

Location	Background Sound Level L_{A90}, dB		PA system sound rating level thresholds, $L_{Ar,T}$, dB			
			LOAEL threshold*		NOEL threshold	
	Daytime 0700-2300	Night-time 2300-0700	Daytime	Night-time	Daytime	Night-time
Huddersfield	56	46**	61	51	46	36
Temporary Hillhouse Compound	52	40	57	45	42	30
Deighton	49	39	54	44	39	29
Mirfield	41	35	46	40	31	25
Ravensthorpe	43	39	48	44	33	29

* The SOAEL is 5 dB above the LOAEL values.

** Background sound level during night-time assumed to be 10 dB below daytime background sound level at this location.

8.5.62 The assessments for each station are provided in Appendix 8-10 and their respective Route Section Assessments, with the results summarised in Table 8-22.

Table 8-22 BS 4142 noise impact assessment of the PA systems

Station	Difference in rating noise relative to background sound		Commentary
	Daytime	Night-time	
Huddersfield	-10 dB (≤NOEL)	+0 dB (>NOEL and < LOAEL)	Assessment indicates complaints are unlikely during the day and less than marginal impact at night according to the subjective rating criteria of BS4142:1997: Not significant
Temporary Hillhouse Compound	-13 dB (≤NOEL)	-1 dB (>NOEL and < LOAEL)	Assessment indicates that complaints are unlikely during daytime periods and less than marginal impact during the night according to the subjective rating criteria of BS 4142:1997: Not significant
Deighton	-4 dB (>NOEL)	+6 (≥LOAEL and <SOAEL)	Assessment indicates a less than marginal impact during the day and a marginal impact at night according to the subjective rating criteria of BS4142:1997: Not significant
Mirfield	+1 dB (>NOEL)	+7 dB (≥LOAEL and <SOAEL)	Assessment indicates a less than marginal impact during the day and a marginal impact at night according to the subjective rating criteria of BS4142:1997: Not significant
Ravensthorpe	-17 dB (≤NOEL)	-13 dB (≤NOEL)	Assessment indicates that complaints are unlikely according to the subjective rating criteria of BS 4142:1997: Not significant

8.5.63 In summary, significant adverse effects would not be expected at any receptors due to PA system noise. However, non-significant adverse effects may be expected, particularly at night, at Deighton and Mirfield stations.

8.5.64 Particular concerns were raised by the local authority regarding potential noise impacts from PA system at NSR. As such, BPM will be applied to achieve the NOEL where possible. Alternatively, PA system noise levels should be as low as reasonably possible (ALARP) and exceedance of the LOAEL limit will be avoided.

8.5.65 In practice, having regard to the nature of the worst-case assessment undertaken, it is likely that the NSRs will be subject to lower noise levels owing to the following factors:

- Loudspeakers will be directional, as opposed to omni-directional as assumed in this assessment, which will reduce the sound levels propagating towards the NSR;
- Consideration will be given to the potential impacts of PA system noise on NSR in the design of the system; and
- There is likely to be less frequent announcements at night than assumed in this assessment, resulting in lower average sound levels.

Permanent stabling siding at Hillhouse Compound

8.5.66 The Hillhouse compound has a long history of railway use including a former engine shed and goods yard; it is retained as operational railway land though some non-rail related transport and storage activity takes place on the site. The Hillhouse Compound will be converted from

its industrial use to a permanent stabling siding with provision for four sidings housing eight 3-car passenger trains. The sidings are anticipated to be electrified for stabling electric trains but would be predominantly used to stable diesel passenger trains overnight. A Mobile Maintenance Train (MMT) would also be stabled at this location.

8.5.67 There will be staggered arrival and departure from the stabling sidings between approximately 21:30 and midnight, and 04:00 and 06:00 respectively. There will typically be no more than one train movement per 15-minutes. The speed limit in the sidings will nominally be 15 mph or 20mph. During normal conditions, the trains will arrive into the sidings and be shut down.

8.5.68 During start-up, trains will typically be required to run and 'tick-over' for approximately 15 minutes to build up break-pressure. It is assumed that only one train will typically be ticking-over the same time as they would leave approximately 15-minutes apart. The initial engine start-up also typically causes a high noise level for several seconds before then ticking-over.

8.5.69 Additionally, on cold nights where there is the potential for freezing, trains will be required to 'tick-over' to maintain a suitable temperature. It is therefore possible that eight trains could be ticking-over simultaneously under this scenario.

8.5.70 The assessment of noise from train movement and ticking-over in the sidings is presented in Appendix 8-7. The results of the assessment are provided in Table 8-23.

Table 8-23 BS 4142:2014 noise impact assessment stabling activity at Hillhouse Compound

Activity	Specific noise level, dB $L_{Aeq,15min}$ (Free-field)	Estimated acoustic character correction	Noise rating level, dB $L_{Ar,Tr}$	Difference between rating and night-time background noise level at NSR (40 dB $L_{A90,15min}$)	Commentary
Arrival/Departure from Hillhouse stabling sidings	34 <LOAEL)	+6 (intermittent and marginally impulsive)	40	0 dB	Specific noise level below LOAEL. Noise rating level is below adverse effect level: Not significant
Train start-up	47 (>LOAEL and < SOAEL)	+6 (intermittent and tonal)	53	+13 dB	Noise level above LOAEL and below SOAEL. Noise rating level >10 above background noise level: Significant
'Ticking-over' for frost prevention on cold nights	54 (>SOAEL)	+6 (intermittent and tonal)	60	+20 dB	Noise level above SOAEL. Noise rating level >10 above background noise level: Significant

8.5.71 The assessment indicates that under normal operating conditions, noise from passenger trains arriving and departing from the stabling sidings will not be significant.

8.5.72 However, during start-up diesel passenger trains have the potential to cause significant adverse noise effects at nearby NSR to the north on Hammond Street, due to the exceedance of the noise rating level above the background noise level by more than 10 dB, depending on the context. The specific noise during start-up at NSR is 47 dB $L_{Aeq,2h}$. This is comparable to the existing ambient noise level during night-time periods at this location (49 dB $L_{Aeq,8h}$). This will increase the average ambient night-time noise level to approximately 52 dB $L_{Aeq,8h}$ (3 dB increase) which will be a minor noise impact over the night-time period, assuming the start-up period is no more than two hours. However, the nature of the noise source is tonal and intermittent and will be a material change to the night-time noise climate at the site. When placed in context, noise from the start-up of diesel trains at the Hillhouse Sidings is expected to cause disturbance at nearby receptors and is therefore significant.

8.5.73 Additionally, on occasional cold nights where there is the potential for freezing, diesel passenger trains 'ticking-over' have the potential to cause significant adverse noise effects at nearby NSR to the north on Hammond Street, due to the exceedance of the noise rating level above the background noise level by more than 10 dB, depending on the context. In terms of absolute noise levels, this would exceed the SOAEL, as well as being potentially intermittent and tonal. The trains will also be expected to tick-over for the duration of being parked (i.e. the majority of the night-time period). Noise from engines 'ticking-over' on occasional cold-nights will be expected to cause disturbance at nearby receptors and will be significant.

