17 Noise and Vibration

This chapter considers the potential noise and vibration impacts of the proposed scheme on noise sensitive receptors (NSR). The study area and calculation area were determined using DMRB guidance.

Noise modelling was undertaken for all NSR, noise sensitive committed developments and noise sensitive amenity areas within the defined calculation area, which extended 600m from the proposed scheme and affected routes. As part of the assessment a baseline noise survey was undertaken at 11 identified NSR to support the validation of the noise model outputs and inform understanding of the existing noise climate within the vicinity of the proposed scheme.

For the purposes of this assessment and when identifying mitigation requirements under the EIA Regulations, operational impacts were considered to be significant where the assessment results indicated impacts of Slight/Moderate Adverse significance or worse and where the predicted absolute façade noise level also exceeded 59.5dB $L_{A10,18h}$ at ground floor level. For night-time noise levels, operational impacts were considered to be significant where the assessment results indicated impacts of Slight/Moderate Adverse or worse significance and where the predicted absolute noise level also exceeded 55.0dB $L_{night,outside}$ at ground and/or first floor levels in the long-term.

Measures embedded in the proposed scheme that attenuate noise include the use of low noise road surfacing and the effect of earthworks (embankments, cuttings). NSR specific mitigation includes sections of the existing A9 to the north of the proposed scheme to be resurfaced with a low noise road surface and five noise barriers. Based on the DMRB Stage 3 design, these would be located at approximately ch1500 – ch1600 at a height of 1.8m, ch2900 – ch3000 at a height of 1.4m, ch4070 – ch4220 at a height of 1.5m, ch5200 – ch5300 at a height of 1.5m and located at ch5260 – ch5300 at a height of 2.4m.

An indicative assessment of potential eligibility for noise insulation for all NSR under the Noise Insulation (Scotland) Regulations was also undertaken. The results indicated that without mitigation, there are nine NSR which may meet the eligibility requirements.

The results of the residual operational noise impact assessment in the short-term indicate that at ground floor level there are 46 dwellings and four other NSR predicted to have a residual impact of Slight/Moderate Adverse significance or worse based on the receptor point with the least beneficial change in noise level. However, the predicted absolute noise level at these NSR was less than 59.5dB $L_{A10,18h}$ and so they are not considered to be significantly affected.

The results of the residual operational noise impact assessment indicate that in the long-term, for the daytime period, at ground floor level there is one dwelling and one other NSR predicted to have a significance of impact of Slight/Moderate Adverse or worse. However, the predicted absolute noise levels at these NSR was less than 59.5dB $L_{A10,18h}$ and so they are not considered to be significantly affected.

The results of the residual operational noise impact assessment indicate that in the long-term, for the night-time period, at ground floor level there is one dwelling and at first floor level there are three dwellings predicted to have a significance of impact of Slight/Moderate Adverse or worse. However, the predicted absolute noise levels at these NSR was less than 55dB $L_{night,outside}$ and so they are not considered to be significantly affected.

In addition to ground level impacts, results for the predicted noise impacts at first floor level for all NSR are reported in full within the chapter. As required by DMRB the results of the noise nuisance and vibration nuisance are also reported.

Potential impacts during the construction phase were also considered. Whilst there is potential for temporary significant impacts due to the proximity of some properties to the location of the works, with appropriate mitigation measures it is anticipated that these could be reduced and would not be considered significant.

17.1 Introduction

17.1.1 This chapter presents the DMRB Stage 3 assessment of potential noise and vibration impacts as a result of construction and operation of the proposed scheme. The chapter is supported by the following appendices, which are cross-referenced in the text where relevant:

- Appendix A17.1 Noise and Vibration Terminology;
- Appendix A17.2 Detailed Baseline Noise Survey Results and Notes;

- Appendix A17.3 Predicted Noise Levels at Receptors;
- Appendix A17.4 Noise Impacts on Committed Developments;
- Appendix A17.5 Noise Impacts on Amenity Areas;
- Appendix A17.6 Operational Residual Noise Impacts; and
- Appendix A17.7 Closest Noise Sensitive Receptors to Construction Works.

17.1.2 The assessment of noise and vibration impacts associated with the proposed scheme has been undertaken in accordance with the Detailed Assessment Methodology of DMRB Volume 11, Section 3, Part 7 HD 213/11 Revision 1 Noise and Vibration (The Highways Agency et al., 2011), hereafter referred to as DMRB Noise and Vibration. Road traffic noise levels were predicted in accordance with the guidance contained in the Department of Transport's and Welsh Office publication: Calculation of Road Traffic Noise (CRTN, The Department of Transport,1988) and supplemented with the additional guidance contained in Annex 4 of DMRB Noise and Vibration.

17.1.3 To assist in the understanding of the noise assessment it is useful to consider the units of noise and how noise is described quantitatively.

17.1.4 The World Health Organisation (WHO, 1999) defines noise as unwanted sound and sound is measured in terms of decibels (dB). The decibel is not an absolute unit of measurement; it is a ratio between a measured quantity and an agreed reference level. The measured quantity is the variation in atmospheric pressure and the reference level is taken as the lowest pressure to which a healthy ear is able to hear as sound, i.e. 2 x 10^{-5} Pascal's (20μPa). It should be appreciated that whilst the audible range of hearing extends from 20 Hertz (Hz) to 20,000Hz, human hearing is not equally sensitive to sound across this range of frequencies and therefore corrections or "weightings" are applied to the measured linear levels to simulate the response of the ear. The A-weighting is most often used to represent the response of the ear to environmental noise. When considering noise levels, it may be of assistance to note that doubling or halving of the traffic flow is equivalent to a change of approximately 3dB(A), and a subjective impression of a doubling of loudness generally corresponds to a 10dB(A) sound level increase. Given that noise is assed as a logarithmic ratio of pressure levels it is often useful to consider the relationship between the subjective evaluations of objective noise levels as shown in Table 17.1.

Table 17.1: Typical noise levels and subjective evaluation

A-weighted Noise Level L_A (dB)	Description
120	Threshold of Pain
100	Diesel drop hammer at 10m distance
95	Pneumatic drill (unsilenced) at 7m distance
85	Heavy diesel lorry (travelling at 40km/h) at 7m distance
85	Jet aircraft take-off at 150m distance
70	Passenger car (travelling at 60km/h) at 7m distance
65	Train (travelling at 40km/h) at 25m distance
60	Busy general office
55	Communication starts becoming difficult
40	Quiet library
35	Typical bedroom
20	Leaves rustling lightly
0	Threshold of hearing

Road Traffic Noise

17.1.5 In terms of road traffic noise, it is useful to understand the causes of noise associated with a flow of road traffic vehicles.

