Cottam Parkway Railway Station

Environmental Statement

Volume 2: Main Statement

Chapter 9: Noise and Vibration

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9 Noise and Vibration

ES Chapter Number	Environmental Topic	Relevant Appendices
9	Noise and Vibration	Appendix 9.1: Figures Appendix 9.2: Noise and Vibration Technical Appendices

9.1 Introduction

9.1.1 An assessment of noise and vibration impacts arising from construction and operation of the Scheme has been undertaken in accordance with national guidance, including the Design Manual for Roads and Bridges (DMRB), LA 111 Noise and Vibration (Revision 2) (Highways England, 2020b). Assessment methodologies and guidance are reported before the potential effects on each of the receptors is identified and detailed. Mitigation is then listed before describing any residual effects.

9.1.2 The following elements of the Scheme have been assessed in this chapter:

- Construction noise assessment;
- Construction vibration assessment;
- Operational road traffic noise assessment;
- Operational railway station noise assessment (noise associated with use of the car park and fixed plant associated with the station); and,
- Operational railway noise assessment (noise associated with use of the railway line).

9.2 Relevant Legislative, Plans, Policies and Background

General

9.2.1 The assessment and mitigation of noise and vibration has been carried out according to established prediction and assessment methodologies that are governed or guided by the following key documents:

- BS 5228: 2009 + A1: 2014 - Code of practice for noise and vibration control (British Standards Institution, 2014a and 2014b) on construction and open sites, which provides guidance for predicting construction noise and vibration and also provides advice on noise and vibration control techniques;
- DMRB LA 111 Noise and Vibration (Revision 2) (Highways England, 2020b), which includes guidance on the assessment methods for noise and vibration for new highways.
- DMRB LA 104 Environmental Assessment and Monitoring (Revision 1) (Highways England, 2020a);
- Calculation of Road Traffic Noise (CRTN) (Department of Transport and Welsh Office, 1988);
- ISO 9613-2 Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation (International Organization for Standardization, 1996); and,
- Calculation of Railway Noise (CRN) (Department of Transport, 1995).

9.2.2 Table 9.1 provides a summary of all the relevant legislation and guidance used to assess the effects of the Scheme.

Table 9.1: Legislation and Guidance Relative to the Assessment

Legislation	Summary of relevant issues
Land Compensation Act 1973	Part 1 of the Act provides a means for compensation to be paid to owners of land or property which has experienced a loss in value caused by the use of public works, such as new or improved roads. Noise and vibration are two factors that would be considered in any claims for compensation, but the claim should consider all changes and effects, including betterment. Claims can be made up to seven years after the opening year.
The Noise Insulation Regulations 1975 (as amended 1988)	The Act imposes a duty on authorities to undertake or make a grant in respect of the cost of undertaking noise insulation work in or to eligible buildings. This is subject to meeting certain criteria given in the Regulations. Regulation 5 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.
Control of Pollution Act (CoPA) 1974	The CoPA allows for those undertaking works to obtain "Prior Consent" for construction works within agreed limits. Applications for such consent are made to the local authority and contain steps to be taken to minimise noise. The local authority has powers to

Legislation	Summary of relevant issues
	attach conditions to, limit or qualify any consent to allow for changes and limit the duration of any consents. Some local authorities request demonstration of best practicable means rather than formal 'Prior Consent' applications.
World Health Organisation (WHO), Guidelines for Community Noise (WHO, 1999), Night Noise Guidelines for Europe (WHO, 2009)	In Guidelines for Community Noise, WHO advise that few people are moderately annoyed when daytime noise levels are below 50 dB $L_{Aeq,16hrs}$. Guidelines for Community Noise has been partially superseded by WHO Environmental Noise Guidelines (2018). However, WHO recommends that they remain valid for any guidelines not covered by the current document, such as industrial noise. WHO night noise guideline (NNG) of 40 dB L_{night} outside is recommended within Night Noise Guidelines for Europe. This noise level is considered by WHO to protect the public, including most of the vulnerable groups (such as children, the chronically ill and elderly), from the adverse health effects of night noise.

National Planning Policy

9.2.3 The National Planning Policy Framework (the NPPF) (MHCLG, 2021), Section 15 Conserving and Enhancing the Natural Environment, seeks for planning policies and decisions to contribute and enhance the natural and local environment by, among other things, preventing new and existing development from contributing to noise pollution.

9.2.4 The Noise Policy Statement for England (NPSE) (DEFRA, 2010) sets out the Government's vision of promoting good health and quality of life through the effective management of noise. It provides the framework to enable decisions to be made, both nationally and locally, regarding what is an acceptable noise burden to place on society. It is supported by the following aims:

'Through the effective management and control of environmental, neighbour, and neighbourhood noise within the context of Government policy on sustainable development:

- *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.*'

9.2.5 The Explanatory Note to the NPSE sets out the following definitions of adverse effects:

- NOEL: No Observed Effect Level. This is the level below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life due to noise;
- LOAEL: Lowest Observed Adverse Effect Level. This is the level above which adverse effects on health and quality of life can be detected; and,
- SOAEL: Significant Observed Adverse Effect Level. This is the level above which significant adverse effects on health and quality of life occur.

9.2.6 Government policy and guidance do not state required values for the NOEL, LOAEL and SOAEL. They are different for different noise sources, for different receptors and at different times and should be defined on a strategic or project basis taking into account the specific features of the area, source or project.

9.2.7 Planning Practice Guidance Noise (MHCLG, 2019) sets out how potential noise impacts from new developments can be managed through planning. It advises the following.

'Plan-making and decision making need to take account of the acoustic environment and in doing so consider:

- *whether or not a significant adverse effect is occurring or likely to occur;*
- *whether or not an adverse effect is occurring or likely to occur; and*
- *whether or not a good standard of amenity can be achieved*.*'*

Local Planning Policy

Central Lancashire Adopted Core Strategy

9.2.8 The Central Lancashire Adopted Core Strategy (Preston City Council et al., 2012) was adopted in 2012. It states that:

'…many factors influence our state of health and wellbeing. Spatial planning can have a positive effects on these factors, and hence health and wellbeing is identified as one of the Core Strategy's main cross-cutting themes: …reducing motor vehicle traffic which in turn leads to reductions in air and noise pollution and road traffic accidents'.

Preston Local Plan

9.2.9 The Preston Local Plan 2012–26 (Preston City Council, 2015 is in general conformity with the objectives of the Central Lancashire Adopted Core Strategy and its strategic vision for Preston and wider Central Lancashire. Policy AD1 (a) states that development within (or in close proximity to) an existing residential area will be permitted provided:

‘b) there would be no adverse impact on residential amenity, particularly by reason of noise, general disturbance and loss of privacy due to the activity under consideration or the vehicular/pedestrian movement it generates.’

Preston Factsheet

9.2.10 Factsheet 40 from Preston City Council website has been reviewed. This states that noisy construction activities would not be expected to be taking place outside of the following hours:

- 08:00 to 18:00 Monday to Friday;
- 08:00 to 13:00 on Saturdays; and,

No noisy works on Sundays or Bank Holidays.

9.2.11 9.1.2 The document goes on to state: ‘Noisy activities are defined as those where a neighbour, whether residential or commercial, could hear the activity in their house, garden or at their business premises. There is scope for negotiation on these hours especially if there are no immediate neighbours or specialist work has to be undertaken'.

9.3 Methodology

Study Areas

9.3.1 The study areas for the noise assessment were defined in accordance with DMRB LA 111 (Highways England, 2020b). Section 1.3 in Appendix 9.2 provides details of study areas used for the noise and vibration assessment of the Scheme, and this information is illustrated on Figure 9.1 and Figure 9.2 in Appendix 9.1 in volume 3 of this ES.

Identification of Noise and Vibration Sensitive Receptors

9.3.2 Details of the identification and selection of sensitive receptors for the noise and vibration assessment are provided in Section 1.4 of Appendix 9.2 in volume 3 of this ES. Examples of types of receptors included are:

- dwellings;
- hospitals;
- schools;
- community facilities; and,
- public rights of way.

9.3.3 Tables 2 and 3 within Appendix 9.2 provide lists of the sample receptors chosen for the construction and operational assessments. Figure 9.1 and Figure 9.2 illustrates the location of the sample sensitive receptors. The methodology for selection of the sample receptors is discussed in Section 1.4 of Appendix 9.2.

Assessment Methodology for Construction Noise and Vibration

9.3.4 The assessment considers the potential temporary noise and vibration impacts on residential and other sensitive receptors in the vicinity of the Scheme. Where sufficient information was available, predictions of indicative noise and vibration levels from various construction activities have been undertaken. Full details of the construction noise and vibration assessment methodology are provided in Appendix 9.2.

Assessment Methodology for Operational Road Traffic Noise and Vibration

9.3.5 Prediction of road traffic noise levels at various noise sensitive receptors has followed the methodology outlined in DMRB LA 111 (Highways England, 2020b). Noise levels have been calculated at all residential dwellings and

other sensitive receptors within the study area. Full details of the assessment methodology are provided in Appendix 9.2.

Assessment Methodology for Operational Railway Station Noise

9.3.6 Prediction of operational railway station noise levels at the nearest noise sensitive receptors to the Scheme has followed the methodology outlined in ISO 9613-2 (International Organization for Standardization, 1996). Full details of the noise calculation methodology and assumptions are provided in Appendix 9.2.

9.3.7 Predicted operational railway station noise levels have been compared with WHO guideline levels (refer to Table 9.1) and baseline residual noise levels (ambient noise levels without operational railway station noise) to determine the likelihood for significant effects to occur. The predicted Do-Minimum 2024 road traffic noise levels have been used to represent baseline residual noise levels. The predicted $L_{A10,18hr}$ daytime road traffic noise levels have been converted to $L_{Aeq,16hr}$ daytime residual noise levels by subtracting 2 dB, in accordance with Transport Analysis Guidance (TAG) Unit A3 – Environmental Impact Appraisal (DfT, 2021). The predicted L_{night} night-time road traffic noise levels have been used directly to represent night-time residual noise levels.