8.5.74 As noted above, the sidings are anticipated to be electrified for stabling electric trains but would be predominantly used to stable diesel passenger trains overnight. The assessment assumes the worst-case scenario that only diesel passenger trains are stabled in the sidings. If electric passenger trains are stabled noise levels would be expected to be lower (by up to approximately 10dB) and less tonal. Therefore, if the sidings were solely used by electric passenger trains noise from the start-up would not be expected to be significant, but noise from 'ticking-over' on cold nights may still be significant.

8.5.75 The above significant effects from the operation of the Hillhouse Compound will affect 30 NSR on Abbey Road, Alder Street, and Hammond Street to the north, namely:

- No. 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, and 22 Abbey Road;
- No 120, 122, 124, 126, 128, and 130 Alder Street; and
- No. 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, and 26 Hammond Street.

8.6 Mitigation measures

Construction mitigation measures

8.6.1 Construction noise and vibration will be managed through the CoCP.

8.6.2 Part A of the CoCP (Appendix 2-1) includes the general processes by which construction will be managed, including general measures for controlling noise and vibration, as detailed in paragraphs 8.6.18 to 8.6.25.

8.6.3 Part B of the CoCP will include details of the management of construction effects for specific disciplines, including a Noise and Vibration Management Plan (NVMP). Part B of the CoCP will be submitted to and approved by the local authority pursuant to a condition to be attached

to the deemed planning permission[20]. Part B of the CoCP will also incorporate an External Communications Programme.

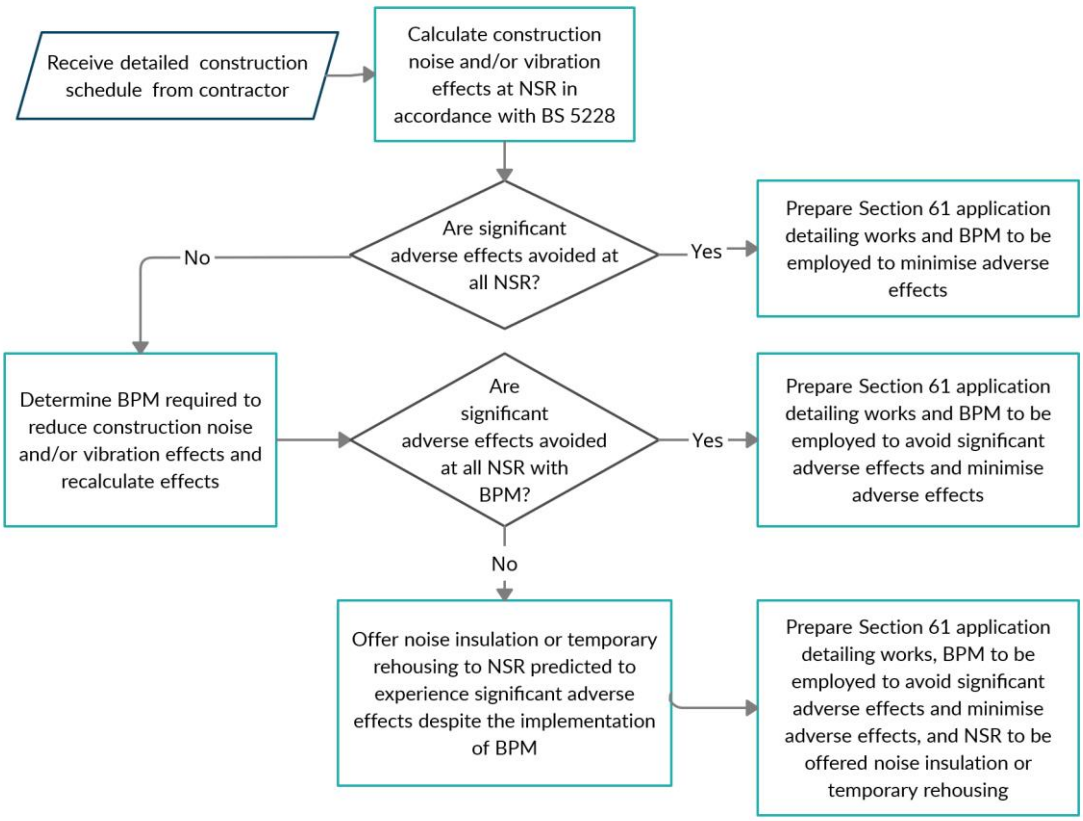
Management process for construction noise and vibration

Noise and Vibration Management Plan

8.6.4 A NVMP will be prepared by the contractor prior to starting works and included in Part B of the CoCP. The NVMP will define the framework by which construction noise and vibration will be managed. It will include:

- how works are to be conducted in accordance with Section 61 consents in consultation with the local authority;
- detail on the scheduling of staged Section 61 applications;
- details of construction noise and vibration thresholds in terms of significance and the criteria for noise insulation or temporary rehousing;
- details of how NSR, such as households, will be kept informed of construction works and how they can contact Network Rail; and
- details of BPM to reduce noise and vibration during construction.

8.6.5 An overview of the approach to construction mitigation for noise and vibration, including the Section 61 assessment process, is described in Insert 8-1 with further details of the management process provided in the following paragraphs.



Insert 8-1 Section 61 construction noise and vibration assessment and mitigation process

[20] On making an order under the Transport and Works Act 1992, the Secretary of State may direct that planning permission shall be deemed to be granted, subject to such conditions (if any) as may be specified in the direction.

Section 61 applications for prior consent

8.6.6 Construction works will be managed through Section 61 applications through consultation with the local authority. Section 61 of the CoPA allows developers to apply for 'prior consent' for noise and vibration generating activities during the construction phase of a development provided that BPM are employed to minimise the effects of noise and/or vibration.

8.6.7 Contractors would be required to follow good construction practices as outlined in BS 5228-1 and BS 5228-2[21] to control noise and vibration, respectively. BS 5228-1 and BS 5228-2 have Approved Code of Practice status (in England) under the powers conferred by sections 71(1)(b), (2) and (3) of the CoPA, as enacted under The Control of Noise (Code of Practice for Construction and Open Sites) (England) Order 2015. Compliance with the best practice noise and vibration requirements stated therein became a statutory obligation under the Act.

8.6.8 A Section 61 application for prior consent requires the assessment of the construction working methods that will be used to undertake the work and a prediction of the likely noise and/or vibration levels at nearby NSR. The Section 61 application(s) for the Scheme will detail the specific construction methods and the BPM, agreed with the local authority, to be used to reduce noise and/or vibration levels.

8.6.9 When approved, the contractor is required to carry out the works following the processes, including the implementation of BPM, as detailed in the Section 61 consent. The agreed methods will be included in the NVMP.

8.6.10 In summary, the Section 61 process identifies:

- NSR where significant adverse effects may occur due to construction noise and/or vibration;
- The BPM that will be applied to avoid these significant adverse effects; and
- NSR to be offered noise insulation or temporary rehousing (where significant adverse effects may still occur even following the implementation of BPM).