17.1.6 Road traffic noise can be separated into two main components. The first is generated by the engine, exhaust system and transmission, and is the dominant noise source when traffic is not freely flowing. This is particularly apparent from heavy good vehicles (HGVs), when accelerating, braking or changing gears and this contributes a significant proportion of low frequency noise. The second noise source component is generated from the interaction of tyres with the road surface and is the dominant noise source under free flow traffic conditions at moderate to high road speeds and contributes a significant proportion of higher frequency noise.

17.1.7 The noise from a stream of traffic at a receptor point is an aggregation of noise from each of a number of vehicles at various distances. There are several factors that influence the noise level experienced at a receptor point and these can be separated into two categories. Firstly, there are factors that affect the noise emissions at source, such as traffic volume, speed and composition (i.e. the percentage of HGVs), the gradient of the carriageway and the surface characteristics of the carriageway. Secondly there are those factors affecting the propagation characteristics, such as the distance of the receptor from the source, the topography and characteristics of the ground between the source and receptor, the presence of any screening or barrier effects and the wind strength and direction.

Measurement of Road Traffic Noise

17.1.8 Noise from traffic on a road will change as traffic flows alter during the day and will also fluctuate within shorter time periods as vehicles pass. In order to compare situations with different traffic noise levels it is necessary to use an index to produce single figure estimates of overall noise levels. The metric used for road traffic noise is $L_{A10,18h}$ which is the arithmetic mean value of the A-weighted noise levels, which are exceeded for 10% of the time in each of the 18 one hour periods between 06:00 hours and 00:00 hours. Paragraph A3.11 of DMRB Noise and Vibration advises that a reasonably good correlation has been shown to exist between traffic noise levels expressed in $L_{A10,18h}$ and residents' dissatisfaction with the noise over a wide range of values.

Road Traffic Vibration

17.1.9 Traffic induced vibration is a low frequency disturbance which can be transmitted through the air or ground. Air-borne vibration from traffic is produced by the engine and exhaust of the vehicle, whereas ground-borne vibration is produced by the interaction between rolling wheels and the road surface.

17.1.10 There are two potential effects of traffic vibration that need to be considered: the effects on buildings, and the disturbance caused to occupiers of properties. Extensive research has been carried out on a range of buildings of various ages and types, and no evidence has been found to support the theory that traffic-induced ground-borne vibration is a source of significant damage to buildings (Watts, 1990). As such, ground-borne vibration is not assessed in this chapter. Ground-borne vibration is much less likely to be the cause of disturbance to occupiers than air-borne vibration (Baughan & Martin, 1981; Watts, 1984). DMRB Noise and Vibration states:

> '*Normal use of buildings such as closing of doors, walking on suspended wooden floors and operating domestic appliances can generate similar levels of vibration to that from traffic*'.

17.1.11 In addition, there is no evidence that traffic induced airborne vibration can cause even minor damage to buildings. However, it can be a source of annoyance to local people, causing vibrations of flexible built elements within the building, (such as doors, windows and, on occasions floors) of properties close to the carriageway. Accordingly, the issue of DMRB Noise and Vibration defined nuisance at properties caused by road traffic induced airborne vibration has been evaluated.

Legislative and Policy Background

17.1.12 The assessment of potential noise and vibration impacts has been carried out with reference to the following documents:

- DMRB Volume 11 Section 3 Part 7 (HD 213/11 – Revision 4) (The Highways Agency et al., 2011);
- CRTN (Department of Transport Welsh Office, 1988);
- The Noise Insulation (Scotland) Regulations (NISR) (HMSO, 1975a);

- Memorandum on the Noise Insulation (Scotland) Regulations (Memorandum) (HMSO, 1975b);
- The Environmental Noise (Scotland) Regulations (HMSO, 2006);
- Control of Pollution Act 1974 (HMSO, 1974);
- Planning Advice Note (PAN) 1/2011– Planning and Noise (The Scottish Government, 2011a);
- Technical Advice Note (TAN) – Assessment of Noise (The Scottish Government, 2011b);
- BS 5228:2009+A1:2014 "*Code of practice for noise and vibration control on construction and open sites*" Part 1 - Noise and Part 2 – Vibration (BSI, 2014);
- WHO Guidelines for Community Noise (WHO, 1999); and
- WHO Night Noise Guidelines (NNG) for Europe (WHO, 2009).

17.1.13 In addition, a review of relevant national, regional and local planning policies and guidance relevant to noise and vibration was undertaken, as identified in Chapter 19 (Policies and Plans).

17.2 Approach and Methods

Scope of Assessment (Study Area)

17.2.1 The assessment study area has been determined in accordance with Paragraph A1.11 of DMRB Noise and Vibration, which sets out the procedure for defining the 'study area' and 'calculation area'. Figure 17.1 details both the study area and calculation area used for the noise and vibration impact assessment of the proposed scheme.

17.2.2 The main study area extends 1km from existing routes that are being improved or bypassed (although it is acknowledged that no section of road is bypassed for the proposed scheme) and any proposed new routes, between the start and end points of the physical works associated with the proposed scheme. Within the 1km boundary the calculation area is then defined as being the area that extends:

- 600m from existing and bypassed and/or improved routes or new routes; and
- 600m from any affected routes within the 1km study area.

17.2.3 An affected route is defined as a road where there is a possibility of a 1dB $L_{A10,18h}$ or more change in noise levels as a consequence of the proposed scheme in the short-term or a 3dB $L_{A10,18h}$ or more in the long-term. Roads where a change of at least 1dB is predicted to occur can be determined by considering changes in traffic flow; where a 25% increase equates to an increase in noise of 1dB and a 20% decrease in the traffic flow equates to a 1dB decrease in noise level, assuming other factors remain unchanged. Similarly, a change in noise level of 3dB $L_{A10,18h}$ would be equivalent to an increase in traffic flows of 100% or a decrease of 50%, assuming other factors such as speed, road surface, gradient and % of HGVs remain unchanged.

17.2.4 Noise levels are calculated at all identified noise sensitive receptor(s) (NSR) within the 600m calculation area that is within the 1km study area boundary. In addition, the predicted change in noise levels has also been assessed separately for:

- All identified noise sensitive committed developments (committed developments are extant planning applications that have been received or determined by the local planning authority in the last three years), which are also assessed in Chapter 8 (People and Communities - Community and Private Assets).
- Amenity areas (which include Sites of Special Scientific Interest, Special Areas of Conservation, core paths, National Parks, golf courses etc.).