Assessment Methodology for Operational Railway Noise

9.3.8 The number of trains operating on the Preston Fylde Junction to Blackpool North line is not expected to change with the introduction of the Scheme. Trains travel at approximately 100 mph in the vicinity of the site location without the Scheme in place. Trains would instead slow and stop at the new railway station, then accelerate away.

9.3.9 Calculation of Railway Noise (CRN) (DfT, 1995) accounts for the potential for increased noise due to diesel locomotives moving from rest at full power but does not account for the potential for increased noise due to diesel multiple-

unit passenger trains moving away from rest. For locations where there are accelerating and/or decelerating trains which are not locomotives, the advice in CRN is to calculate the rolling noise based on the average of the speeds over each line segment. Rolling noise decreases as speed decreases. Therefore, for multiple-unit passenger train railway noise levels predicted in accordance with CRN, trains stopping at a station will result in lower railway noise levels compared to if the trains did not stop due to the reduced train speeds.

9.3.10 An indicative assessment for the potential for increased noise due to diesel multiple-unit passenger trains moving away from rest has been undertaken based on the available information on full power noise for diesel locomotives, which is considered to represent a conservative approach.

9.3.11 CRN (DfT, 1995) does not account for the potential for increased noise due to brake squeal while trains are slowing down. An indicative assessment for the potential for increased noise due to brake squeal has been undertaken based on applying a ‘penalty’ to predicted railway noise levels for trains which are slowing down as they pass receptors.

9.3.12 The indicative assessment of operational railway noise levels has been undertaken at the nearest noise sensitive receptor to the Scheme, 1 Railway Cottages. At noise sensitive receptors further away from the Scheme, accelerating trains will be moving at an increasing speed, and therefore the sound exposure level of accelerating trains on full power will decrease.

9.3.13 Full details of the noise calculation methodology and assumptions are provided in Appendix 9.2.

Assumptions and Limitations

Baseline Conditions

9.3.14 The most notable data gap is baseline noise monitoring data not being measured, for the following reasons:

- Construction works for the Preston Western Distributor Road (PWDR) was underway at the time of the assessment; therefore, measured baseline noise levels would not be representative of typical baseline conditions due to the potential for atypical construction noise to be measured;
- The baseline scenario for the Scheme construction and operational noise assessment assumes that the PWDR is fully operational; therefore, current noise levels, or noise levels measured during any surveys previously undertaken in the area, will not be representative of opening year baseline conditions as PWDR is not yet completed and open to road traffic; and,
- The coronavirus pandemic has resulted in several issues for conducting baseline noise assessments. During much of the assessment timeframe, the UK Government has imposed a series of differing levels of lockdown and travel restrictions, which has resulted in atypical noise environments for most of the UK due to changes in traffic, likely to render any baseline noise measurements unrepresentative of normal baseline conditions.

9.3.15 For the above reasons, baseline noise measurements have not been undertaken as part of this assessment. Instead, conservative assumptions/alternative approaches have been used as described below.

Construction

9.3.16 The construction assessment is indicative and, at the time of undertaking the assessment, there was no construction contractor appointed for the Scheme.

However, the preliminary construction data and, where available, the programme has been used to develop an assumed list of plant and equipment based upon conservative assumptions as to the construction methods.

9.3.17 Baseline noise measurements are often used to derive the LOAEL and SOAEL; however, as discussed above, baseline noise measurements were not available for this assessment. An alternative approach has been used based upon predicted noise levels from the operational noise modelling undertaken without the Scheme in place in the opening year to determine baseline noise levels. This approach is acceptable in terms of DMRB LA 111 (Highways England, 2020b). Paragraph 3.9 of DMRB LA 111 states:

'Construction noise baseline shall be determined via one or more of the following methods:

- *noise measurements, based upon actual survey data;*
- *predicted noise levels (noise model outputs);*
- *existing noise mapping undertaken by public bodies or as part of other developments*.'

9.3.18 The approach adopted complies with the second point above.

Operation

9.3.19 The operational assessment of road traffic noise has been undertaken following DMRB LA 111 (Highways England, 2020b) and CRTN (Department of Transport and Welsh Office, 1988). It is considered that all traffic model data inputs for this assessment are adequate to support the assessment requirements defined in DMRB LA 111. Appendix 9.2 provides details of the operational noise model assumptions and the sources used.

9.3.20 Traffic data is fundamental to predicting operational noise levels. Traffic flow (numbers of vehicles), composition (percentage of heavy vehicles) and

speed data all contribute. Traffic data has been provided for the year of opening (2024) and future assessment year (2039) for the Do-Minimum (without the Scheme in place) and Do-Something (with the Scheme in place) scenarios.

9.3.21 No minimum traffic flow threshold has been imposed for roads with very low traffic flows. Excluding such roads or adjusting the traffic flows so that they are within the range of validity for the CRTN method has the potential to both obscure and overestimate adverse noise effects. On this matter CRTN advises the following.

'…calculations can be extended outside the quoted ranges for the purpose of assessing changes in noise levels, e.g. environmental appraisal of road schemes at distances greater than 300 m from a road, and generally for situations where reduced accuracy in predicting absolute levels can be accepted'.

9.3.22 It is therefore considered that, while noise levels calculated for roads with very low flows may be subject to increased error, the approach adopted is the most accurate in this situation.

9.3.23 There are many residential developments under construction within the operational noise study area, which are likely to be built and occupied in the opening year (2024). These properties have been included in the noise models for all scenarios, based on satellite imagery and planning application drawings, and included in the assessment as noise and vibration sensitive receptors.

9.3.24 The main limitations associated with the assessment of railway station and operational railway noise are the assumptions that were made regarding the operation of the Scheme. These are assumptions are related to:

- the number of train movements per day which would stop at the Scheme;
- the operating characteristics (e.g. speed) of the trains along the route;

- the effect of accelerating and decelerating on railway noise levels; and,
- the frequency and noise level associated with railway station platform announcements.

9.3.25 For further details on the assumptions made refer to Appendix 9.2.

9.4 Baseline Description and Evaluation

Baseline Sources

9.4.1 The following key sources of information have been used in the assessment:

- Forecast traffic data for the Do-Minimum (baseline) 2024 scenario was provided by the traffic modelling team on 9 June 2021. This data included the following:
    - 18-hour (06:00 – 00:00) annual average weekday traffic (AAWT) volume;
    - Percentage of HGVs for 18-hour AAWT;
    - Traffic model 18-hour AAWT speed, pivoted in accordance with DMRB LA 111; and,
- Defra's Noise Action Plan (Department for Environment, Food and Rural Affairs, 2019) to identify any Noise Important Areas (NIAs) within the study area.

Baseline Conditions

9.4.2 The baseline noise environment in the vicinity of the Scheme is likely to be dominated by road traffic noise from the local road network and from the PWDR which is assumed to be operational in the baseline year (2024). Railway noise is also likely to contribute to baseline noise levels near the Preston Fylde Junction to Blackpool North line. Within the operational noise study area, there are 1,078 noise sensitive receptors. Most of the receptors

are dwellings in North West Preston as well as more scattered houses and farms. Where relevant, predicted baseline noise levels are provided in the results tables presented Sections 9.6 and 9.7.

9.4.3 Defra have undertaken noise mapping exercises in accordance with the Environmental Noise (England) Regulations (2006) the latest of which (Round 3 mapping) was published in 2019. Defra have produced a list of NIAs, identified as areas requiring action to reduce noise levels. No NIAs have been identified within the noise and vibration study areas.

9.5 Consultation

9.5.1 Consultation has been undertaken with the Environmental Protection Department at Preston City Council. In this consultation, the proposed approach, detailed in Appendix 9.2 was discussed and agreed.

9.5.2 Public consultation was carried out on the Scheme between December 2021 and January 2022. A full summary of the consultation can be viewed in Consultation Statement in Appendix 4.1. No comments relating to noise and vibration were received.

9.6 Impacts – Construction

9.6.1 This section describes the potential impacts of the Scheme on noise and vibration sensitive receptors during construction that could arise in the absence of essential mitigation.

9.6.2 During the construction phase of the Scheme, access to the construction works is expected to be principally via Lea Road, which is predicted to have annual average two-way 18-hour traffic flows (between 06:00 and 00:00) of approximately 4,000 in the opening year.

9.6.3 Table 3.17 and paragraphs 3.18 to 3.19 of DMRB LA 111 (Highways England, 2020b) provide guidance on the potential for significant effects as a

result of increases in road traffic noise during construction. DMRB LA 111 states that magnitude of impacts of moderate or more in the short-term have the potential to result in significant effects.

9.6.4 To experience an increase in noise level of 3 dB or more (i.e. experience a moderate or more impact), the road traffic flow on Lea Road would need to approximately double. However, it is expected that road traffic from construction vehicles would increase traffic flows on the Lea Road by a small fraction of this. Therefore, construction vehicles expected to use Lea Road required to construct the Scheme are likely to have a **negligible impact** in terms of increasing noise levels at sensitive receptors along this road. As a consequence of this, no further assessment of construction traffic noise has been undertaken.

9.6.5 Likely additional traffic movements and access routes during construction are currently indicative until a construction contractor is appointed; therefore, this may require further consideration at later stages of the project. Construction methods shall be set out in a Construction Environmental Management Plant (CEMP) together with any proposed mitigation measures considered necessary in consultation with the Planning Authority under CoPA 1974.