8.6.11 It should be noted that BPM are required to applied at all times, even in the absence of significant adverse effects, in order to reduce adverse effects at nearby NSR.

Noise insulation and temporary rehousing during construction

8.6.12 As part of the Section 61 application process, residential NSR eligible for noise insulation or temporary rehousing will be identified. Households will be eligible for noise insulation or temporary rehousing where significant adverse effects are predicted to occur despite the implementation of BPM to minimise the effects of noise and/or vibration. To be eligible for noise insulation or temporary rehousing the construction noise and/or vibration level (only temporary rehousing for significant vibration effects), despite implementation of BPM, must exceed either:

- The construction noise SOAEL value at the residential NSR during the relevant period as defined in Table 8-2; or
- A sustained vibration level of at least 1 mm/s at the residential NSR; and
- The duration of noise and/or vibration exceedance must be for a period of:
  - 10 or more days in any 15 consecutive days; or
  - 40 or more days in any 6 consecutive months.

[21] British Standard 5228-2:2009+A1:2014 Code of practice for noise and vibration on construction and open sites – Part 2: Vibration

Community liaison

8.6.13 An External Communications Programme will be incorporated into Part B of the CoCP. Good relations with people living and working in the vicinity of site operations are of paramount importance. Early establishment and maintenance of these relations throughout the carrying out of site operations will go some way towards allaying people's concerns. Good relations can be developed by keeping people informed of progress and by treating complaints fairly and expeditiously.

8.6.14 It is well established that people's attitudes to noise can be influenced by their attitudes to the source or activity itself. Noise from a site will tend to be accepted more readily by residents if they consider that the contractor is taking all possible measures to avoid unnecessary noise. The attitude to the contractor can also be improved through good community liaison and information distribution and the provision of a helpline to respond to queries or complaints. The acceptability of the Scheme itself can also be a factor in determining community reaction.

8.6.15 Local residents and applicable local authority and council officers will be informed of the commencement and likely duration of the construction work activities through a letter drop. The letter will include a contact telephone number for the Network Rail helpline which is manned 24 hours a day. In line with good practice the helpline team will be briefed on the Scheme in advance of works.

Construction noise mitigation

Specific noise mitigation measures

8.6.16 There are potential significant impacts from construction noise at 47 NSR during daytime periods due to the Scheme. There are also potential significant adverse effects due to night-time construction activities, particularly due to works at the Hillhouse Compound. The significant adverse effects at these locations can be adequately mitigated with the best practice mitigation detailed in paragraphs 8.6.18 to 8.6.22.

8.6.17 However, noise barriers and non-statutory noise insulation are required in Route Section 2 to mitigate the temporary and permanent operational noise impacts from the Hillhouse stabling sidings, as detailed in paragraphs 8.6.51 to 8.6.56. These measures will also minimise some adverse noise effects from construction activities at this location, as they will be put in place in the early stages of the programme of works at the site. It is proposed to install the noise barrier following the construction of the retaining wall located adjacent to the proposed barrier location at the north of the site. The barrier will therefore provide mitigation of noise from subsequent construction activity at the Hillhouse Compound at NSR to the north.

General best practice noise mitigation measures

8.6.18 There are many general measures than can reduce noise levels at source, and the following are examples of items that are considered under BPM (detailed within Part A of the CoCP) and as part of the Section 61 application(s):

- Avoid unnecessary revving of engines and switch off equipment when not required;
- Keep internal haul routes well maintained and avoid steep gradients, where possible;
- Use rubber linings in, for example, chutes and dumpers to reduce impact noise;
- Minimize drop height of materials;
- Start-up plant and vehicles sequentially rather than all together;
- Continuous noisy plant should be housed in acoustic enclosures, where practicable;
- Exhaust silencing and plant muffling equipment should be fitted and maintained in good working order;

- Static plant known to generate significant levels of vibration should be fitted with vibration dampening features;
- Each item of plant used should be selected so as to comply with the noise limits quoted in the relevant European Commission Directive 2000/14/EC/United Kingdom Statutory Instrument (SI) 2001/1701 as transposed into UK legislation by the Noise Emission in the Environment by Equipment for use Outdoors Regulations 2001/1701;
- Consideration will be given to the recommendations set out in Annex B of BS 5228-1, noise sources, remedies and their effectiveness;
- Equipment should be well maintained and where possible should be used in the mode of operation that minimises noise;
- Plant and equipment will be shut down when not in use;
- Semi-static equipment will be sited and orientated as far as is reasonably practicable away from occupied buildings and, where feasible, will be fitted with suitable enclosures or screened using noise barriers;
- Materials will be handled in a manner that minimises noise; and
- All appropriate personnel will be instructed on BPM measures to reduce noise and vibration as part of their induction training and followed up by 'tool-box' talks.

8.6.19 If noisy processes can be avoided, then the amount of noise reaching NSR will be reduced. Alternative ways of reducing noise is to either increase the distance between the construction noise source and NSR or to introduce noise reduction screens, barriers or bunds.

8.6.20 The movement of plant onto and around the site should have regard to the normal operating hours of the site and the location of any noise sensitive premises as far as is reasonably practicable.

8.6.21 The use of conventional audible reversing alarms has caused problems on some sites and alternatives are available. Where possible, designing site access as a one-way system will help reduce the need for reversing and associated reversing alarms. Audible reversing warning systems on mobile plant and vehicles should be of a type which, whilst ensuring that they give proper warning, have a minimum noise impact on persons outside sites. When reversing, mobile plant and vehicles should travel in a direction away from noise sensitive properties whenever possible. Where practicable, alternative reversing warning systems should be employed to reduce the impact of noise outside sites. These measures are set out in Part A of the CoCP.

8.6.22 The plant and activities to be employed on the site should be reviewed to ensure that they are the quietest available for the required purpose; this is in accordance with BPM. Where reasonably practicable, noisy plant or activities should be replaced by less noisy alternatives if noise problems are occurring.

Construction vibration mitigation

General best practice vibration mitigation measures

8.6.23 The following measures are included in Part A of the CoCP:

- Where reasonably practicable, plant and/or methods of work causing significant levels of vibration at NSR should be replaced by other less intrusive plant and/or methods of working. For example, rotary bored piling produces significantly less vibration than percussive or vibratory piling; and
- Stationary plant with the potential to generate vibration should be located away from NSR or/and isolated using resilient mountings.

8.6.24 With regards to percussive or vibratory piling, the level of vibration generated at a receptor is

proportional to the energy of the input of the equipment into the pile per blow/cycle. Reducing the energy input would therefore reduce the level of vibration at nearby NSR. However, the trade-off is that the duration for driving the piles to the required depth would be extended, which may cause a greater overall impact in terms of both vibration and noise. This may require consideration on a site-by-site basis.

8.6.25 Reducing the resistance to pile penetration can reduce the levels of vibration generated by piling. This can be achieved by pre-boring, which removes some of the soil that would otherwise be displaced during the early stages of pile driving.