17.2.5 DMRB Noise and Vibration also requires an assessment of noise impacts be undertaken for the wider road network on the Basic Noise Level[1]. The wider road network relates to those roads beyond the

[1] The Basic Noise Level as defined in CRTN is *"The basic noise level at a reference distance of 10m away from the nearside carriageway edge is obtained from the traffic flow, the speed of the traffic, the composition of the traffic, the gradient of the road and the road surface*".

calculation area and the assessment is undertaken for affected roads, defined as those roads where there is a 1dB increase or decrease of noise in the baseline year and/or a 3dB increase or decrease in the future assessment year when compared to the baseline year.

17.2.6 As the A9 Dualling Programme is currently being assessed in 11 sections between Perth and Inverness, the noise and vibration impacts on the wider road network are scoped out from the individual A9 dualling project assessments. A wider network assessment at the A9 Dualling Programme level will be undertaken using traffic data generated by the central traffic model, which will assess the wider network noise and vibration impacts of the total A9 Dualling Programme.

17.2.7 Therefore, the wider network area is the area beyond all of the individual A9 dualling projects detailed study areas to the extent of the validated traffic model. It is noted that the wider network study area will include sections of the A9 that are currently dual carriageway, and will consider receptors such that there is no double counting in these areas.

17.2.8 To obtain an overview of the existing ambient noise environment at NSR within the vicinity of the proposed scheme, 11 monitoring locations were identified to undertake unattended baseline noise level measurements. Ambient noise monitoring allows existing road traffic noise sources in addition to other sources of noise to be measured and observed prior to the construction and operation of the proposed scheme. The measured noise levels are used to inform the noise model predictions. The monitoring locations were agreed with the Environmental Health Department of Perth & Kinross Council (PKC). These properties were considered to be representative of their surrounding locale.

Requirements of a DMRB Stage 3 Noise and Vibration Detailed Assessment

17.2.9 The assessment follows the detailed assessment methodology set out in DMRB Noise and Vibration and requires consideration of permanent impacts including traffic noise, traffic nuisance and traffic induced vibration, together with temporary and cumulative impacts of the proposed scheme.

17.2.10 To assess the potential permanent noise and vibration impacts, it is necessary to make comparisons of noise levels in the 'short-term' (the baseline year, which for this proposed scheme is 2026) and in the 'long-term' (the future assessment year, which for this proposed scheme is 2041).

17.2.11 When referring to the short-term and long-term, DMRB Noise and Vibration uses the terminology 'Do-Minimum' to refer to the existing road network should the proposed scheme not be built and 'Do-Something' when referring to the road network if the proposed scheme is built. The comparisons are as follows:

- Do-Minimum scenario in the baseline year (DM 2026) versus Do-Minimum scenario in the future assessment year (DM 2041);
- Do-Minimum scenario in the baseline year (DM 2026) versus the Do-Something scenario in the baseline year (DS 2026); and
- Do-Minimum scenario in the baseline year (DM 2026) versus the Do-Something scenario in the future assessment year (DS 2041).

Assessment of Construction Noise and Vibration Impacts

17.2.12 Guidance on the approach to control construction noise is contained within British Standard BS 5228: Part 1:1997 and Part 4:1992 Noise and Vibration Control on Construction and Open Sites[2]. BS 5228 states that '*Good relations with people living and working in the vicinity of site operations are of paramount importance*'. It suggests that the early establishment and maintenance of these relations throughout the contract would go some way to allaying people's concerns.

[2] It should be noted that a newer version of BS 5228 came into force on 1 January 2009, which was subsequently amended in February 2014. At present the previous 1997 Part 1 and 1992 Part 4 versions are still officially approved under Section 71 of the Control of Pollution Act 1974 via The Control of Noise (Codes of Practice for Construction and Open Sites) (Scotland) Order 2002. Therefore, BS 5228: Part 1:1997 and Part 4:1992 are still referred to in this context.

17.2.13 The standard also advises that it is not possible to provide detailed guidance for determining whether or not noise from a site would constitute a problem in a particular situation as a number of factors would affect the acceptability of the site noise and vibration. These factors are:

- site location;
- existing ambient noise and vibration levels;
- duration of site operations;
- hours of work;
- attitude to site operator; and
- noise and vibration characteristics.

17.2.14 The level of noise experienced by inhabitants in the vicinity would vary according to the following factors:

- sound power outputs of processes and plant;
- periods of operation of processes and plant;
- distance from source(s) to receiver(s);
- presence of screening by barriers;
- reflection of sound associated with topographical features;
- phasing/programming of demolition works;
- soft ground attenuation; and
- meteorological factors.

17.2.15 To facilitate accurate prediction of noise levels it is necessary to know working methods, timing and phasing of the works and the number and type of plant likely to be used. At this stage such information is not available.

17.2.16 However, should the proposed scheme proceed and a contractor be appointed a construction noise and vibration assessment is usually required. The provisions of Sections 60 and 61 of the Control of Pollution Act 1974 offers some protection to those living near the construction. Section 60 enables a local authority to serve a notice specifying its noise control requirements covering:

- plant or machinery that is or is not be used;
- hours of working; and
- levels of noise or vibration that can be emitted.

17.2.17 Section 61 relates to prior consent, and is for situations where a contractor or developer takes the initiative and approaches the local authority before work starts to obtain approval for the methods to be used and any noise and vibration control techniques that may be required.

17.2.18 With regard to construction noise impacts BS 5228-1:2009+A1:2014 Annex E provides examples of criteria for the assessment of the potential significance of noise effects and the adoption of any of these examples should be fully justified.

17.2.19 BS 5228-2:2009+A1:2014 provides recommendations for basic methods of vibration control relating to construction and open sites where work activities/operations generate significant vibration levels, including industry specific guidance. With consideration to the nature and size of the proposed scheme as well as the likely construction processes, it is considered that any required blasting, piling or heavy earthmoving processes are the key construction activities that have the potential to give rise to significant vibration impacts.

17.2.20 In cognisance of the above, a qualitative assessment of potential construction noise and vibration impacts has been undertaken to determine the likely significance of noise impact associated with the construction of the proposed scheme based on the guidance above and using professional judgement.

17.2.21 The significance of noise impacts during construction noise will be determined as follows:

- construction noise 10dB below ambient noise level = Neutral;
- construction noise between 10 to 0dB below ambient noise level = Slight Adverse;
- construction noise between 0 to 5dB above ambient noise level = Slight/Moderate Adverse;
- construction noise between 5 to 10dB above ambient noise level = Moderate/Large Adverse; and
- construction noise greater than 10dB above ambient noise level = Large/Very Large Adverse.

17.2.22 It should be noted that although a NSR may have a Significance of Impact of greater than Slight/Moderate adverse, this is not necessarily an indication of a significant construction noise impact as the methods for assessing potential significant impacts from construction noise in BS 5228 is subject to exceedances of a noise level limit.