Construction Noise - Daytime

9.6.6 A list of construction activities has been provided for the access road and access road bridge and an anticipated construction sequence, programme and activity duration has been provided for the railway station construction works. In lieu of detailed methods of working, the draft plant presented in Table 9.2, developed through experience of similar schemes and professional judgement, form the basis of the assessment of potential noise impacts during construction.

Table 9.2: Draft Plant and Equipment Associated with the Construction Works

Activity	Plant	No.	% on time	Noise Level dB(A) at 10 m	BS 5228-1 Source Term
Initial topsoil strip	35t excavator	2	83	75	C.2.16
	20t articulated dump truck (tipping fill)	4	83	74	C.2.32
	Dozer	1	83	81	C.2.12
	Lorries	2	10	80	C.2.34
Earthworks	35t excavator	2	83	75	C.2.16
	20t articulated dump truck (tipping fill)	4	83	74	C.2.32
	Motor grader	1	83	80	*
	Vibrator roller	1	83	74	C.2.39
	Dozer	1	83	81	C.2.12
	Hydraulic vibratory compactor (tracked excavator)	1	83	78	C.2.42
	Lorries	2	10	80	C.2.34
Surfacing	Asphalt paver (+ tipper lorry); 112kW; 12 t hopper	1	83	75	C.5.30
	Twin drum vibratory roller	1	83	75	C.5.20
	Dozer	1	83	81	C.2.12
	Single drum vibratory roller	1	83	74	C.2.39
	17t road planer	1	83	82	C.5.7
	Lorries	2	10	80	C.2.34

Activity	Plant	No.	% on time	Noise Level dB(A) at 10 m	BS 5228-1 Source Term
Piling	35t excavator	2	83	75	C.2.16
	Mobile crane	1	15	71	C.4.50
	Compact roller	1	50	78	C.2.42
	Piling rig	1	40	88	C.3.8
	Concrete pump	1	70	82	C.4.25
	Cutters, drills and small tools	2	40	65	C.3.35
Site compound installation	Dozer	1	20	81	C.2.12
	Tracked excavator	1	20	71	C.4.65
	Dumper	1	15	79	C.4.6
	Vibratory roller	1	15	80	C.5.21
	Lorry with lifting boom	1	20	77	C.4.53
	Diesel generator	1	50	60	C.4.80
Foundations	Mobile crane	1	20	71	C.4.50
	Excavator	1	70	76	C.2.5
	Cutters, drills and small tools	4	40	65	C.3.35
	Compactor / roller	1	50	78	C.2.42
	Concrete pump	1	70	82	C.4.25
	Concrete mixer truck	1	70	80	C.4.20
	Generators	1	40	64	C.4.78
	Lorries	2	10	80	C.2.34

Activity	Plant	No.	% on time	Noise Level dB(A) at 10 m	BS 5228-1 Source Term
Utility diversion	Mini track excavator	1	30	74	C.4.67
	Dumper	1	30	79	C.4.6
	Vibratory roller	1	30	77	C.5.28
	Vibratory compacter (asphalt)	1	25	82	C.5.29
Fit out	Cutters, drills and small tools	4	40	65	C.3.35
	Mobile crane	1	15	71	C.4.50
	Lorries	1	10	80	C.2.34
Lift installation	Cutters, drills and small tools	4	40	65	C.3.35
	Welding generator	1	80	57	C.3.33
	Mobile crane	1	15	71	C.4.50
	Lorries	1	10	80	C.2.34
OLE installation	Cutters, drills and small tools	4	40	65	C.3.35
	Tower crane	1	15	76	C.4.48
	Lorries	1	10	80	C.2.34
Installation of station building	Mobile crane	1	15	71	C.4.50
	Cutters, drills and small tools	4	70	65	C.3.35
	Forklift truck	2	30	76	D.7.93
Piling cap	Cutters, drills and small tools	2	40	65	C.3.35
	Concrete pump	1	70	82	C.4.25
	Hydraulic vibratory compactor (tracked	1	50	78	C.2.42

Activity	Plant	No.	% on time	Noise Level dB(A) at 10 m	BS 5228-1 Source Term
	excavator)				

*Noise source data provided by construction contractor (to Jacobs) for a similar scheme assessed in early 2016.

9.6.7 The anticipated construction sequence and programme provided for the railway station construction works has been used to determine draft construction phases where more than one construction activity may be occurring concurrently, resulting in higher construction noise levels. The same level of information is not available for the road construction; therefore, each road construction activity has been assessed as a separate phase. The construction phases assessed are presented in Table 9.3.

Table 9.3: Construction Phases Assessed

Construction Phase	Construction Activity	Location
Road 1	Initial topsoil strip	Road and secondary means of escape
Road 2	Earthworks	Road and secondary means of escape
Road 3	Surfacing	Road and secondary means of escape
Road 4	Piling	Access road bridge
Station 1	Site compound installation	Site compounds
Station 2	Utility diversion	Railway station site
	Foundations	Railway station car park
Station 3	Earthworks	Railway station platforms
	Piling	Railway station footbridge
	Foundations	Railway station building
Station 4	Earthworks	Railway station platforms
	Pile cap	Railway station footbridge
	Foundations	Railway station building
	Piling	Railway station car park
Station 5	Piling	Railway station platforms
	Pile cap	Railway station footbridge
	Installation of station building	Railway station building
Station 6	Foundations	Railway station platforms
	Fit out	Railway station footbridge
	Lift installation	Railway station footbridge

Construction Phase	Construction Activity	Location
	Fit out	Railway station building
	OLE installation	OLE
Station 7	Surface works	Railway station platforms
	Fit out	Railway station platforms

9.6.8 Table 9.4 shows the predicted daytime construction noise levels per construction phase at sample representative receptors, along with magnitude of impact derived in line with Table 6 in Appendix 9.2. Those phases predicted to be above or equal to the applicable SOAEL (as set out in Tables 4 and 5 in Appendix 9.2), and therefore predicted to experience a moderate or major magnitude of impact.

9.6.9 It should be noted that the predicted noise levels presented in Table 9.4 assume that the activity is occurring at the edge of the Scheme closest to each noise sensitive receptor, thereby representing a worst-case scenario. The majority of construction activities are transient in nature (with the exception of specific structures); therefore, noise levels would be reduced as these activities move further from the receptor.

Table 9.4: Predicted Daytime Construction Noise Levels (without Essential Mitigation)

Receptor	Phase	Construction Noise Level	Baseline Noise Level / LOAEL	BS 5228-1 Threshold Level / SOAEL	Magnitude of Impact
		$L_{Aeq,T}$ dB			
Quaker Lodge	Road 1	64	53	65	Minor
	Road 2	**67**			**Moderate**
	Road 3	**66**			**Moderate**
	Road 4	58			Minor
	Station 1	42			Negligible
	Station 2	52			Negligible
	Station 3	54			Minor

Receptor	Phase	Construction Noise Level	Baseline Noise Level / LOAEL	BS 5228-1 Threshold Level / SOAEL	Magnitude of Impact
		$L_{Aeq,T}$ dB			
	Station 4	57			Minor
	Station 5	52			Negligible
	Station 6	50			Negligible
	Station 7	50			Negligible
Clock House	Road 1	52	53	65	Negligible
	Road 2	54			Minor
	Road 3	53			Minor
	Road 4	48			Negligible
	Station 1	40			Negligible
	Station 2	52			Negligible
	Station 3	54			Minor
	Station 4	56			Minor
	Station 5	51			Negligible
	Station 6	49			Negligible
	Station 7	51			Negligible
5 Edgewater Oaks	Road 1	59	52	65	Minor
	Road 2	61			Minor
	Road 3	59			Minor
	Road 4	60			Minor
	Station 1	43			Negligible
	Station 2	51			Negligible
	Station 3	55			Minor
	Station 4	57			Minor
	Station 5	53			Minor
	Station 6	51			Negligible
	Station 7	52			Minor
Danes Pad	Road 1	58	54	65	Minor
	Road 2	60			Minor
	Road 3	59			Minor
	Road 4	49			Negligible

Receptor	Phase	Construction Noise Level	Baseline Noise Level / LOAEL	BS 5228-1 Threshold Level / SOAEL	Magnitude of Impact
		$L_{Aeq,T}$ dB			
	Station 1	48			Negligible
	Station 2	55			Minor
	Station 3	61			Minor
	Station 4	62			Minor
	Station 5	58			Minor
	Station 6	56			Minor
	Station 7	56			Minor
Yew Tree Lodge	Road 1	60	57	65	Minor
	Road 2	62			Minor
	Road 3	60			Minor
	Road 4	38			Negligible
	Station 1	51			Negligible
	Station 2	58			Minor
	Station 3	61			Minor
	Station 4	63			Minor
	Station 5	59			Minor
	Station 6	57			Minor
	Station 7	57			Minor
4 The Shires	Road 1	**71**	59	65	**Major**
	Road 2	**73**			**Major**
	Road 3	**72**			**Major**
	Road 4	51			Negligible
	Station 1	56			Negligible
	Station 2	**65**			**Moderate**
	Station 3	**65**			**Moderate**
	Station 4	**69**			**Moderate**
	Station 5	63			Minor
	Station 6	61			Minor
	Station 7	62			Minor
116 Lea	Road 1	**69**	57	65	**Moderate**

Receptor	Phase	Construction Noise Level	Baseline Noise Level / LOAEL	BS 5228-1 Threshold Level / SOAEL	Magnitude of Impact
		$L_{Aeq,T}$ dB			
Road	Road 2	**71**			**Major**
	Road 3	**70**			**Major**
	Road 4	46			Negligible
	Station 1	58			Minor
	Station 2	56			Negligible
	Station 3	58			Minor
	Station 4	61			Minor
	Station 5	57			Minor
	Station 6	54			Negligible
	Station 7	55			Negligible
Leyland Bridge Barn	Road 1	64	55	65	Minor
	Road 2	**66**			**Moderate**
	Road 3	**65**			**Moderate**
	Road 4	48			Negligible
	Station 1	55			Minor
	Station 2	57			Minor
	Station 3	59			Minor
	Station 4	62			Minor
	Station 5	58			Minor
	Station 6	56			Minor
	Station 7	56			Minor
1 Railway Cottages	Road 1	**69**	51	65	**Moderate**
	Road 2	**71**			**Major**
	Road 3	**70**			**Major**
	Road 4	56			Minor
	Station 1	48			Negligible
	Station 2	**71**			**Major**
	Station 3	64			Minor
	Station 4	**74**			**Major**
	Station 5	59			Minor

Receptor	Phase	Construction Noise Level	Baseline Noise Level / LOAEL	BS 5228-1 Threshold Level / SOAEL	Magnitude of Impact
		$L_{Aeq,T}$ dB			
	Station 6	56			Minor
	Station 7	55			Minor

9.6.10 As set out in Section 1.5.3 of Appendix 9.2, an impact of moderate magnitude or above is considered potentially significant, dependent upon the duration of the activity.