Vibration monitoring

8.6.26 Vibration levels may be monitored on a case-by-case basis at nearby locations during vibration generating activities where there is the potential for cosmetic building damage (i.e. vibration levels >12.5 mm/s PPV). Trigger levels will be set such that works will stop should significant levels occur. Works would only commence once BPM to reduce the level of vibration have been applied. As noted above, reducing the level of vibration may lead to an increased works duration, which may in some situations be more significant than a higher vibration level for a shorter duration. This would be assessed on a site-by-site basis. A proportionate vibration monitoring programme will be detailed in the NVMP and/or Section 61 applications and monitoring locations and reporting will be agreed with the local authority.

Building condition surveys

8.6.27 The vibration level at which cosmetic damage to buildings may occur is significantly higher than the level at which vibration may be perceptible. However, people's apprehension and perception of the possibility of damage occurs at much lower levels. As such, building condition surveys could be conducted at buildings close to vibration generating activities, where vibration levels are expected to approach or exceed 12.5 mm/s PPV. Specific vibration thresholds will be detailed in the NVMP and CoCP informed by the Section 61 assessment.

8.6.28 Building condition surveys would be conducted at applicable buildings prior to and following construction works, detailing any existing damage and subsequently any damage that may have been caused by construction works. Where damage is considered to have been caused by the Scheme construction works, this would be rectified by Network Rail.

Mitigation of noise due to construction traffic and temporary diversions

8.6.29 Temporary traffic diversions and traffic routes will be managed by the Construction Traffic Management Plan (CTMP) which will be submitted to and agreed by the Local Authority as a condition attached to the deemed planning permission before construction works commence.

8.6.30 The Scheme is reducing the amount of material that needs to be removed, and thus, associated vehicle movements, through its policy of reusing or recycling as much of the excavated material as reasonably practicable.

8.6.31 Where it is necessary to move excavated material and it is reasonably practicable to do so, excavated material will be transported by public highway along designated lorry routes. Using A roads and motorways where possible and minimising the use of local roads.

8.6.32 Additionally, where possible, rail transport will be used for the movements of materials in bulk. This will primarily be the case for OLE and track works.

Operational mitigation measures

Operational railway noise mitigation

Operational railway noise barriers

8.6.33 Noise barriers are the acoustically preferred mitigation measure, compared to noise insulation, as they have the potential to benefit both external and internal amenity as well as the wider area.

8.6.34 Proposed noise barriers within 5m of the track will be absorptive to prevent any degradation in acoustic performance due to the reverberant build-up of noise between the barrier and the train. The exact heights, lengths and positions of the barriers are subject to detailed design and will take into account any non-acoustic constraints such as safe running of the railway. Final details of the barrier locations and type will be agreed with the local authority as part of a condition attached to the deemed planning permission.

8.6.35 Noise barriers are proposed at eight locations where there will be potential significant adverse effects and where a barrier may be effective (i.e. where they will remove line-of-sight of the railway at the NSR).

8.6.36 The proposed track side barriers are detailed in Table 8-24 and are shown visually in the outline environmental mitigation plan in Figure 2-3 and in Figures 8-6 and 8-7.

Table 8-24 Potential trackside barrier locations

Barrier location	Approximate number of significant adverse effects avoided	Approximate number of adverse effects mitigated	Location (Easting/ Northing)	Approximate barrier length (m)	Track side
Red Doles Road, Huddersfield	3	20	415168, 418397	175	Down
Topaz Close, Huddersfield	8	50	415274, 418750	175	Down
Station Road, Bradley	4	0	417205, 419994	85	Down
Helm Lane, Mirfield	3	3	418871, 420280	120	Up
Woodend Road, Mirfield	12	15	419930, 419644	160	Up
Mirfield Viaduct	5	30	420011, 419609	70	Up
Huddleston Court/Marina	15	11	420186, 419561	215	Down
Mavis Street/Mavis Avenue	19	24	423446, 420672	170	Down
Total	69	150			

8.6.37 Operational railway noise levels would be reduced in the location of the proposed barriers such that significant adverse effects will be avoided at 69 NSR. Additionally, adverse effects will be mitigated at 150 NSR.

8.6.38 Forty-seven NSR would have potentially exceeded the thresholds for statutory noise insulation under the NIRR without mitigation in the form of barriers as identified in Table 8-24. Based on

the results of the modelling conducted for this ES, including the mitigation in the form of barriers, and subject to a full assessment, 10 NSR would potentially exceed the statutory noise insulation thresholds under the NIRR due to the Scheme. This is therefore a reduction of 37 NSR potentially exceeding the thresholds for statutory noise insulation due to the provision of track-side noise barriers.

Statutory Noise insulation (operational rail noise)

8.6.39 Where noise barriers are not feasible for non-acoustic reasons, consideration will then be given to statutory noise insulation. Noise insulation may take the form of enhanced or secondary glazing, together with consideration of the ventilation requirements. Noise insulation is considered secondary to noise barriers as it does not have the potential to benefit external amenity, nor the wider area. It should be noted that this assessment details receptors that *may* prove eligible for statutory noise insulation and is therefore indicative, but the full assessment for eligibility under the NIRR would be conducted at a later stage, taking into account the benefits of the track-side noise barriers detailed above.

8.6.40 The 10 NSR which would potentially prove eligible for statutory noise insulation under the NIRR are:

- No. 11 & 13 Whitacre Street;
- No. 11 & 12 Lilac Court;
- No. 682 & 684 Leeds Road;
- Hopton Care Cottages (multiple apartments);
- Ledgard Wharf (multiple apartments); and
- No. 24 & 26 Brooks Yard.

8.6.41 Whilst not technically eligible for statutory noise insulation, No. 28 and 30 Brooks Yard would also be offered noise insulation by Network Rail, under the power granted by the NIRR due to the contiguous façades of these properties, should No. 24 & 26 Brooks Yard prove eligible.

Non-statutory Noise insulation (operational rail noise)

8.6.42 Additionally, there are 12 NSR that would not be expected to prove eligible for statutory noise insulation under the NIRR, despite experiencing significant adverse effects, and where noise barriers would not be a viable means of mitigation; namely:

- No. 43, 45, 47, 49, 51 & 54 Whitacre Close;
- No. 14, 16, 18 & 20 Mavis Street; and
- No. 20 & 22 Mavis Avenue.

8.6.43 To address the effects of noise at these NSR, they may be offered non-statutory noise insulation. A further assessment will be conducted to determine whether suitable internal noise levels could be achieved with the existing glazing and ventilation measures. Where suitable noise levels are not considered achievable by the existing provision, the noise insulation of the property may be improved by an amount at least equal to increase in noise due to the Scheme, or by an amount at which reasonable internal noise levels can be achieved (whichever is lower).

PA system noise mitigation

8.6.44 The assessment of PA noise is based on generic ‘typical worst-case’ data and assumptions as details of the system designs are not currently available and will be developed at a later stage. Consideration will be given to reducing the impacts of noise from the PA systems at nearby NSR as far as practical whilst providing adequate coverage, in line with the requirements of Network Rail in terms of safety and speech intelligibility.