Operational Noise Impact Assessment

Predicting Noise Levels – Noise Modelling

17.2.23 All road traffic noise levels for the Base, Do-Minimum and Do-Something scenarios are predicted using the CadnaA® noise modelling software, which predicts the $L_{A10,18h}$ traffic noise level at dwellings and other NSR in accordance with CRTN and the supplementary CRTN guidance contained in DMRB Noise and Vibration. The Base scenario includes the traffic flow information for the existing A9 and surrounding roads for 2015 and is used to compare predicted noise levels with measured noise levels.

17.2.24 Receptor points around buildings have been modelled at 5m intervals, 1m from the façade. In accordance with DMRB Noise and Vibration, where noise levels are predicted at different façades of dwellings and other buildings, the summary of assessment results report the least beneficial change in noise level. DMRB Noise and Vibration therefore acknowledges that the results from this assessment may often show the worst case and highlight mainly the adverse impacts.

17.2.25 All modelled calculations are based on predicted traffic flows and associated variables in the form of 18 Hour Annual Average Weekday Traffic (AAWT), using traffic data modelled for the following scenarios, based on the latest available Transport Model for Scotland 2014 (TMfS 2014):

- Base Model Traffic Data (BMDT 2015)
- Do-Minimum in first full year of operation (DM 2026);
- Do-Something in first full year of operation (DS 2026);
- Do-Minimum in the design year (DM 2041); and
- Do-Something in the design year (DS 2041).

17.2.26 The prediction methodology of CRTN has a lower validity range of 1000 vehicles per day (06:00 – 00:00 hours). Accordingly, road links that have flows of less than 1000 vehicles have been excluded from the noise model. There is an exception where a road link may have a flow of less than 1000 in the Do-Minimum scenario but greater than 1000 in the Do-Something scenario, etc., and these road links have been included within the noise model.

17.2.27 It should be noted that the terminology used when referring to the TMfS is different from the terminology used in DMRB Noise and Vibration. Accordingly, where the TMfS refers to the ‘first full year of operation’ this is equivalent to the term ‘baseline year’ in DMRB Noise and Vibration and where the TMfS refers to a ‘design year’ this is the equivalent of the ‘future assessment year’.

17.2.28 Additional CadnaA® noise model input data includes;

- Road speeds in kilometres per hour (km/h).

- HGV percentages.
- Existing topography for the calculation area comprised of survey data undertaken for the proposed scheme and supplemented with a 3D digital terrain model (DTM) using 5m resolution height data.
- Proposed topography (3D DTM data taken from the MX road design model).
- Existing road surface types for the Do-Minimum in the baseline year are assumed to be impervious bitumen, such as hot rolled asphalt (HRA), with 2mm texture depth, with the exception of the following sections of the existing A9, which are assumed to currently be surfaced with existing low noise road surfacing (LNRS):
  - the northbound carriageway between ch1450 and ch1750 (both carriageways have been assumed to be existing LNRS to provide a worst case assessment);
  - the north and southbound carriageway between ch2350 and ch4450; and
  - the north and southbound carriageway between ch6550 and ch6950.
- Road surface types for the existing A9 in the Do-Minimum in the future assessment year are all assumed to be LNRS and all other roads are assumed to be impervious bitumen, such as HRA, with 2mm texture depth.
- All new roads constructed on the mainline and slip roads of the proposed scheme will be LNRS.
- Conventional HRA surfacing of 2mm texture depth is assumed to have a surface correction of 0dB(A) at speeds where the mean traffic speed is ≥75km/h and -1dB(A) where the mean traffic speed is <75km/h (Paragraph 16 of CRTN).
- Existing LNRS in the Baseline Year is assumed to have a surface correction of -2.5dB(A) at speeds where the mean traffic speed is ≥75km/h and -1dB(A) where the mean traffic speed is <75km/h (Paragraphs A4.25 and A4.27 of DMRB Noise and Vibration).
- New LNRS in the baseline year and the future assessment year and existing LNRS in the Future Assessment Year[3] is assumed to have a surface correction of -3.5dB(A) at speeds where the mean traffic speed is ≥75km/h and -1dB(A) where the mean traffic speed is <75km/h (Paragraphs A4.26 and A4.29 of DMRB Noise and Vibration).
- Ground absorption factor: for open land and grassed areas (I=1); surfaces within residential areas (I=0.5) and roads and water (I=0).
- Existing building heights are assumed to be 8m high, equivalent of a two storey building.
- Small buildings, defined as those which have a total footprint area of less than 25m^2, are not included in the noise model.

Significance of Impacts

17.2.29 It should be noted that whilst DMRB Noise and Vibration provides guidance for the magnitude of noise level changes, it does not provide any guidance on assessing the significance of noise impacts. Accordingly, the reported noise impacts have been assessed using the significance of noise impact scale provided in the Scottish Government's Technical Advice Note (TAN) (The Scottish Government, 2011b) which accompanies PAN 1/2011 (The Scottish Government, 2011a) together with the mitigation threshold in determining an overall significant effect. The significance of impact matrix, presented in Table 17.5, is based on the predicted noise levels, the magnitude of noise level change between each scenario (based on the magnitude of impact tables of DMRB Noise and Vibration) and the sensitivity of NSR (presented in the TAN).

Sensitivity of Noise Sensitive Receptors

17.2.30 The sensitivity of NSR to road traffic noise has been determined using the criteria provided in Table 17.2 (reproduced from TAN Table 2.1, Scottish Government 2011b).

[3] It is assumed that existing LNRS will be resurfaced before the future assessment year and hence a -3.5dB(A) correction is applied, instead of the -2.5dB(A) correction assumed for the baseline year.

Table 17.2: Criteria used to define noise sensitive receptors

Sensitivity	Description	Examples of Receptor Usage
High	Receptors where people or operations are particularly susceptible to noise	• Residential, including private gardens where appropriate • Quiet outdoor areas used for recreation • Conference facilities • Theatres/Auditoria/Studios • Schools during the daytime • Hospitals/residential care homes • Places of worship
Medium	Receptors moderately sensitive to noise, where it may cause some distraction or disturbance	• Offices • Bars/Cafes/Restaurants where external noise may be intrusive • Sports grounds when spectator noise is not a normal part of the event and where quiet conditions are necessary (e.g. tennis, golf, bowls)
Low	Receptors where distraction or disturbance is minimal	• Buildings not occupied during working hours • Factories and working environments with existing high noise levels • Sports grounds when spectator noise is a normal part of the event • Night Clubs

Magnitude of Noise Impacts

17.2.31 In general, when considering two sounds with similar acoustic properties, i.e. similar spectral and temporal characteristics, a change of more than 3dB(A) is regarded as being just perceptible to the human ear. However, with respect to changes in road traffic noise levels, DMRB Noise and Vibration (Paragraph 3.37) advises:

> '*A change in road traffic noise of 1dB $L_{A10,18h}$ in the short term (e.g. when a project is opened) is the smallest that is considered perceptible. In the long-term (typically 15 years after project opening), a 3dB $L_{A10,18h}$ change is considered perceptible*.'