9.6.11 At Quaker Lodge and Leyland Bridge Barn, earthworks and surfacing for the road and secondary means of escape are predicted to result in a **moderate impact magnitude** when at the point nearest to this noise sensitive receptors. At 4 The Shires, 116 Lea Road and 1 Railway Cottages, initial topsoil stripping, earthworks and surfacing for the road and secondary means of escape are predicted to result in a **moderate or major impact magnitude** when at the point nearest to these noise sensitive receptors. A draft construction programme for the road is not available at this stage; however, it is possible that the total number of days with a moderate or major impact could exceed ten or more days in any 15 consecutive days. Therefore, these construction activities are considered to result in a significant effect.

9.6.12 At 4 The Shires, station phases 2, 3 and 4 are predicted to result in a **moderate impact magnitude** when at the point nearest to the noise sensitive receptor. These impacts have been considered in more detail:

- The moderate impact magnitude predicted for station phase 2 is due to the foundation works (installing the sub-base) for the car park. The assumed duration of these works for the whole car park is 30 days. Given that the predicted construction noise level at the nearest point to the receptors is 65 $L_{Aeq,T}$, it is considered unlikely that the total number of days with a moderate impact would exceed ten or more days in any 15

consecutive days. Therefore, this construction activity is not considered to result in a significant effect.

- The moderate magnitude predicted for station phase 3 is due to the combination of railway station platforms earthworks, piling at the railway station footbridge and railway station foundation works. Given that the predicted construction noise level at the nearest point to the receptor is 65 dB $L_{Aeq,T}$, it is considered unlikely that these three construction activities would be undertaken concurrently at the nearest point to the receptor, such that the total number of days with a moderate impact would exceed ten or more days in any 15 consecutive days. Therefore, this construction activity is not considered to result in a significant effect.

- The moderate impact magnitude predicted for station phase 4 is due to the piling for the car park. The assumed duration of these works for the whole car park is 20 days. Given the relative short duration of the piling across the whole car park, it is considered unlikely that the total number of days with a moderate impact would exceed ten or more days in any 15 consecutive days. Therefore, this construction activity is not considered to result in a significant effect.

9.6.13 At 1 Railway Cottages, station phases 2 and 4 are predicted to result in a major impact magnitude when at the point nearest to the noise sensitive receptor.

- The major impact magnitude predicted for station phase 2 is due to the foundation works (installing the sub-base) for the car park. The assumed duration of these works for the whole car park is 30 days. Given that the predicted construction noise level at the nearest point to the receptors is 71 dB $L_{Aeq,T}$, it is considered possible that the total number of days with a moderate or major impact would exceed ten or more days in any 15 consecutive days. Therefore, this construction activity is considered to result in **a significant effect**.

- The major impact magnitude predicted for station phase 4 is due to the piling for the car park. The assumed duration of these works for the whole car park is 20 days. Given the relative short duration of the piling across the whole car park, it is considered possible that the total number of days with a moderate or major impact would exceed ten or more days in any 15 consecutive days. Therefore, this construction activity is considered to result in a **significant effect**.

9.6.14 For those noise sensitive receptors predicted to experience a significant effect from the construction of the Scheme, essential mitigation will be required and recommendations are provided in Section 9.8.

Construction Noise – Night-time

9.6.15 Most of the construction activities are assumed to be undertaken between the hours of 07:30 to 18:00 on Mondays to Fridays and 08:30 to 13:00 on Saturdays. Any construction work proposed outside these permitted hours would need prior approval from the Planning Authority.

9.6.16 Additional works which would fall outside the scope of the proposed hours are likely to take place when interfacing with Network Rail assets or during roadwork tie ins (local road network). It is likely that overnight and/or weekend working would be required for these works, which would need approval from the Planning Authority.

9.6.17 At this stage, a list of plant and construction activities for interfacing with Network Rail assets or the local road network has not been provided. To provide an indicative assessment at this stage, the draft plant presented in Table 9.2 for surfacing, representing overlay works, form the basis of the assessment of potential noise impacts during construction during night-time.

9.6.18 Table 9.5 shows the predicted indicative night-time construction noise levels at sample representative receptors, along with magnitude of impact derived in line with Table 6 in Appendix 9.2. Those phases predicted to be above or equal to the applicable SOAEL (as set out in Tables 4 and 5 in Appendix

9.2), therefore predicted to experience a moderate or major magnitude of impact, are highlighted in bold text.

Table 9.5: Predicted Night-time Overlay Works Construction Noise Levels (without Essential Mitigation)

Receptor	Construction Noise Level	Baseline Noise Level / LOAEL	BS 5228-1 Threshold Level / SOAEL	Magnitude of Impact
	$L_{Aeq,T}$ dB			
Quaker Lodge	**66**	46	50	**Major**
Clock House	**53**	45	50	**Moderate**
5 Edgewater Oaks	**59**	44	50	**Major**
Danes Pad	**59**	47	50	**Major**
Yew Tree Lodge	**60**	50	55	**Major**
4 The Shires	**72**	52	55	**Major**
116 Lea Road	**70**	49	55	**Major**
Leyland Bridge Barn	**65**	48	55	**Major**
1 Railway Cottages	**70**	44	50	**Major**

9.6.19 The predicted indicative night-time construction noise levels presented in Table 9.5 are all predicted to result in a moderate or major impact magnitudes at all representative sample receptors. For the purposes of this assessment, the overlay works represented here are considered likely to take place for a period of a few days each. Therefore, it is considered unlikely that the total number of days with a moderate or major impact would exceed ten or more nights in any 15 consecutive nights. As a result, this construction activity is not considered to result in a significant effect.

Construction Vibration

Vibratory Earthwork Compaction – Vibration Impact on Human Receptors

9.6.20 Of the construction activities proposed, those associated with vibratory earthwork compaction are expected to give rise to the highest vibration levels at nearby receptors.

9.6.21 For the purposes of vibratory earthworks compaction calculations, it has been assumed that an 18 tonne Bomag BW 216 PD-5 single drum vibratory compactor would be used. Like most vibratory compactors, the BW 216 has a lower vibration amplitude setting and vibration levels have been calculated for both settings. Table 9.6 shows the predicted construction vibration levels when operating with the higher vibration amplitude setting at the construction sample representative receptors within 100m of the Scheme's site boundary. Predicted vibration levels above or equal to the SOAEL (peak particle velocity (PPV) 1.0 mm/s), therefore predicted to experience a moderate or major magnitude of impact. It should be noted that the predicted vibration levels presented in Table 9.7 assume that the activity is occurring at the edge of the Scheme's site boundary closest to each sample representative receptor, thereby representing a worst-case scenario. The majority of construction activities are transient in nature (with the exception of specific structures), and therefore, vibration levels would be reduced as these activities move further from the receptor.

Table 9.6: Predicted PPV Levels due to Vibratory Earthworks Compaction – Higher Vibration Amplitude Setting

Receptor	Distance to Scheme Site Boundary (m)	Predicted Vibration Level from Vibratory Compaction Works for 5 % and 50 % Probability of Predicted Value being Exceeded			
		Steady State		Start-up and Run-down	
		50 %	5 %	50 %	5 %
Quaker Lodge	46	0.5	**1.8**	0.9	**2.5**
4 The Shires	18	**1.8**	**6.8**	**2.9**	**7.9**
116 Lea Road	14	**2.6**	**9.4**	**3.9**	**10.6**
Leyland Bridge Barn	91	0.2	0.7	0.4	**1.1**
1 Railway Cottages	16	**2.2**	**7.9**	**3.3**	**9.1**

9.6.22 The calculations indicate that vibration levels have the potential to be above or equal to the SOAEL and below 10 mm/s at most of the nearest sensitive receptors to the scheme, indicating moderate adverse magnitudes of impact, and the potential for significant vibration effects.

9.6.23 In one case (116 Lea Road) the predicted vibration level is above 10 mm/s during start up and run down of the vibratory compactor assuming a 5 % probability of this level being exceeded (which is considered to represent a conservative approach). Vibration levels of this magnitude indicate a **major adverse magnitude of impact** and the potential for significant vibration effects.

9.6.24 The predicted vibration levels presented in Table 9.7 reflect the use of the BW 216 using the lower vibration amplitude setting.