8.6.45 The mitigation measures will include the specification of the system in terms of loudspeaker location, directivity, orientation. Electronic visual information displays may also be incorporated but these will typically complement the PA system and are not as a replacement.

8.6.46 The PA system at the temporary Hillhouse Compound station will be temporary for 14 months between Winter 2023 and Spring 2025, at which point it will be removed. The PA systems at other stations would be permanent.

Road traffic noise mitigation

Roadside noise barriers

8.6.47 Roadside noise barriers are not considered feasible for reducing the effects of the proposed realignment of Thornhill Road at Brooks Yard, particularly at the upper floors, due to the angle of view between the NSR and the road. However, a new garden wall is proposed between the proposed realignment of Thornhill Road and the rear garden of 26 Brooks Yard which would serve as a noise barrier to reduce noise levels in external amenity space and ground floor areas.

Statutory noise insulation (road traffic noise)

8.6.48 This assessment details receptors that *may* prove eligible for statutory noise insulation and is therefore indicative, but the full assessment for eligibility under the NIR and would be conducted at a later stage.

8.6.49 The following two NSR are considered likely to prove eligible for statutory noise insulation under the NIR due to the Scheme, and are shown visually in Figures 8-6 and 8-7:

- No. 24 & 26 Brooks Yard.

8.6.50 Whilst not technically eligible for statutory noise insulation, No. 28 and 30 Brooks Yard would also be offered noise insulation by Network Rail, under the power granted by the NIR due to the contiguous façades of these properties, should No. 24 & 26 Brooks Yard prove eligible.

Mitigation of the temporary and permanent operational phases of Hillhouse stabling sidings

8.6.51 The mitigation of noise from the temporary and permanent operational phases of the Hillhouse stabling sidings, as detailed in paragraphs 8.5.30 to 8.5.35 and 8.5.66 to 8.5.75 respectively, requires a combined set of measures which are described in the following paragraphs. These measures would also serve to attenuate construction noise during the construction phase.

Noise barriers (Hillhouse stabling sidings)

8.6.52 A noise barrier is proposed to the rear of properties to the north of the Hillhouse Compound on Alder Street, Abbey Road and Hammond Street. The location and design of the barriers is subject to a feasibility study.

8.6.53 The barriers are not likely to attenuate noise such that significant adverse effects are entirely avoided. As such, in additional to the noise barriers, additional mitigation will be offered in the form of an offer of non-statutory sound insulation to affected residential NSR below.

Non-statutory Noise insulation (Hillhouse stabling sidings)

8.6.54 Glazing and ventilation will be offered to qualifying residential NSR adjacent to the Hillhouse Compound which may experience significant adverse effects from both the temporary and permanent operation of the compound during night-time periods.

8.6.55 Where feasible, the specification will be capable of achieving internal noise levels in bedrooms

between 5 and 10 dB below the guideline noise level of 30 dB $L_{Aeq,8h}$ stated in BS 8233:2014 (i.e. 20-25 dB $L_{Aeq,8h}$) or a Noise Rating level of 20 dB (NR20) during periods of freezing temperatures when the trains in the stabling sidings may be ticking-over.

8.6.56 Subject to a further assessment following detailed design and the barrier feasibility study, an indicative glazing specification of 42 dB R_w+C_{tr}[22] is proposed to bedroom spaces facing the Hillhouse stabling sidings site. Such a specification would typically require enhanced double glazing and secondary glazing. An alternative means of ventilation will be provided which meets the requirements of the Building Regulations 2010 Approved Document F, reducing the reliance on open windows (although windows will be openable at the occupants' discretion) that does not compromise the integrity of the sound insulation.

Site Management of Hillhouse stabling sidings

8.6.57 The Hillhouse sidings will employ BPM in the management of the site to reduce noise egress as far as possible.

8.7 Residual effects

Residual construction effects

8.7.1 With the mitigation detailed within Section 8.6, there will be no permanent significant residual adverse effects from construction activities associated with the Scheme. However, there will be temporary significant residual effects from road traffic noise at NSR due to temporary diversions and construction traffic along the affected routes detailed Table 8-17.

Residual operational effects

Rail traffic noise

8.7.2 This section summarises the results of the assessment of operational railway noise effects with the inclusion of the indicative barriers detailed in Table 8-24. The full results of the noise modelling are shown visually in Figures 8-6 and 8-7 for daytime and night-time respectively.

8.7.3 There were no significant adverse effects at non-residential NSR. As such, the assessment of residual effects focuses on residential NSR.

Magnitude of impacts

8.7.4 The magnitudes of the long-term change in noise levels at NSR with mitigation in the form of track-side noise barriers is summarised in Table 8-25.

Table 8-25 Operational railway noise impact magnitude assessment summary with mitigation

Increase or decrease	Magnitude of change in noise level	Number of residential NSR affected			
		With mitigation		Compared to unmitigated scenario	
		Day	Night	Day	Night
Increase	Major	0	0	+0	+0
	Moderate	9	2	-13	-5
	Minor	299	10	-236	-20

[22] The weighted sound reduction index 'R_w' is a single number quantity which characterizes the airborne sound insulating properties of a material or building element over a range of frequencies; 'C_{tr}' is a correction term applied against the sound insulation single-number values (such as R_w) to provide a weighting against low frequency performance.

Increase or decrease	Magnitude of change in noise level	Number of residential NSR affected			
		With mitigation		Compared to unmitigated scenario	
		Day	Night	Day	Night
	Negligible	4270	1063	+96	-591
Neither	No Change	304	1466	+12	-135
Decrease	Negligible	98	2312	+92	+580
	Minor	33	88	+33	+86
	Moderate	16	77	+16	+76
	Major	0	11	+0	+11

8.7.5 With mitigation in the form of barriers at the locations identified in Table 8-25, there are no major long-term increases in noise at any NSR, but there are moderate increases in noise at nine NSR during daytime periods and two NSR during night-time periods. All other long-term impacts are, at worst, minor.

8.7.6 Compared to the existing DN scenario, the barriers would result in a minor reduction in noise levels at 33 NSR and a moderate reduction at 16 NSR. During night-time periods, there would be a minor reduction in noise at 88 NSR, a moderate reduction at 77 NSR, and a major reduction at 11 NSR.

Significance of effects

8.7.7 The summary of potential residual significant effects with mitigation, taking account of absolute noise level and long-term noise change, is shown for residential NSR during daytime periods in Table 8-26.

Table 8-26 Operational railway noise significance assessment summary with mitigation - Daytime

Assessment criteria	Residential NSR - Daytime			
	With mitigation		Compared to unmitigated scenario	
	≥LOAEL-<SOAEL	≥SOAEL	≥LOAEL-<SOAEL	≥SOAEL
No. of NSR above threshold without Scheme (DN 2026)	2179	7	-	-
No. of NSR above threshold with Scheme (DS 2041)	2666	11	-125	-33
Change in no. of NSR within effect level band	487	4		
No. of NSR with adverse effects	281	-	-197	-
No. of NSR with significant adverse effects	8	10	-13	-36
Total no. of NSR with significant adverse effects	18		-47	

8.7.8 With regards to residential NSR, the assessment indicates that with mitigation there are significant adverse effects at 18 residential NSR during daytime periods. This is a reduction of 47 NSR compared to the unmitigated scenario.