17.2.32 Similarly, the Department for Transport document Transport Appraisal Guidance Unit A3.3.2 (Department for Transport, 2014) states:

> *'For freely flowing traffic, a difference of about 3dB in noise level is required before there is a statistically significant change in the average assessment of nuisance. The assessment of nuisance however could still be affected even if there is only a 1dB change in the noise level if the change is associated with changes in the view of traffic or if the change occurs suddenly.'*

17.2.33 This highlights that people are more sensitive to abrupt changes in traffic noise associated with new road schemes that would be predicted from steady state evidence. In the period following a change in traffic flow, people may experience adverse or beneficial effects when the noise changes are as small as 1dB.

17.2.34 Section 3 of DMRB Noise and Vibration provides guidance on the magnitude of impacts for road traffic noise. The magnitude of impacts is considered for both the short-term and long-term. As stated above, a change in road traffic noise of 1dB $L_{A10,18h}$ in the short-term, for example, when a project is opened, is the smallest that is considered perceptible. In the long-term, a change in road traffic noise levels of 3dB $L_{A10,18h}$ is considered perceptible. The classification of noise impacts is detailed in Table 17.3 and Table 17.4, below reproduced from DMRB Noise and Vibration Tables 3.1 and 3.2 (The Highways Agency et al., 2011).

Table 17.3: Short-term road traffic noise level magnitude of impacts

Noise Level Change (rounded to 0.1dB) $L_{A10, 18h}$	Magnitude of Impact
0.0	No Change
0.1 – 0.9	Negligible
1.0 – 2.9	Minor
3.0 – 4.9	Moderate
5.0+	Major

Table 17.4: Long-term road traffic noise level magnitude of impacts

Noise Level Change (rounded to 0.1dB) $L_{A10, 18h}/L_{night,outside}$	Magnitude of Impact
0.0	No Change
0.1 – 2.9	Negligible
3.0 – 4.9	Minor
5.0 – 9.9	Moderate
10.0+	Major

17.2.35 DMRB Noise and Vibration does not differentiate between adverse and beneficial impacts. It is assumed that any increase in noise level would have an adverse impact, while any decrease in noise level would have a beneficial impact.

Significance of Noise Impacts

17.2.36 The short and long-term significance of operational road traffic noise impacts are then determined according to the relationship between the magnitude of noise level change and the noise sensitivity of the receptor, as shown in Table 17.5 (reproduced from TAN Table 2.6, Scottish Government, 2011b).

Table 17.5: Significance of noise impacts

Sensitivity / Magnitude	Low	Medium	High
Major	**Slight/Moderate**	**Moderate/Large**	**Large/Very Large**
Moderate	Slight	**Slight/Moderate**	**Moderate/Large**
Minor	Neutral/Slight	Slight	**Slight/Moderate**
Negligible	Neutral/Slight	Neutral/Slight	Slight
No Change	Neutral	Neutral	Neutral

17.2.37 The EIA Regulations (refer to Chapter 6: Overview of Assessment Process) require consideration of the 'likely significant effects', but do not provide a definition of what constitutes a significant environmental effect as this is determined according to the environmental parameter under consideration, and in the context in which the relevant assessment is made. For the purposes of this assessment and when identifying mitigation requirements, impacts were considered to be 'significant', under the EIA Regulations, where the assessment results indicated impacts of Slight/Moderate adverse or worse significance (shown in bold in Table 17.5) and where the predicted absolute noise level also exceeds 59.5dB $L_{A10,18h}$ at ground floor level. For night-time noise levels, impacts were considered to be 'significant' where the assessment results indicated impacts of Slight/Moderate adverse or worse significance and where the predicted absolute noise level also exceeds 55.0dB $L_{night,outside}$ at ground and/or first floor. The reasoning for the absolute noise level is discussed in more detail below. Significant impacts, as defined in bold above, are highlighted in bold through the remainder of this chapter.

Noise Mitigation Threshold Criteria

17.2.38 Mitigation would be implemented, where practicable, where the noise impact is of 'Slight/Moderate Adverse' or worse significance of noise impact at ground floor for either short or long-term impacts.

This is an onerous target as mitigation would therefore be considered where there is an increase of greater than 1dB in the short-term (in recognition of the sudden change effects as reported within DMRB Noise and Vibration), or 3dB in the long-term, irrespective of the absolute existing ambient noise level and should be applied with caution in areas where there are existing low levels of ambient noise.

17.2.39 For guidance on the effects of noise, reference can be made to the current WHO document entitled 'Community Noise' (WHO, 1999). This document does not contain recommendations, but provides guideline values based on the precautionary principle. The WHO document states that:

> '*To protect the majority of people from being seriously annoyed during the daytime, the outdoor sound level from steady, continuous noise should not exceed 55dB L_{Aeq}[4] on balconies, terraces and in outdoor living areas. To protect the majority of people from being moderately annoyed during the daytime, the outdoor sound level should not exceed 50dB L_{Aeq}. Where it is practical and feasible, the lower outdoor sound level should be considered the maximum desirable sound level for new development*'.

17.2.40 For the purposes of this noise impact assessment, mitigation is considered where the noise level exceeds 55dB $L_{Aeq,T}$. The WHO refers to a daytime time base of 16 hours ($L_{Aeq,16h}$), and CRTN predictions are in terms of $L_{A10,18h}$. To convert the WHO $L_{Aeq,16h}$ to $L_{A10,18h}$ a correction of approximately +2dB is required (Transport Appraisal Guidance Unit A3 (Department for Transport, 2015)), with a further +2.5dB necessary to translate into façade levels. When this conversion is applied to 55dB $L_{Aeq,16h}$, this results in an equivalent threshold façade level of 59.5dB $L_{A10,18h}$.

17.2.41 In addition, it is necessary that in all cases where it is considered, mitigation should comply with acceptable standards in terms of traffic, safety, environmental and economic issues (DMRB Volume 11, Section 3, Part 7, Chapter 4 – Design and Mitigation, Paragraph 4.10). Considerations which could preclude the use of mitigation are disproportionate cost, unacceptable visual impact and road safety.

17.2.42 Due to the increasing use of the strategic road network by long distance goods traffic during night-time hours and the associated potential to increase the level of noise and the potential for disturbance at night, a night-time noise impact assessment is now to be considered as part of the DMRB Noise and Vibration assessment process where the noise level is greater than 55dB $L_{night,outside}$ in any scenario. The $L_{night,outside}$ noise metric is the free-field A-weighted average sound level over the 8 hour night-time period of 23:00 – 07:00 hours.