Table 9.7: Predicted PPV Levels due to Vibratory Earthworks Compaction – Lower Vibration Amplitude Setting

Receptor	Distance to Scheme Site Boundary (m)	Predicted Vibration Level from Vibratory Compaction Works for 5 % and 50 % Probability of Predicted Value being Exceeded			
		Steady State		Start-up and Run-down	
		50 %	5 %	50 %	5 %
Quaker Lodge	46	0.2	0.7	0.4	**1.0**
4 The Shires	18	0.7	**2.6**	**1.1**	**3.1**
116 Lea Road	14	**1.0**	**3.6**	**1.5**	**4.1**
Leyland Bridge Barn	91	0.1	0.3	0.2	0.4
1 Railway Cottages	16	0.8	**3.1**	**1.3**	**3.5**

9.6.25 The predicted vibration levels presented in Table 9.7 show that, with the lower vibration setting selected, vibration levels at the nearest sensitive receptors are substantially reduced, although **moderate adverse magnitudes of impact** are still predicted.

Piling – Vibration Impact on Buildings and Structures

9.6.26 There is potential for damage to the designated canal bridge, Quaker's Bridge, because of vibration associated with the construction of the access road bridge over Lancaster Canal, where sheet piling is anticipated. Piling may also be chosen by the contractor as the method of constructing the bridge foundations. Both percussive and vibratory sheet piling have been considered in this vibration assessment.

9.6.27 For the calculations undertaken, it has been assumed that the distance along the ground surface between potential piling works undertaken for the access road bridge and Quaker's Bridge is 27m. As the pile depths are not known at this stage, 27 m has conservatively also been assumed for the slope distance from the pile toe to Quaker's Bridge. It has been assumed

that percussive piles are driven to refusal. Table 9.8 shows the predicted piling vibration levels at Quaker's Bridge.

Table 9.8: Predicted PPV Levels due to Piling

Receptor	Distance to Proposed Bridge (m)	Predicted Vibration Level		
		Vibratory Piling Works (Start up and run down) for 5 % and 50 % Probability of Predicted Value being Exceeded		Percussive Piling Works
		50 %	5 %	
Quaker's Bridge Lodge	27	1.1	5.1	0.6

9.6.28 After comparing the calculated vibration levels presented in Table 9.8 with the guidance in BS 5228-2 (British Standards Institution, 2014b) (see Section 1.6.4 of Appendix 9.2), it is considered that piling is unlikely to result in damage to Quaker's Bridge. Nonetheless, it is recommended that this be revised at the construction phase by a qualified structural engineer, to confirm the bridge's tolerance to groundborne vibration

Significance of Effect – Construction Vibration

9.6.29 Table 9.6 indicates that the Bomag BW 216 PD-5, when used with a high vibration amplitude setting, is not suitable for use within 100m of vibration sensitive receptors as it results in vibration levels above the SOAEL. This significance assessment for construction vibration has therefore focused on the use of the Bomag BW 216 PD-5 using the lower vibration setting.

9.6.30 Table 9.7 indicates the potential for moderate adverse impacts to occur when vibratory compaction plant is working in close proximity to the nearest vibration sensitive receptors to the Scheme. These works are transient in nature and the assessment performed assumes that the vibratory compaction plant is operating at the nearest point of the Scheme's boundary to the vibration sensitive receptor. As such, the vibration levels presented in

Table 9.7 are considered to represent the worst case and, at other times, would be lower than those presented.

9.6.31 Based on the significance criteria provided in Section 1.6.3 of Appendix 9.2, none of the moderate impacts predicted are considered to be significant adverse effects as the duration of the impact is likely to be less than 10 days in a 15-day period or 40 days in a six-month period.

9.7 Impacts – Operation

9.7.1 This section describes the potential operational effects of the Scheme on noise sensitive receptors within the study area in the absence of essential mitigation. The embedded mitigation measures discussed in Section 9.8 have been incorporated into the operational noise assessment.

Operational Road Traffic Noise Impacts

Operational Road Traffic Noise Levels at Sample Representative Receptors

9.7.2 Sample receptor locations are shown in Figure 9.2. Table 9.9 and Table 9.10 present the predicted daytime and night-time noise levels at sample receptor locations in the short-term with and without the Scheme and in the long-term with and without the Scheme, along with the associated noise changes and magnitudes of impact.

Table 9.9: Comparison of Predicted Daytime Noise Impacts at Sample Representative Receptors, With and Without the Scheme in Place

Address	Do-Minimum dB $L_{A10,18hr}$		Do-Something dB $L_{A10,18hr}$		Short-term		Long-term with Scheme		Long-term without Scheme	
	2024	2039	2024	2039	Change (dB)	Magnitude of Impact	Change (dB)	Magnitude of Impact	Change (dB)	Magnitude of Impact
229 Hoyles Lane	63.6	66.1	63.9	66.8	0.3	Negligible adverse	3.2	Minor adverse	2.5	Negligible adverse
Invercauld	61.5	62.8	61.6	63.1	0.1	Negligible adverse	1.6	Negligible adverse	1.3	Negligible adverse
Quaker Lodge	57.1	56.5	56.1	56.0	-1.0	Minor beneficial	-1.1	Negligible beneficial	-0.6	Negligible beneficial
7 Thornthwaite Road	64.1	65.5	64.0	65.4	-0.1	Negligible beneficial	1.3	Negligible adverse	1.4	Negligible adverse
Danes Pad	61.2	61.8	60.3	61.3	-0.9	Negligible beneficial	0.1	Negligible adverse	0.6	Negligible adverse
4 The Shires	63.1	63.2	61.7	62.4	-1.4	Minor beneficial	-0.7	Negligible beneficial	0.1	Negligible adverse
1 Railway Cottages	55.5	56.2	55.9	56.9	0.4	Negligible adverse	1.4	Negligible adverse	0.7	Negligible adverse
Leyland Bridge Barn	64.7	64.8	63.7	64.4	-1.0	Minor beneficial	-0.3	Negligible beneficial	0.1	Negligible adverse

9.7.3 Table 9.9 shows that 229 Hoyles Lane is predicted to experience a negligible adverse magnitude of impact in the short-term and a **minor adverse magnitude of impact** in the long-term with the Scheme in place. The long-term adverse impact is, in part, due to a small increase in traffic on Hoyles Lane with the introduction of the Scheme but is primarily due to an increase in traffic flow on Hoyles Lane in the long-term, which would occur with or without the Scheme. All other adverse daytime impacts with the Scheme in place fall into the **negligible adverse magnitude of impact** category.

9.7.4 Quaker Lodge, 4 The Shires and Leyland Bridge Barn are predicted to experience a **minor beneficial magnitude of impact** in the short-term and a **negligible beneficial magnitude of impact** in the long-term with the Scheme in place. At Quaker Lodge this is due to the realignment of the existing road network at the north end of the Scheme. At 4 The Shires and Leyland Bridge Barn this is due to decreases in traffic flow on Lea Road. All other beneficial daytime impacts with the Scheme in place fall into the **negligible beneficial magnitude of impact** category.

9.7.5 In the long-term daytime period, without the Scheme in place, no sample representative receptor is predicted to experience more than a negligible magnitude of impact, either beneficial or adverse.

Table 9.10: Comparison of Predicted Night-time Noise Impacts at Sample Representative Receptors, With and Without the Scheme in Place

Address	Do-Minimum dB L_{night}		Do-Something dB L_{night}		Short-term		Long-term with Scheme		Long-term without Scheme	
	2024	2039	2024	2039	Change (dB)	Magnitude of Impact	Change (dB)	Magnitude of Impact	Change (dB)	Magnitude of Impact
229 Hoyles Lane	51.2	53.5	51.5	54.1	0.3	Negligible adverse	2.9	Negligible adverse	2.3	Negligible adverse
Invercauld	49.3	50.5	49.4	50.8	0.1	Negligible adverse	1.5	Negligible adverse	1.2	Negligible adverse
Quaker Lodge	45.4	44.9	44.5	44.4	-0.9	Negligible beneficial	-1.0	Negligible beneficial	-0.5	Negligible beneficial
7 Thornthwaite Road	51.7	52.9	51.6	52.9	-0.1	Negligible beneficial	1.2	Negligible adverse	1.2	Negligible adverse
Danes Pad	49.0	49.6	48.2	49.1	-0.8	Negligible beneficial	0.1	Negligible adverse	0.6	Negligible adverse
4 The Shires	50.7	50.9	49.5	50.2	-1.2	Minor beneficial	-0.5	Negligible beneficial	0.2	Negligible adverse
1 Railway Cottages	43.9	44.5	44.3	45.2	0.4	Negligible adverse	1.3	Negligible adverse	0.6	Negligible adverse
Leyland Bridge Barn	52.2	52.3	51.3	52.0	-0.9	Negligible beneficial	-0.2	Negligible beneficial	0.1	Negligible adverse

9.7.6 Table 9.10 shows that night-time noise changes at sample representative receptors are similar to the daytime noise changes, though in some cases slight differences in the noise changes result in different impact category. In terms of the sample representative receptors, all the adverse daytime impacts with the Scheme in place fall into the **negligible adverse magnitude of impact c**ategory.

9.7.7 In terms of beneficial impacts with the Scheme in place, 4 The Shires is predicted to experience a minor beneficial magnitude of impact in the short-term and a negligible beneficial magnitude of impact in the long-term. This is due to decreases in traffic flow on Lea Road. All other beneficial daytime impacts with the Scheme in place fall into the **negligible beneficial magnitude of impact** category.

9.7.8 In the long-term daytime period, without the Scheme in place, no sample representative receptor is predicted to experience more than a negligible magnitude of impact, either beneficial or adverse.