8.7.9 The summary of potential residual significant effects with mitigation, taking account of absolute noise level and long-term noise change, is shown for residential NSR during night-time periods in Table 8-27.

Table 8-27 Operational railway noise significance assessment summary with mitigation – Night-time

Assessment criteria	Residential NSR – Night-time			
	With mitigation		Compared to unmitigated scenario	
	≥LOAEL-<SOAEL	≥SOAEL	≥LOAEL-<SOAEL	≥SOAEL
No. of NSR above threshold without Scheme (DN 2026)	3103	332	-	-
No. of NSR above threshold with Scheme (DS 2041)	2990	275	-87	-65
Change in no. of NSR within effect level band	-119	-57		
No. of NSR with adverse effects	7	-	-14	-
No. of NSR with significant adverse effects	2	6	-1	-25
Total no. of NSR with significant adverse effects	8		-26	

8.7.10 With regards to residential NSR, the assessment indicates that with mitigation there are significant adverse effects at eight residential NSR during night-time periods. This is a reduction of 26 NSR compared to the unmitigated scenario.

8.7.11 Details of the significantly affected NSR are provided in Table 8-28.

Table 8-28 Details of receptors potentially significantly affected by railway noise

Route Section	Potentially affected residential NSR	
	Daytime	Night-time
1 – Huddersfield	No significant adverse effects	No significant adverse effects
2 – Hillhouse and Fartown	No significant adverse effects	No significant adverse effects
3 – Deighton and Bradley	No. 43, 45, 47, 49, 51 & 54 Whitacre Close; No. 11 & 13 Whitacre Street; No. 11 & 12 Lilac Court; No. 682 & 684 Leeds Road.	No. 49 & 51 Whitacre Close
4 – Colne Bridge and Battyeford	No significant adverse effects	No significant adverse effects
5 – Mirfield and Lower Hopton	Hopton Care Cottages (multiple apartments); Ledgard Wharf (multiple flats)	Hopton Care Cottages (multiple apartments)
6 – Ravensthorpe and Westtown	No. 18 & 20 Mavis Street; No. 24 & 26 Brooks Yard	No. 14,16 & 18 Mavis Street; No. 20 & 22 Mavis Avenue

8.7.12 The NSR detailed in Table 8-28 are all at locations where trackside noise barriers are not considered to be an effective form of mitigation. Ten of the above NSR are expected to prove eligible for statutory noise insulation under the NIRR, as detailed in 8.2.15, subject to further assessment.

8.7.13 The remaining 12 NSR may be offered non-statutory sound insulation should the existing glazing and ventilation provision at the properties be unlikely to provide reasonable internal noise levels following completion of the Scheme, again, subject to further assessment.

Significant adverse effects in terms of internal amenity will be avoided at all NSR should the offer be accepted. There would, however, be residual significant adverse effects in the external amenity areas during daytime periods at the following NSR:

- No. 43, 45, 47, 49, 51 & 54 Whitacre Close;
- No. 11 & 13 Whitacre Street;
- No. 11 & 12 Lilac Court;
- No. 682 & 684 Leeds Road and
- No. 24 & 26 Brooks Yard.

8.7.14 No. 28 and 30 Brooks Yard will also be offered noise insulation under the power granted by the NIRR and NIR due to the contiguous façades of these properties.

Road traffic noise

8.7.15 The NSR at Brooks Yard are expected to prove eligible for statutory noise insulation under the NIR, subject to further assessment. Additionally, the construction of the perimeter/garden wall will provide mitigation of road traffic noise in external amenity areas. As such, significant adverse effects will be avoided. It is noted that these properties also qualify for statutory sound insulation under the NIRR for railway noise.

Permanent stabling siding at Hillhouse Compound

8.7.16 The proposed noise barrier at northern boundary of the Hillhouse sidings would be expected to reduce noise levels from the temporary and permanent operation of the proposed stabling sidings during night-time periods by up to 5 dB at first floor level (i.e. bedrooms). This is not sufficient to avoid significant adverse effects at residential NSR to the north of the site. As such, affected NSR will be offered non-statutory sound insulation capable of achieving suitable internal noise levels, including an alternative form of ventilation to reduce the reliance on open windows. This form of mitigation is dependent on acceptance of the offer of non-statutory sound insulation by the household. Assuming the offer would be accepted, significant adverse effects will be avoided.

Summary of principal findings

8.7.17 A summary of the noise and vibration assessment is provided in Table 8-29.

Table 8-29 Summary of assessment

Topic	Receptor	Description of potential impact	Significant of effect pre-mitigation	Mitigation	Significance of residual effect
Construction noise	Residential and non-residential NSR	Long and short-term impacts from construction activities	Significant adverse effects at 46 NSR	Implementation of CoCP measures and BPM; Noise barriers and potentially noise insulation and/or temporary rehousing in relation to extended works at Hillhouse Compound	No significant adverse effects
Construction vibration (Humans)	Residential and non-residential NSR	Short-term impacts from construction activities	No significant adverse effects at NSR,	Implementation of CoCP measures and BPM	No significant adverse effects
Construction vibration (Sensitive commercial locations)	Non-residential NSR (Dr Reddy's)	Short term impacts from construction activities	Potential temporary effects at Dr Reddy's in term of use of sensitive equipment during vibration generating construction activity.	Implementation of CoCP measures and BPM; Stakeholder liaison	No significant adverse effects
Construction vibration (Structures)	Buildings/structures	Short-term impacts from construction activities	Potential cosmetic building damage at 30 buildings	Implementation of CoCP measures and BPM; Structural condition surveys; Remediation works (if required)	No significant adverse effects
Temporary construction traffic and diversions	Residential and non-residential NSR	Temporary impacts from construction traffic and temporary diversions	Significant temporary effects along nineteen roads, and potential significant adverse effects form bus replacement service at Hillhouse Compound during night-time periods	Implementation of CoCP measures and CTMP; Noise barrier at Hillhouse Compound	Significant temporary effects from temporary construction traffic and diversions along nineteen roads

Topic	Receptor	Description of potential impact	Significant of effect pre-mitigation	Mitigation	Significance of residual effect
Airborne railway noise	Residential and non-residential NSR	Long-term noise impact from railway operation	Significant adverse effects at 70 NSR	Noise barriers at eight locations, and statutory and non-statutory sound insulation.	No significant adverse effects with regards to internal amenity. However, significant adverse effects on external amenity where barriers are not effective or feasible at 14 NSR.
Airborne noise from operational activity at Hillhouse Compound	Residential and non-residential NSR	Long-term noise impact from stabling siding operation	Significant adverse effects at 30 NSR	Implementation of BMP, site management, noise barriers and non-statutory noise insulation	No significant adverse effects
Ground-borne noise from railway	Residential and non-residential NSR	Long-term noise impact from railway operation	No significant adverse effects	N/A	No significant adverse effects
Vibration from railway	Residential and non-residential NSR	Long-term vibration impact from railway operation	No significant adverse effects	N/A	No significant adverse effects
Operational road traffic noise	Residential and non-residential NSR	Long-term noise impact from railway operation	Significant adverse effects at two NSR	Noise insulation and new garden wall between road and external amenity space	No significant adverse effects
PA system noise	Residential and non-residential NSR	Long-term noise impact from station operation	No significant adverse effects	Implementation of BPM	No significant adverse effects

8.8 Cumulative effects

8.8.1 Cumulative effects can include intra-Scheme impacts and inter-Scheme impacts. Intra-Scheme impacts are where in-combination impacts arise from the Scheme. Inter-Scheme impacts occur due to impacts from more than one scheme.