17.2.43 The Transport Research Laboratory (TRL) report 'Converting the UK traffic noise index $L_{A10,18h}$ to EU noise indices for noise mapping' (Abbott & Nelson, 2002) has been used to derive the night-time noise levels for each scenario using Method 3 of the TRL report which converts the predicted daytime noise levels ($L_{A10,18h}$) to equivalent $L_{night,outside}$.

17.2.44 In summary, taking into account the above WHO and DMRB Noise and Vibration guidance, mitigation is considered where the significance of impact at a NSR has been assessed as Slight/Moderate Adverse or worse, and where the predicted façade level exceeds 59.5dB $L_{A10,18h}$ at ground floor level. In addition, mitigation taking cognisance of the WHO Night Noise Guidelines for Europe (WHO, 2009) publication has also been considered during the night-time period in the long-term where the significance of impact at a NSR has been assessed as Slight/Moderate Adverse or worse, and where the predicted noise level exceeds 55dB $L_{night,outside}$ at ground and first floor levels.

17.2.45 In general, mitigation will be considered in terms of NSR specific measures that could comprise of acoustic screens of various forms and/or revised earthworks. This can be summarised as shown in Table 17.6. The use of low noise road surfacing is embedded in the design of the proposed scheme.

[4] The $L_{Aeq,T}$ noise index is the equivalent continuous A-weighted sound pressure level and is further defined in Appendix A17.1

Table 17.6: Summary of general aim of measures employed to address potential noise impacts

Type of Measure	Description
Prevent	Where practicable, road aligned to avoid closely populated areas
Reduce	Construction of noise barriers, earthwork bunds and the use of low noise road surfacing will reduce the predicted road traffic noise levels
Offset	A list of properties that may be eligible for noise insulation in terms of the NISR due to the increase in noise caused by the new road will be drawn up and assessed prior to construction.

Noise Nuisance Assessment

17.2.46 The term 'nuisance' is defined in Paragraph A.5.3 of DMRB Noise and Vibration as "*the percentage of people bothered by traffic noise (i.e. those who say they are 'very much' or 'quite a lot' bothered on a four point scale*)", and should not be confused with statutory nuisance. The response to noise by individuals varies widely. However, average or community response is deemed to be relatively stable, with community average degree of annoyance, associated with long-term average exposure. Consequently, change in average noise emission levels between assessed scenarios, together with estimates of population density, based on residential property counts and assumptions on the numbers of residents per property, enable changes in estimated populations annoyed to be determined.

17.2.47 DMRB Noise and Vibration advises the following noise nuisance assessments should be undertaken:

- Do-Minimum scenario in the baseline year against Do-Minimum scenario in the future assessment year; and
- Do-Minimum scenario in the baseline year against Do-Something scenario in the future assessment year.

17.2.48 DMRB Noise and Vibration (Paragraph A1.29) advises that the change in DMRB Noise and Vibration defined noise nuisance should be carried out for each property where noise calculations have been undertaken. Due to variability in individual responses, DMRB Noise and Vibration recommends that community annoyance ratings are used for each noise level. It is therefore important to note that the results of the DMRB Noise and Vibration nuisance assessment should not be related to individual annoyance responses.

17.2.49 The method of assessing traffic noise and vibration nuisance is presented in Annex 6 of DMRB Noise and Vibration.

Noise Insulation Assessment

17.2.50 Although it is not a requirement of DMRB Noise and Vibration, consideration has also been given for the number of properties that are likely to be eligible for statutory insulation. The NISR provide for acoustic insulation to be offered for residential properties. The qualifying criteria are detailed within the NISR and within the Memorandum on the Noise Insulation (Scotland) Regulations 1975, Regulations 3 and 6 (HMSO, 1975b). The qualifying criteria, which all must be met, are as follows:

- the properties are situated within 300m of the new or altered carriageway;
- the properties lie within the triangular area at the terminal point of the new road, the apexes of which are 50m along the centreline of the existing road form the terminal point of the bases of which extend from points 300m on either side of the road to the nearest point on the carriageway, at right angles to the centreline of the carriageway;
- a straight line can be drawn from any point of the property to a point on the carriageway without passing another building;
- the use of the road causes, or is expected to cause, noise at a level not less than 68dB(A); and
- the property will experience noise levels exceeding the 'prevailing noise level' by at least 1.0dB(A).

17.2.51 A full NISR noise impact assessment is required within 12 months of the proposed scheme opening and again in the 5th, 10th and 15th year after the year of opening.

Vibration Assessment

17.2.52 DMRB Noise and Vibration requires an assessment of traffic induced vibration, including an assessment of the numbers of people bothered by airborne vibration (ground borne vibration has been scoped out as stated in Paragraph 17.1.10). It should be appreciated that the vibration assessments are for comparison only and, as such, are not indicative of an individual's responses. Also, only properties within approximately 40m of carriageways of all modelled roads which have predicted or measured road traffic noise levels greater than 58dB $L_{A10,18h}$ are included in the vibration assessment. This is because the DMRB Noise and Vibration vibration-bothered relationship is only validated up to a distance of 40m from carriageways (DMRB Noise and Vibration Paragraph 3.46).

17.2.53 DMRB Noise and Vibration requires that the following vibration assessments are undertaken:

- Do-Minimum scenario in the baseline year against the Do-Minimum scenario in the future assessment year (Do-Minimum); and
- Do-Minimum scenario in the baseline year against the Do-Something scenario in the future assessment year (Do-Something).

Consultation

17.2.54 The PKC Environmental Health Department and Planning Department was consulted regarding the baseline noise survey. Both the noise monitoring locations and the noise measurement procedure were agreed with an Environmental Health Officer from PKC via email letter on 24 August 2016 and 31 August 2016, prior to the surveys commencing.

Assessment Limitations

17.2.55 The road traffic noise prediction methodology of the NISR Memorandum has, through the publication of CRTN, been updated and improved. However, this update has yet to be incorporated into either the NISR or NISR Memorandum. DMRB Noise and Vibration notes that the NISR Memorandum methodology is to be used to determine NISR eligibility in Scotland. However, the prediction methodology employed in the DMRB assessment is based on the more detailed and accurate predictive methods set out in CRTN, supplemented with the additional guidance contained in Annex 4 of DMRB Noise and Vibration.

17.2.56 Therefore, to facilitate an indicative assessment of NISR noise insulation eligibility, a CRTN predicted level of 65dB $L_{A10,18h}$ has been used as a proxy for 68dB $L_{A10,18h}$, in conjunction with the other qualifying criteria.