Magnitude of Impact – Operational Road Traffic Noise

9.7.9 Tables 9.11, Table 9.12 and Table 9.13 provide the noise level change comparisons for all noise sensitive receptors in the study area in accordance with the reporting requirements of DMRB LA 111 (Highways England, 2020b). It should be noted that, in the commentary that follows these tables, emphasis is placed on discussion of noise changes of minor magnitude or more (more than 1 dB change in the short-term and 3 dB in the long-term) as these changes are those which are potentially significant based upon the criteria in Section 1.7.2 of Appendix 9.2. It should be noted that, whilst Table 12 in Appendix 9.2 only indicates that impacts of moderate or major are potentially significant, Table 13 in Appendix 9.2 states that minor noise changes (1 dB or more in the short-term) where noise levels are above SOAEL are also potentially significant, subject to consideration of other contextual factors.

Table 9.11: Short-term Noise Impact – Do-Minimum 2024 vs Do-Something 2024

Scenario/Comparison: Do-Minimum 2024 against Do-Something 2024					
Change in Noise Level dB(A)		**Daytime**		**Night-time**	
		No. of Dwellings	**No. of Other Noise Sensitive Receptors**	**No. of Dwellings**	**No. of Other Noise Sensitive Receptors**
Increase in noise level, $L_{A10,18hr}$ / L_{night}	<1.0	257	3	161	2
	1.0 – 2.9	0	0	0	0
	3.0 – 4.9	0	0	0	0
	>5	0	0	0	0
No change	0	69	0	332	1
Decrease in noise level, $L_{A10,18hr}$ / L_{night}	<1.0	686	1	548	1
	1.0 – 2.9	62	0	33	0
	3.0 – 4.9	0	0	0	0
	>5	0	0	0	0

9.7.10 Table 9.11 shows that, in the short-term with the Scheme in place, 62 dwellings are predicted to experience a **minor beneficial magnitude of impact** during the daytime. For the night-time period, 33 dwellings are predicted to experience a **minor beneficial magnitude of impact**. No minor adverse magnitudes of impact are expected, and no moderate or major magnitudes of impact, adverse or beneficial, are expected.

9.7.11 Noise sensitive receptors predicted to experience **minor beneficial magnitudes of impact** in the short-term are located alongside Lea Road. Traffic flows along Lea Road are predicted to reduce, and as such, noise levels in these areas are also predicted to decrease.

9.7.12 All other short-term impacts in both the daytime and night-time short-term scenarios are predicted to be of negligible magnitude of impact or less.

Table 9.12: Long-term Noise Impact with the Scheme – Do-Minimum 2024 vs Do-Something 2039

Scenario/Comparison: Do-Minimum 2024 against Do-Something 2039					
Change in Noise Level dB(A)		**Daytime**		**Night-time**	
		No. of Dwellings	**No. of Other Noise Sensitive Receptors**	**No. of Dwellings**	**No. of Other Noise Sensitive Receptors**
Increase in noise level, $L_{A10,18hr}$ / L_{night}	<3.0	991	4	989	4
	3.0 – 4.9	2	0	0	0
	5.0 – 9.9	0	0	0	0
	>10	0	0	0	0
No change	0	9	0	13	0
Decrease in noise level, $L_{A10,18hr}$ / L_{night}	<3.0	72	0	72	0
	3.0 – 4.9	0	0	0	0
	5.0 – 9.9	0	0	0	0
	>10	0	0	0	0

9.7.13 Table 9.12 shows that in the long-term, with the Scheme in place, two dwellings are predicted to experience a **minor adverse magnitude of impact** during the daytime. The predicted long-term impact magnitude at all other noise sensitive receptors during the daytime and all noise sensitive receptors during the night-time is either **negligible or unchanged** with the Scheme.

Table 9.13: Long-term Noise Impact without the Scheme – Do-Minimum 2024 vs Do-Minimum 2039

Scenario/Comparison: Do-Minimum 2024 against Do-Minimum 2039					
Change in Noise Level dB(A)		Daytime		Night-time	
		No. of Dwellings	No. of Other Noise Sensitive Receptors	No. of Dwellings	No. of Other Noise Sensitive Receptors
Increase in noise level, $L_{A10,18hr}$ / L_{night}	<3.0	1,059	4	1,057	4
	3.0 – 4.9	0	0	0	0
	5.0 – 9.9	0	0	0	0
	>10	0	0	0	0
No change	0	3	0	4	0
Decrease in noise level, $L_{A10,18hr}$ / L_{night}	<3.0	12	0	13	0
	3.0 – 4.9	0	0	0	0
	5.0 – 9.9	0	0	0	0
	>10	0	0	0	0

9.7.14 Table 9.13 shows that the predicted long-term impact magnitude at all noise sensitive receptors is either negligible or unchanged if the Scheme were not to go ahead.

Noise Change Contour Plots

9.7.15 Table 9.11, Table 9.12 and Table 9.13 are supplemented by Figures 9.3a to 9.3f, which provide noise change contour plots for the following scenarios:

- Figure 9.3a – Short-term noise change contour plot with the Scheme (Do-Minimum 2024 vs Do-Something 2024) Daytime;
- Figure 9.3b – Long-term noise change contour plot with the Scheme (Do-Minimum 2024 vs Do-Something 2039) Daytime;

- Figure 9.3c – Long-term noise change contour plot without the Scheme (Do-Minimum 2024 vs Do-Minimum 2039) Daytime;
- Figure 9.3d – Short-term noise change contour plot with the Scheme (Do-Minimum 2024 vs Do-Something 2024) Night-time;
- Figure 9.3e – Long-term noise change contour plot with the Scheme (Do-Minimum 2024 vs Do-Something 2039) Night-time; and,
- Figure 9.3f – Long-term noise change contour plot without the Scheme (Do-Minimum 2024 vs Do-Minimum 2039) Night-time.

Magnitude of Impact – Basic Noise Levels (BNLs)

9.7.16 DMRB LA 111 (Highway England, 2020) requires consideration of the impact on the wider road network (outside of the area within 600m of new road links or road links physically changed or bypassed by the Scheme) where there are predicted BNL changes of dB or more in the short-term or 3dB or more in the long-term. This occurs at one road link, where Lea Road continues south beyond the area within 600m of the Scheme. A BNL change of -1.0dB is predicted at this road link, resulting in a **minor beneficial magnitude of impact.** There are nine noise sensitive receptors within 50m of this road link.

Magnitude of Impact – Public Rights of Way

9.7.17 As well as noise sensitive buildings, DMRB LA 111 (Highways England, 2020b) also identifies areas such as public rights of way as noise sensitive receptors. Whilst noise levels can be calculated at specific points around a noise sensitive building, public rights of way and other open areas often span a considerable area/length. Therefore, rather than assessing an arbitrary point within these noise sensitive receptors, an assessment of the potential noise impacts has been undertaken across the total length of public rights of way within the study area to provide a more balanced approach.

9.7.18 Within the operational noise study area, eight public rights of way have been identified and assessed. The percentage of each public right of way that falls

into each magnitude of change category has been calculated. The total percentage of all eight public rights of way that falls within each magnitude of change category in both the short-term and long-term are presented in Table 9.14 and Table 9.15, respectively.

Table 9.14: Short-term Noise Impact on Public Rights of Way

Change in Noise Level dB(A)		Percentage of Public Rights of Way within each Magnitude of Impact Category
Increase in noise level, $L_{A10,18hr}$ / L_{night}	<1.0	33
	1.0 – 2.9	8
	3.0 – 4.9	0
	>5	0
No change	0	33
Decrease in noise level, $L_{A10,18hr}$ / L_{night}	<1.0	26
	1.0 – 2.9	0
	3.0 – 4.9	0
	>5	0

9.7.19 Table 9.14 shows that none of the public rights of way within the study area are predicted to experience impacts of **moderate or major adverse magnitude of impact** in the short-term, and 8 % of the public rights of way within the study area are predicted to experience a minor adverse magnitude of impact. Therefore, **no short-term significant effects** are predicted for public rights of way within the study area.

Table 9.15: Long-term Noise Impact on Public Rights of Way

Change in Noise Level dB(A)		Percentage of Public Rights of Way within each Magnitude of Impact Category
Increase in noise level, $L_{A10,18hr}$ / L_{night}	<3.0	98
	3.0 – 4.9	0
	5.0 – 9.9	0
	>10	0

Change in Noise Level dB(A)		Percentage of Public Rights of Way within each Magnitude of Impact Category
No change	0	1
Decrease in noise level, $L_{A10,18hr}$ / L_{night}	<3.0	1
	3.0 – 4.9	0
	5.0 – 9.9	0
	>10	0

9.7.20 Table 9.15 shows that none of the public rights of way within the study area are predicted to experience impacts of minor, moderate or major adverse magnitude of impact in the long-term. Therefore, **no long-term significant effects** are predicted for public rights of way within the study area.

Significance of Effect – Operational Road Traffic Noise

9.7.21 An assessment of the significance of effects has been carried out following analysis of the predicted noise levels in all operational assessment scenarios and the resultant change in noise levels, following the methodology for significance assessment described in Section 1.7.3 of Appendix 9.2. Additionally, the contextual elements detailed in Table 13 of Appendix 9.2 have been considered in determining significance.

9.7.22 Figure 9.4 in Appendix 9.1 shows noise sensitive receptors within the operational noise study area predicted to experience either significant adverse or beneficial effects, whilst Table 9.16 presents a summary of the predicted significant effects and the justification for the significance conclusion.

Table 9.16: Significant Operational Road Traffic Noise Effects

Receptor (or Group of Receptors)	No. of Receptors	Short-term Magnitude of Impact	Final Operational Significance	Justification of Significance Judgement
1 Westleigh Mews	1	Minor beneficial	Significant beneficial	Minor beneficial magnitude reduction in noise level in the short-term during both daytime and night-time, with daytime and night-time noise levels reducing from above the SOAEL to below the SOAEL.
106, 108 and 110 Lea Road	3	Minor beneficial	Significant beneficial	Minor beneficial magnitude reduction in noise level in the short-term during the daytime and night-time with night-time noise levels reduce from above the SOAEL to below the SOAEL.
39 Ash Coppice	1	Minor beneficial	Significant beneficial	Minor beneficial magnitude reduction in noise level in the short-term during both daytime and night-time, with daytime and night-time noise levels reducing from above the SOAEL to below the SOAEL.