Intra- scheme (synergistic) impacts

8.8.2 Potential intra-Scheme effects may occur from interaction with other technical disciplines.

8.8.3 Potential synergistic impacts have been identified that correspond to noise and vibration. These include:

- Air quality;
- Traffic and transport; and
- Population and human health.

8.8.4 Such effects may occur where a receptor experiences adverse or significant adverse effects from, for example, both noise and dust due to construction activities.

8.8.5 There are potential intra-Scheme cumulative construction noise and/or vibration effects due to the multiple construction activities associated with the Scheme. Typically, construction noise impacts at individual receptors will be dominated by the closest, or noisiest activity. A detailed timetable of works is not currently available and concurrent activities at any given location are not known. Potential cumulative intra-Scheme noise impacts will be assessed and mitigated as part of the Section 61 application process as described in paragraphs 8.6.6 - 8.6.11. BPM will be employed to reduce intra-Scheme cumulative noise and vibration impacts.

8.8.6 There are potential cumulative effects at NSR due to the various sources of operational noise, including rail noise, road noise (due to road realignments and/or changes in road traffic flows due to the Scheme), and PA system noise. Cumulatively, the effects may be significant at Deighton and Mirfield Stations where there is an increase in rail noise and PA system noise is around the LOAEL. Mitigation measures are proposed in relation to PA system design minimise the adverse effects as far as practicable. No further measures are required to reduce potential cumulative effects.

8.8.7 No. 26 & 28 Brooks Yard are predicted to experience significant adverse effects from both railway and road noise due to the Scheme. These properties qualify for noise insulation under both the NIR and the NIRR. Consideration will be given to both sources of noise in the provision of noise insulation. Whilst not technically eligible for noise insulation, No. 28 and 30 Brooks Yard would also be offered noise insulation by Network Rail, under the power granted by the NIRR and NIR due to the contiguous façades of these properties, should No. 24 & 26 Brooks Yard prove eligible.

8.8.8 Further details of cumulative effects is provided in Chapter 22 of this ES (Cumulative Effects).

Intra-Scheme cumulative construction effects

8.8.9 Inter-Scheme cumulative effects may occur from interaction with other proposed developments (Reasonably Foreseeable Future Projects (RFFPs) located near the Scheme. When combined with the Scheme, construction and operational noise and vibration could cumulatively affect sensitive receptors. Inclusion of RFFPs includes their proximity to the Scheme, likely impacts and timing of construction and operation.

8.8.10 Potential inter-scheme cumulative effects regarding noise and vibration are shown in Table 8-30.

Table 8-30 Potential inter-scheme cumulative effects

Route Section	Planning Application ref.	Development description	Location	Planning status	EIA available	Potential cumulative effects	
						Construction	Operation
1 – Huddersfield	2020/90014	Demolition of existing building and erection of car sales and speculative B1/B2 unit with associated parking and access	11, The Triangle, Market Street, Paddock, Huddersfield, HD1 4RN	Conditional Full Permission – March 2020	No supporting environmental information, but noise is conditioned within the planning permission	Potential that construction periods may overlap. Should works be limited to highways improvements, cumulative effects not likely to be significant.	Noise is conditioned as part of the planning permission such that adverse effects would be avoided. Significant cumulative effects are therefore not likely.
1 – Huddersfield	Strategic highway scheme	Highways improvements to the junction of Huddersfield Ring Road/Southgate/ orthumberland Street.	Kirklees Council	Strategic Scheme	No information available.	No formal application has been made in relation to the development, so the precise impact is not fully understood at this stage. Potential that construction periods may overlap. Should works be limited to highways improvements, cumulative effects not likely to be significant.	No significant cumulative effects are predicted.
1 – Huddersfield	Strategic highway scheme	Highways improvements to the junction of Leeds Road/Lower Fitzwilliam Street/Gasworks Street.	Kirklees Council	Strategic Scheme	No information available.	No formal application has been made in relation to the development, so the precise impact is not fully understood at this stage. Potential that construction periods may overlap. Should works be limited to highways improvements, cumulative effects not likely to be significant	No significant cumulative effects are predicted.
1 – Huddersfield 2 – Hillhouse and Fartown	Strategic highway scheme	A62 Smart Corridor (Leeds Road - Phase 1)	Kirklees Council	Strategic Scheme	No information available.	No formal application has been made in relation to the development, so the precise impact is not fully understood at this stage. Potential that construction periods may overlap. Should works be limited to highways improvements, cumulative effects not likely to be significant.	No significant cumulative effects are predicted.
1 – Huddersfield 2 – Hillhouse and Fartown	Strategic highway scheme	Highways improvements to the junction of Leeds Road/Thistle Street/Hillhouse Lane.	Kirklees Council	Strategic Scheme	No information available.	No formal application has been made in relation to the development, so the precise impact is not fully understood at this stage. Potential that construction periods may overlap. Should works be limited to highways improvements cumulative effects not likely to be significant	No significant cumulative effects are predicted.
2 – Hillhouse and Fartown	Strategic highway scheme	Highways improvements to the junction of Leeds Road/Old Fieldhouse Road.	Kirklees Council	Strategic Scheme	No information available.	No formal application has been made in relation to the development, so the precise impact is not fully understood at this stage. Potential that construction periods may overlap. Should works be limited to highways improvements cumulative effects not likely to be significant	No significant cumulative effects are predicted.
3 – Deighton and Bradley	2017/91111	Outline application for erection of industrial development for B1 (business), B2 (general industry), and B8 (storage and distribution) uses	Station Road, Bradley, HD2 1UT	Conditional Outline Permission August 2017	No EIA but application is supported by environmental assessments in relation to contaminated land, transport, arboriculture, ecology as well as a FRA	Given the distance to nearby noise sensitive receptors, no significant cumulative effects are expected from construction.	Given the distance to nearby noise sensitive receptors, no significant cumulative effects are expected during operation.