17.2.57 In addition, there are limitations with undertaking a construction noise impact assessment, which are discussed fully in Section 17.4 (Potential Impacts).

17.3 Baseline Conditions

17.3.1 The baseline noise monitoring locations (listed in a south to north direction) are provided in Table 17.7 and also on Figure 17.2.

Table 17.7: Baseline noise monitoring locations

ID	Address	Grid Reference	
		Easting	Northing
R3.001	Warren Lodge, Ballinluig, PH9 0NS	300515	745690
R3.002	St Colme's, Ballinluig, PH9 0NR	300346	746894
R3.003	The Mill, Dowally, PH9 0NT	300428	747862
R3.004	1 Dowally Cottage, Dowally, PH9 0NT	300126	747978

ID	Address	Grid Reference	
		Easting	Northing
R3.005	Guay Farmhouse, Guay, PH9 0NP	299802	749142
R3.006	The Schoolhouse, Guay, PH9 0NX	300093	749240
R3.007	The Knoll, Guay, PH9 0NT	299836	749190
R3.008	Morven, Kindallachan, PH9 0NW	299393	750067
R3.009	Croftnascallaig Farmhouse, Ballinluig, PH9 0NN	299602	750247
R3.010	Haugh of Kilmorich, Ballinluig, PH9 0NN (two locations: near to A9 and back garden)	299083	750640
R3.011	Westhaugh of Tulliemet, Ballinluig, PH9 0NN	298647	751233

17.3.2 The noise survey was undertaken from 5 September 2016 to 10 October 2016, with the intention of capturing a minimum of two days of noise data in favourable weather conditions (i.e. light wind speeds and no rain). The actual period of monitoring varied between each property, but can be viewed in Appendix A17.2 (Detailed Baseline Noise Survey Results). At ten measurement locations noise monitoring equipment was left unattended within the garden area of the NSR. Although the monitoring was unattended, survey staff did visit each location for a period of 20 to 30 minutes in the morning, afternoon and evening periods during the measurement period in order to subjectively characterise the noise climate and make detailed notes on meteorological conditions. At Guay farmhouse a short-term 3 hour attended measurement was undertaken in accordance with the short-term measurement method described in CRTN.

17.3.3 Appendix A17.2 (Detailed Baseline Noise Survey Results) provides detailed site notes, photographs and noise levels measured at each of the monitoring locations. However, for ease of reference the average measured $L_{A10,18h}$, $L_{Aeq,16h}$ and $L_{night,outside}$ noise levels over the survey periods are summarised in Table 17.8 and Table 17.9.

Table 17.8: Summary of unattended baseline noise measurements, including periods of rainfall

ID	Address/Representative Location	Average Measured Noise Levels (dB)		
		$L_{A10,18h}$	$L_{Aeq,16h}$	$L_{night,outside}$
R3.001	Warren Lodge, Ballinluig, PH9 0NS	59.8	58.6	50.7
R3.002	St Colme's, Ballinluig, PH9 0NR	53.7	52.4	45.2
R3.003	The Mill, Dowally, PH9 0NT	58.0	57.7	57.4
R3.004	1 Dowally Cottage, Dowally, PH9 0NT	70.9	68.0	61.8
R3.005	Guay Farmhouse, Guay, PH9 0NP	73.3	-	-
R3.006	The Schoolhouse, Guay, PH90NX	43.7	50.7	41.4
R3.007	The Knoll, Guay, PH9 0NT	67.3	64.2	58.5
R3.008	Morven, Kindallachan, PH9 0NW	63.5	61.0	55.1
R3.009	Croftnascallaig Farmhouse, Ballinluig, PH9 0NN	52.9	52.3	44.2
R3.010a	Haugh of Kilmorich, Ballinluig, PH9 0NN (near to A9)	68.1	65.6	59.9
R3.010b	Haugh of Kilmorich, Ballinluig, PH9 0NN (back garden)	61.6	60.2	50.6
R3.011	Westhaugh of Tulliemet, Ballinluig, PH9 0NN	61.6	60.5	54.2

Table 17.9: Summary of unattended baseline noise measurements, excluding periods of rainfall

ID	Address/Representative Location	Average Measured Noise Levels (dB)		
		$L_{A10,18h}$	$L_{Aeq,16h}$	$L_{night,outside}$
R3.001	Warren Lodge, Ballinluig, PH9 0NS	59.8	57.5	50.5
R3.002	St Colme's, Ballinluig, PH9 0NR	53.9	51.9	45.2
R3.003	The Mill, Dowally, PH9 0NT	57.3	57.4	58.0
R3.004	1 Dowally Cottage, Dowally, PH9 0NT	71.3	67.7	61.6
R3.005	Guay Farmhouse, Guay, PH9 0NP	73.3	-	-
R3.006	The Schoolhouse, Guay, PH90NX	43.9	50.3	39.6
R3.007	The Knoll, Guay, PH9 0NT	67.3	63.9	58.4

ID	Address/Representative Location	Average Measured Noise Levels (dB)		
		$L_{A10,18h}$	$L_{Aeq,16h}$	$L_{night,outside}$
R3.008	Morven, Kindallachan, PH9 0NW	63.7	60.9	53.9
R3.009	Croftnascallaig Farmhouse, Ballinluig, PH9 0NN	53.0	53.2	44.1
R3.010a	Haugh of Kilmorich, Ballinluig, PH9 0NN (near to A9)	68.2	65.6	59.0
R3.010b	Haugh of Kilmorich, Ballinluig, PH9 0NN (back garden)	61.7	60.3	50.8
R3.011	Westhaugh of Tulliemet, Ballinluig, PH9 0NN	61.7	60.6	53.5

Comparison of Measured Noise levels with Modelled Predicted Noise Levels

17.3.4 To undertake a validation of the 3D CadnaA® noise model, modelled predicted noise levels were compared with the measured noise levels at the 11 sample receptors. The predicted noise levels of the existing road network were calculated using the assumptions previously discussed in Paragraph 17.2.28 and traffic data for BMDT 2015.

17.3.5 It should be noted that there will rarely be perfect agreement between predicted and measured noise levels as the predicted noise levels use traffic flow data for an 18-hour period and the measured levels also comprise of other noise sources other than road traffic noise. Accordingly, the measured noise levels are, in general, likely to be slightly higher than predicted noise levels. Table 17.10 provides a comparison between the predicted and measured noise levels.