9.7.23 The overall results from Table 9.16 are summarised in Table 9.17.

Table 9.17: Summary of Significant Operational Road Traffic Noise Effects

Receptor Type	Significant Adverse	Significant Beneficial
Dwelling	0	5
Other	0	0

9.7.24 Table 9.16 and Table 9.17 demonstrate that no noise sensitive receptors are predicted to experience significant adverse effects as a result of operation of the Scheme.

9.7.25 The Scheme is predicted to result in a reduction in traffic on Lea Road, resulting in five dwellings experiencing **significant beneficial effects**.

Noise Insulation Regulations

9.7.26 An indicative Noise Insulation Regulations assessment has been performed using the methodology set out in Section 1.7.4 of Appendix 9.2.

9.7.27 No dwellings within 300m of the Scheme have both a relevant noise level of at least 68 dB $L_{A10,18hr}$ (façade) and a noise increase between the relevant noise level and the prevailing noise level of at least 1 dB(A). Therefore, no dwellings would meet both the second and third qualifying criteria detailed in Section 1.7.4 of Appendix 9.2.

9.7.28 Accordingly, it is expected that no dwellings would qualify for noise insulation due to the Scheme. However, this would be subject to further assessment once the final design and traffic forecast data is available.

Operational Station Noise Impacts

9.7.29 Daytime and night-time operational station noise levels have been predicted at the nearest noise sensitive receptors to the west and east of the Scheme, at 1 Railway Cottages and 4 The Shires, respectively, using the methodology set out in Section 1.8 of Appendix 9.2. The receptors are

shown in Figure 9.2 in Appendix 9.1. The predicted residual and operational station noise levels are presented in Table 9.18.

Table 9.18: Predicted Residual and Operational Station Noise Levels

Receptor	Predicted Daytime Noise Level dB $L_{Aeq,16hr}$		Predicted Night-time Noise Level dB L_{night}	
	Residual	Station Operation	Residual	Station Operation
1 Railway Cottages	52	43	43	35
4 The Shires	61	40	51	33

9.7.30 Table 9.18 shows that the predicted operational station noise levels are 9 dB below the predicted residual noise levels during daytime and 8 dB below the predicted residual noise levels during night-time at 1 Railway Cottages. Accordingly, the addition of operational station noise to the baseline residual noise would result in an increase in noise of less than 1 dB.

9.7.31 Table 9.18 shows that the predicted operational station noise levels are 21 dB below the predicted residual noise levels during daytime and 18 dB below the predicted residual noise levels during night-time at 4 The Shires. Accordingly, the addition of operational station noise to the baseline residual noise would not result in an increase in noise.

9.7.32 Table 9.18 shows that the predicted operational station noise levels are at least 5 dB below the WHO guideline noise levels for daytime and night-time (50 dB $L_{Aeq,16hr}$ and 40 dB L_{night}, respectively – refer to Table 9.1).

9.7.33 Based on the comparison of predicted operational station noise levels with baseline residual noise levels and WHO guideline noise levels, it is considered that significant operational station noise effects are unlikely to occur.

Operational Railway Noise Impacts

9.7.34 Daytime and night-time operational railway noise levels have been predicted at the nearest noise sensitive receptor to the Scheme, 1 Railway Cottages, using the methodology set out in Section 1.9 of Appendix 9.2. The location of 1 Railway Cottages is shown in Figure 9.2. The predicted railway noise levels when calculated in accordance with CRN (Department of Transport, 1995) with and without the Scheme are presented in Table 9.19.

Table 9.19: Predicted Railway Noise Levels

Receptor	Predicted Daytime Noise Level dB $L_{Aeq,16hr}$		Predicted Night-time Noise Level dB L_{night}	
	Without Scheme	With Scheme	Without Scheme	With Scheme
1 Railway Cottages	62.8	59.9	60.2	59.1

9.7.35 Table 9.19 shows that the predicted operational railway noise levels decrease by 2.9 dB during daytime and 1.1 dB during night-time at 1 Railway Cottages, resulting in minor beneficial impacts. This is due to the slower speed of trains which stop at the Scheme as they pass 1 Railway Cottages.

9.7.36 An assessment of the significance of effects has been carried out following the methodology described in section 1.7.3 of Appendix 9.2. The predicted reductions in operational railway noise are not considered to be significant during the daytime; however, benefits are considered to be significant during night-time as the predicted railway noise level exceed the night-time SOAEL of 55 dB L_{night}.

9.7.37 As discussed in section 9.3, CRN (Department of Transport, 1995) does not account for the potential for increased noise due to diesel multiple-unit passenger trains accelerating away from the Scheme or brake squeal from trains stopping at the Scheme. Table 9.20 presents the results of the indicative assessment which includes consideration of these factors as described in section 9.3 and Appendix 9.2.

Table 9.20: Predicted Railway Noise Levels (Indicative Assessment Incorporating Consideration of Acceleration Noise and Brake Squeal)

Receptor	Predicted Daytime Noise Level dB $L_{Aeq,16hr}$		Predicted Night-time Noise Level dB L_{night}	
	Without Scheme	With Scheme	Without Scheme	With Scheme
1 Railway Cottages	62.8	62.2	60.2	59.7

9.7.38 Table 9.20 shows that the predicted operational railway noise levels decrease by 0.6 dB during daytime and 0.5 dB during night-time at 1 Railway Cottages in the indicative assessment incorporating consideration of acceleration noise and brake squeal, resulting in **negligible beneficial impacts**. The predicted reductions in operational railway noise are not considered to be significant during daytime or night-time.

9.8 Mitigation

Mitigation During Construction

9.8.1 The potential for significant adverse noise effects during the construction phase have been identified. Therefore, in addition to embedded good practice noise and vibration mitigation measures, some specific mitigation measures may also be required.

9.8.2 It should be noted that the construction assessment is indicative as it is based upon assumed plant/equipment, construction programme and working methods. The appointed contractor should update the assessment once the working methods, working times, plant and construction equipment and the construction programme have been finalised.

Good Practice Mitigation Measures (Embedded and Essential Mitigation)

9.8.3 All construction work would be undertaken in accordance with the best practice measures set out in BS 5228-1 and BS 5228-2 (British Standards

Institution, 2014a and 2014b). It is anticipated that the following mitigation measures would be employed on site to ensure that noise and vibration levels are adequately controlled (all of which are considered to be examples of BPM, and which would be set out within the CEMP:

- Appropriate selection of plant and equipment, construction methods and programming. Only plant conforming with, or better than, relevant national or international standards, directives or recommendations on noise or vibration emissions would be used. Construction plant would be maintained in good condition;
- Training of site personnel to raise awareness of noise and nearby noise sensitive receptors;
- Ensuring good stakeholder engagement with local residents and other stakeholders, including provision of information to the public on expected construction noise and vibration, including duration, especially to those likely to be exposed to moderate and major magnitude effects. A manned complaints phone number should also be provided to residents in advance of works commencing;
- All vehicles, plant and equipment would be switched off when not in use;
- Use of appropriate noise abatement site hoardings and screens, where appropriate;
- Where practicable, gates (to compounds and construction areas) would not be located close to noise sensitive receptors;
- Careful selection of routes and programming for the transport of construction materials, spoil and personnel to avoid noise sensitive receptors or noise sensitive periods, where practicable;
- Vehicle and mechanical plant/equipment used for the purpose of the works would be fitted with exhaust silencers;

- The positioning of construction plant and activities to minimise noise at sensitive locations;
- Equipment that breaks concrete by pulverising or similar, rather than by percussion, would be used where practicable;
- Mufflers shall be used on pneumatic tools;
- The use, where necessary, of effective sound reducing enclosures or barriers;
- Programming works so that the requirement for noisy construction activity outside normal working hours is minimised;
- Minimise the potential for higher vibration levels from vibratory rollers, by taking into account the guidance within TRL Report 429 Groundborne vibration caused by mechanised construction works (Transport Research Laboratory, 2000) to ensure that the vibratory roller is not started, stopped, or the direction of travel reversed close to sensitive receptors; and,
- Use lower vibration settings on plant when working within 100 m of a vibration sensitive receptor.

9.8.4 It is anticipated that a schedule of noise and vibration monitoring would be agreed with the Planning Authority and noise and vibration limits included within any CEMP agreed. It is also anticipated that, as part of the CEMP, the appointed contractor would update this noise and vibration assessment once their construction programme is known and develop a specific noise and vibration mitigation plan to demonstrate how they plan to reduce the potential significant adverse effects identified in this assessment. This noise and vibration mitigation plan should include a combination of the mitigation measures outlined above, as required, for mitigating noise and vibration levels at different noise sensitive receptors.

9.8.5 The appointed contractor is expected to undertake construction works between:

- 07:30 to 18:00 on Mondays to Fridays; and,
- 08:30 to 13:00 on Saturdays.

9.8.6 This assessment has assessed night-time working for one activity where it is currently expected that night-time working is required (interfacing with existing assets). However, it is envisaged that once a contractor is appointed to construct the Scheme and develops a specific construction programme of works, some further night-time and/or weekend working may be required on occasion. The night-time and weekend periods are more sensitive than daytime as baseline noise levels are normally lower. Where works during such periods are required, the appointed contractor should liaise with the Planning Authority to agree working practices, and where relevant, noise limits. It would be anticipated that the appointed contractor would need to demonstrate that there is no alternative to night-time working, that BPM would be applied to the required works and any potential significant mitigated as much as reasonably practicable.