Route Section	Planning Application ref.	Development description	Location	Planning status	EIA available	Potential cumulative effects	
						Construction	Operation
4 – Colne Bridge and Battyeford	2016/93896	Erection of 4 dwellings and associated works	Site off, Station Road, Bradley, Huddersfield, HD2 1US	Conditional Full Permission – February 2017	No EIA – application is supported by a Design and Access Statement.	No details in relation to environmental effects of development are known. Scheme works are limited in this area to parapet works and demolition of bridge and so significant cumulative effects are not expected.	No significant cumulative effects – similar to existing adjacent properties.
4 – Colne Bridge and Battyeford	2017/91208	Outline application for erection of industrial development of up to 3684 sqm B1c/B2/B8, with means of access (to, but not within, the site) from Colnebridge Road	Land adjacent to Colnebridge WWTW, Colnebridge Road, Bradley	Conditional Outline Permission – Nov 2017	No EIA but application is supported by environmental assessments in relation to noise, transport, arboriculture, ecology as well as a FRA.	Given the distance separation of the Scheme and this development, no significant cumulative effects are expected from construction.	Given the distance separation of both schemes, no significant cumulative effects are expected from operation.
4 – Colne Bridge and Battyeford	Strategic highway scheme	A62/A644 Wakefield Road (Cooper Bridge) - The junction of A62 Cooper Bridge/A644 Wakefield Road/A62 Leeds Road lies further to the north of the proposed works.	Kirklees Council	Strategic Scheme	No information available.	No formal application has been made in relation to the development, so the precise impact is not fully understood at this stage. Potential that construction periods may overlap. Should works be limited to highways improvements cumulative effects not likely to be significant	No significant cumulative effects are predicted.
4 – Colne Bridge and Battyeford	Strategic housing scheme	Kirklees Local Plan Allocation HS11 – housing allocation for 1.460 dwellings with potential for a further 498 dwellings beyond the plan period	Land north of Bradley Road, Bradley		No information available.	Given the distance separation of both schemes, no significant cumulative effects are expected from construction.	Given the distance separation of both schemes, no significant cumulative effects are expected from operational noise.
6 – Ravensthorpe and Westtown	2017/94119	Demolition of existing building, erection of new building for educational classroom, cafe and toilets, upgraded access road, car parking, cycle parking, picnic and play areas.	Land off Sands Lane, Mirfield, WF14	Conditional Full Permission – May 2018	No EIA or supporting information relating to noise and vibration.	Demolition works are complete. Scheme does reference works to railway (including track realignment and electrification) so has considered the mitigation requirements required in relation to the scheme proposed	Development references upgrade works to railway so has considered this. Railway works to this area are limited to four-tracking and OLE and significant cumulative effects are not anticipated.
6 – Ravensthorpe and Westtown	2017/90443	Erection of 3 units for B1 (light industrial) and B8 use, erection of two storey office building and alterations to existing building	Ratcliffe Mills, Forge Lane, Thornhill Lees, Dewsbury, WF12 9BU	Conditional Full Permission – Nov 2017	No EIA but application is supported by environmental assessments in relation to agriculture, transport as well as a FRA.	Given the distance to nearby noise sensitive receptors, no significant cumulative effects are expected.	No significant cumulative effects are predicted as railway is sufficient distance from proposed development.
6 – Ravensthorpe and Westtown	2016/94241	Non-Material Amendment to previous permission 2007/91742 for erection of 7 terraced industrial units	Calder Bank Road, Thornhill Lees, Dewsbury, WF12 9QB	NMA Approved – May 2017	No EIA but supported by a Noise Impact Assessment for operational noise	Given the distance to nearby noise sensitive receptors, no significant cumulative effects are expected from construction.	Noise levels from operation of the units expected to be below background noise level and therefore not significant and significant cumulative effects are not anticipated.
6 – Ravensthorpe and Westtown	2016/94118	Outline application for residential development	Land off Ravensthorpe Road, Dewsbury	Conditional Outline Permission – April 2017	No EIA or supporting information relating to noise and vibration. Planning condition 14 of the development requires a noise impact assessment in relation to nearby industrial noise sources.	Potential cumulative effects at properties on Ravensthorpe Road if works are conducted cumulatively. However, the impact of the RFFP would be expected to dominate. Furthermore, the access roundabout to the RFFP is within the	Potential increases in road traffic on existing roads due to RFFPs are included in the assessment for the Scheme. No sources of

Route Section	Planning Application ref.	Development description	Location	Planning status	EIA available	Potential cumulative effects	
						Construction	Operation
						Scheme area and so works here could not be conducted concurrently and the roundabout would otherwise form part of the committed development works. As such, significant cumulative effects are not expected.	operational noise are expected as part of the RFFP. No significant cumulative effects are therefore expected.
6 – Ravensthorpe and Westtown	2016/94117	Outline application for 120 residential units at Lees Hall Road	Land off Lees Hall Road, Dewsbury	Conditional Outline Permission	No EIA or supporting information relating to noise and vibration. Planning condition 14 of the development requires a noise impact assessment in relation to traffic noise on Lees Hall Road.	Given the distance separation of the Scheme and this development, no significant cumulative effects are expected from construction.	Potential increases in road traffic on existing roads due to RFFPs are included in the assessment for the Scheme. No sources of operational noise are expected as part of the RFFP. No significant cumulative effects are therefore expected.
6 – Ravensthorpe and Westtown	2017/94080	Erection of precast concrete production unit, demolition of existing casting shed and ancillary buildings, associated site works to modify external storage areas and installation of gantry cranes – condition to vary plans and specs (2019/92570)	C R Longley And Co Ltd, Ravensthorpe Road, Thornhill Lees, WF12 9EF	Conditional Full Permission – July 2018 (approval of condition November 2019)	No EIA but application is supported by environmental assessments in relation to noise, air quality, ecology and transport. A conservation/heritage assessment and FRA have also been submitted.	Should intrusive works come forward at the same time considered not considered to give rise to cumulative effects as construction noise of development would be temporary in nature and would be in lieu of current operation noise levels (operations temporarily ceased to allow construction to occur on existing plot).	No significant cumulative effects are predicted – development application considers that noise levels will be reduced due to building reconfiguration.
6 – Ravensthorpe and Westtown	Strategic housing scheme	Kirklees Local Plan Allocation HS61 (Dewsbury Riverside) – housing allocation for 4000 units (1869 units during plan period, with potential for a further 2131 beyond the plan period).	Land off Ravensthorpe Road, Dewsbury		Dewsbury Riverside Masterplan document is available.	Potential cumulative effects at properties on Ravensthorpe Road if works are conducted cumulatively. However, the impact of the RFFP would be expected to dominate. Furthermore, an access roundabout to the RFFP is within the Scheme area and so works here could not be conducted concurrently and the roundabout would otherwise form part of the committed development works. As such, significant cumulative effects are not expected.	Potential increases in road traffic on existing roads due to RFFPs are included in the assessment for the Scheme. No sources of significant operational noise are expected as part of the RFFP. No significant cumulative effects are therefore expected.

8.8.11 It is anticipated that any developments brought forward will be subject to National and Local Policy as well as legislative requirements and application of BPM and will be required to ensure that mitigation and control measures are adopted during construction and operation of the projects.