Mitigation During Operation

Embedded Mitigation

9.8.7 During the development of the Scheme, embedded mitigation measures have been incorporated into the design through route selection. The alignment chosen minimises the number of sensitive receptors near to the Scheme.

Essential Mitigation

9.8.8 No significant adverse operational noise effects have been identified and, therefore, no essential mitigation for operational noise is proposed.

9.9 Monitoring and Management

Construction

9.9.1 DMRB LA 111 (Highways England, 2020b) advises that likely significant environmental effects from noise and/or vibration during construction shall be monitored. It states the following in paragraph 4.1.1:

'Monitoring of likely significant effects should include one or more of the following:

- *verification that specific noise and vibration mitigation measures are in place for activities where there is potential for likely significant effects to occur in their absence;*
- *measurement of noise and/or vibration; and,*
- *checking that noise and vibration management procedures and practices are sufficient to ensure that adverse effects are no worse than set out in the assessment report.*'

9.9.2 It is anticipated that a schedule of noise and vibration monitoring would be agreed with the Planning Authority and noise and vibration limits included within any CEMP agreed.

Operation

9.9.3 DMRB LA 111 (Highways England, 2020b) paragraph 4.2 states that:

'Likely significant environmental effects from noise during operation shall be monitored and include:

- *Ensuring mitigation measures included with the project design are incorporated with the as-built project. Where they are not included, ensuring resultant noise levels, taking account of any additional mitigation*

installed but not included in the assessed design, are no higher than set out in the project assessment.

- *Ensuring specifications of noise mitigation measures, including barriers and low noise surfaces, meet design specifications*.'

9.9.4 DMRB LA 111 paragraph 4.2 NOTE states that:

9.9.5 'Post construction noise monitoring cannot provide a reliable gauge for whether the predicted magnitude and extent of operational adverse impacts are greater or less than those predicted in the assessment due to the following reasons:

- *The assessment is based on annual average conditions with and without the project to ensure a like for like comparison which is not possible to replicate through monitoring within a reasonable timescale.*

- *Monitoring in the absence of the project would need to be completed before the start of the construction works, and would therefore be a number of years before the with scheme monitoring and the assessment completed for the environmental statement is based on calculated road traffic noise levels, whereas ambient noise monitoring can be affected by other noise sources such as people, agricultural activities, military activities, aircraft etc.*'

9.9.6 Given the above, it is not anticipated that any post construction operational noise monitoring will be required. Nevertheless, it is recommended that any subsequent and/or significant design refinements be reassessed to ensure that significant operational noise effects are no worse than reported within this chapter.

9.10 Cumulative Effects

9.10.1 For inter-project cumulative effects during the construction phase, the construction activities from any other nearby developments which occur

simultaneously will also be implementing appropriate Best Practicable Means (BPM) to minimise construction noise and vibration in accordance with their respective planning permissions.

9.10.2 In terms of operational noise, there are unlikely to be inter-project cumulative effects beyond those already considered within the assessment. For example, the road traffic flows associated with the Preston Western Distributor Road and other relevant committed developments were included in all traffic scenarios assessed. Additionally, residential schemes that are not built at the time of writing but are likely to exist in the year of opening (2024), i.e. schemes with planning approval or that are under construction, have been included in the assessment based on their planning application layouts. Therefore the assessment of road traffic emissions during the operational phase includes the contribution from other projects.

9.11 Summary

9.11.1 The Scheme is predicted to have both beneficial and adverse effects on noise and vibration sensitive receptors.

9.11.2 During the construction phase, potential significant noise effects have been identified for a number of noise sensitive receptors. Whilst the application of BPM for controlling construction noise would provide a reasonable level of mitigation, it cannot be guaranteed that all adverse impacts would be reduced to a level resulting in no significant effects at the nearest noise sensitive receptors. As such, it is likely, even with the inclusion of noise mitigation measures, that some significant adverse effects would remain. These effects, however, would only affect a limited number of receptors (Quaker Lodge, The Shires and Ashton Lodge, 110 – 116 Lea Road, Leyland Bridge Barn and Railway Cottages) and would be transient in nature (when plant is operating in close proximity).

9.11.3 During the construction phase, no potential significant vibration effects have been identified because, assuming BPM are applied to control vibration, the

duration of the vibration impacts is likely to be less than 10 days in a 15-day period or 40 days in a six-month period.

9.11.4 Operational road traffic noise modelling was undertaken for all noise sensitive receptors within the defined operational study area. The Scheme is predicted to result in a number of significant beneficial effects in the short-term. These beneficial effects have been predicted along Lea Road, which is predicted to experience a reduction in traffic flow with the Scheme in place. No significant adverse effects are predicted.

9.11.5 Operational station noise modelling was undertaken for the nearest noise sensitive receptors to the west and east of the scheme. No significant effects are predicted as a result of operation of the station.

9.11.6 Overall, the Scheme is predicted to result in a relatively low number of significant effects. There are a greater number of adverse effects than beneficial effects, with the adverse effects occurring during construction and the beneficial effects occurring in the short-term during operation.

9.11.7 A summary of predicted significant effects associated with the Scheme is provided in Table 9.21.

Table 9.21: Summary of Significant Residual Effects

Receptor	Description of Effect	Significance of Effect (Prior to Mitigation)	Proposed Mitigation	Residual Effect (After Mitigation)
Construction Noise				
Quaker Lodge and Leyland Bridge Barn	Moderate adverse impact during construction	Significant adverse	Application of BPM (as described in Section 9.9) including limiting duration of exposure to noise levels above SOAEL. Contractor to conduct updated noise and vibration assessment and create noise and vibration mitigation strategy as part of CEMP.	Significant adverse
The Shires and Ashton Lodge (5 dwellings)	Major adverse impact during construction	Significant adverse		Significant adverse
110 - 116 Lea Road (9 dwellings) and Railway Cottages (5 dwellings)	Moderate to major adverse impact during construction	Significant adverse		Significant adverse
Operational Road Traffic Noise				
1 Westleigh Mews	Minor beneficial	Significant beneficial	N/A	Significant beneficial
106, 108 and 110 Lea Road	Minor beneficial	Significant beneficial	N/A	Significant beneficial
39 Ash Coppice	Minor beneficial	Significant beneficial	N/A	Significant beneficial

9.12 References

British Standards Institution. 2014a. BS 5228-1: 2009 + A1: 2014 - Code of practice for noise and vibration control on construction and open sites – Part 1: Noise. London, British Standards Institution.

British Standards Institution. 2014b. BS 5228-2: 2009 + A1: 2014 - Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration. London, British Standards Institution.

Department for Environment, Food and Rural Affairs. 2010. Noise Policy Statement for England. [online] Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/69533/pb13750-noise-policy.pdf [Accessed October 2021]

Department for Environment, Food and Rural Affairs. 2019. Noise Action Plan – Roads. [online] Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/813666/noise-action-plan-2019-roads.pdf [Accessed October 2021]

Department for Transport. 2021. TAG Unit A3 – Environmental Impact Appraisal. [online] Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/999917/tag-unit-A3.pdf [Accessed October 2021]

Department of Transport. 1995. Calculation of Railway Noise. London, Her Majesty's Stationery Office.

Department of Transport and Welsh Office. 1988. Calculation of Road Traffic Noise. London, Her Majesty's Stationery Office.

Highways England. 2020a. Design Manual for Roads and Bridges, LA 104 Environmental Assessment and Monitoring (Revision 1). [online] Available at: https://standardsforhighways.co.uk/dmrb/search/0f6e0b6a-d08e-4673-8691-cab564d4a60a [Accessed October 2021]

Highways England. 2020b. Design Manual for Roads and Bridges, LA 111 Noise and Vibration (Revision 2). [online] Available at: https://www.standardsforhighways.co.uk/dmrb/search/cc8cfcf7-c235-4052-8d32-d5398796b364 [October 2021]

International Organization for Standardization. 1996. ISO 9613-2 – Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation. Switzerland, International Organization for Standardization.

Ministry of Housing, Communities and Local Government. 2019. Planning Practice Guidance: Noise. [online] Available at: https://www.gov.uk/guidance/noise--2 [Accessed October 2021]

Ministry of Housing, Communities and Local Government. 2021. National Planning Policy Framework. [online] Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1005759/NPPF_July_2021.pdf [Accessed October 2021]

Preston City Council, South Ribble Borough Council and Chorley Council. 2012. Central Lancashire Adopted Core Strategy Local Development Framework July 2012. Preston, PCC Design & Print Centre.

Preston City Council. 2015. Preston Local Plan 2012-2026 Site Allocations and Development Policies (Adopted 2nd July 2015). Preston, PCC Design & Print Centre.

Transport Research Laboratory. 2000. Groundborne vibration caused by mechanised construction works (TRL Report 429). Crowthorne, Transport Research Laboratory.

UK Government. 1973. Land Compensation Act 1973. [online] Available at: https://www.legislation.gov.uk/ukpga/1973/26/contents [Accessed October 2021]

UK Government. 1974. Control of Pollution Act 1974. [online] Available at: https://www.legislation.gov.uk/uksi/1975/1763/contents/made [Accessed October 2021]

UK Government. 1975. The Noise Insulation Regulations 1975 (as amended 1988) [online] Available at: https://www.legislation.gov.uk/uksi/1975/1763/contents/made [Accessed October 2021]

UK Government. 2006. The Environmental Noise (England) Regulations 2006. [online] Available at: https://www.legislation.gov.uk/uksi/2006/2238/contents/made [Accessed October 2021]

World Health Organization. 1999. Guidelines for Community Noise. Geneva, World Health Organization.

World Health Organization. 2009. Night Noise Guidelines for Europe. Denmark, The Regional Office for Europe of the World Health Organization.