Table 17.10 Modelled and predicted noise levels versus measured noise levels

ID	Address/Representative Location	Modelled Predicted Noise Level ($L_{A10,18h}$) (dB)	Measured Noise Level ($L_{A10,18h}$) (dB)	Noise Level Difference (dB)
R3.001	Warren Lodge, Ballinluig, PH9 0NS	63.9	59.8	+4.1
R3.002	St Colme's, Ballinluig, PH9 0NR	56.7	53.9	+2.8
R3.003	The Mill, Dowally, PH9 0NT	43.6	57.3	-13.7
R3.004	1 Dowally Cottage, Dowally, PH9 0NT	68.9	71.3	-2.4
R3.005	Guay Farmhouse, Guay, PH9 0NX	71.5	73.3	-1.8
R3.006	The Schoolhouse, Guay, PH9 0NT	40.6	43.9	-3.3
R3.007	The Knoll, Guay, PH9 0NT	65.0	67.3	-2.3
R3.008	Morven, Kindallachan, PH9 0NW	64.2	63.7	+0.5
R3.009	Croftnascallaig Farmhouse, Ballinluig, PH9 0NN	53.5	53.0	+0.5
R3.010a	Haugh of Kilmorich, Ballinluig, PH9 0NN (near to A9)	70.2	68.2	+2.0
R3.010b	Haugh of Kilmorich, Ballinluig, PH9 0NN (back garden)	62.3	61.7	+0.6
R3.011	Westhaugh of Tulliemet, Ballinluig, PH9 0NN	62.1	61.7	+0.4

The results in Table 17.10 show that at nine of the locations there is a reasonably good correlation (a difference of approximately 2dB) between the modelled predicted noise levels and the measured noise levels. At the three remaining locations the discrepancies between the measured and modelled levels are discussed in further detail below:

- At NSR R3.001 the difference between the predicted and measured noise levels is +4.1dB. A dense line of trees, approximately 45m deep, is situated between this NSR and the A9, shielding the view to the road, and it is considered likely that the tree belt identified is providing noise attenuation to R3.001. This would explain the difference in measured and predicted noise levels. DMRB Noise and Vibration details that the use of shrubs or trees as a noise barrier is effective only if the foliage is at least 10m deep, dense and consistent for the full height of the vegetation. DMRB Noise and Vibration makes reference to the Department for Transport (TRL) publication *'The use of vegetation for traffic noise screening'*. The TRL publication details that 10m of vegetation can result in a noise reduction of 5dB greater than grass or 8dB greater than a hard reflecting surface.
- At NSR R3.002 the difference between the predicted and measured noise levels is +2.8dB. A dense line of trees, approximately 50m deep, is situated between this NSR and the A9, shielding

the view to the road, and it is considered likely that the tree belt identified is providing noise attenuation to R3.001. This would explain the difference in measured and predicted noise levels.

- At NSR R3.003 the difference between the predicted and measured noise levels is -13.7dB. Further analysis of the measured noise levels indicated that the noise climate at this location was dominated by flowing water in Dowally Burn, approximately 15m to the north of the measurement location, as can be seen in the relationship between the measured $L_{Aeq,T}$, $L_{A90,T}$ and $L_{A10,T}$ noise levels (shown in Appendix 17.2).
- At NSR R3.006 the difference between the predicted and measured noise levels is -3.3dB. During the measurement period it was noted that the noise climate included the sound of flowing water in Sloggan Burn, approximately 10m to the south of the measurement location.

17.3.6 Based on the above, the modelled results were determined to be suitable for use and, as such, no amendments were made to the noise models.

17.4 Potential Impacts

Construction

17.4.1 Temporary impacts for road schemes normally occur between the start of advance works and the end of the construction period. Although temporary, construction-related noise and vibration impacts can be significant.

17.4.2 Construction work of any type that involves heavy plant activities will generate noise, which may result in complaints if sensitive scheduling and control of works is not exercised. The noise levels generated by construction activities and experienced by nearby NSR such as residential properties, depends upon a number of variables, the most notable of which are:

- the noise generated by plant or equipment used on site, generally expressed as sound power levels (SWL);
- the periods of operation of the plant on the site, known as its 'on-time';
- the distance between the noise source and the NSR; and
- the attenuation due to ground absorption, air absorption and barrier effects.

17.4.3 To evaluate the noise during the construction it is necessary to have knowledge of the various activities that would be undertaken. Contractors may use different working methods and plant to achieve the same ends. An accurate demolition and construction noise and vibration impact assessment is not normally possible until appointment of the approved Contractor with knowledge of the exact working routine and plant schedule. However, for any assessment undertaken during the construction phase, the use of plant, and the likely noise impact thereof, would be determined following the guidance detailed in BS 5228:2009+A1:2014 and, where necessary, mitigation would be provided. Moreover, should complaints be received from local residents, the local authority may determine whether the best practicable means to reduce noise and vibration impacts are being applied. Therefore, best practicable means would be employed to ensure that noise levels are minimised. Outline mitigation measures to reduce construction impacts can be found in Section 17.5 (Mitigation).

17.4.4 It is likely that the potentially worst affected NSR in respect of construction noise would be those located immediately adjacent to the proposed scheme, with lesser impacts at those properties located adjacent to the existing road network due to potential increase in HGV movements.

17.4.5 Disturbance due to construction noise from a proposed scheme of this sort, although it may be significant, is usually short-term since the period of noisy construction work is relatively limited and disturbance is normally reversed once the noisy parts of the construction phase are completed.

17.4.6 Although a quantitative assessment of construction noise impacts has not been undertaken, based on professional judgement it is not unreasonable to assume that, without mitigation, the significance of

construction noise impacts may result in temporary, short-term impacts of **Moderate/Large** Adverse significance at NSR closest to the works.

17.4.7 The 2008 version of DMRB Noise and Vibration previously advised that construction impacts should be considered by providing an estimate of the number of dwellings within 100m of the alignment of the proposed scheme. In practice, construction noise levels and resulting impacts are likely to vary during the different construction phases of the proposed scheme depending upon the works activities, location and proximity of receptors. There are 44 NSR within 100m of the indicative land made available for construction of the proposed scheme (detailed in Appendix A17.7: Noise Sensitive Receptors Closest to Construction Works), the closest of which are Guay Farm, 1 Dowally Cottage, Dowally Church, Bracken Cottage, Reviresco and East Dowally Farm.

17.4.8 Concern is often expressed by local residents that vibration from construction activities could cause structural damage to their properties. However, DMRB Noise and Vibration states that:

> *'it has been shown that vibrations that can be felt indoors and which often cause occupants anxiety are an order of magnitude smaller than would be needed to activate pre-existing strains and cause cracks to propagate. It should be borne in mind that superficial cracks in plaster around openings such as doors and windows can often appear during the life of a building'.*

17.4.9 Surface plant, such as cranes, compressors and generators, are not recognised as sources of high levels of environmental vibration. Also, it is generally accepted that without a highly detailed understanding of the media, waveform and frequency distribution, ground-borne vibration prediction methods are complex and beset with uncertainties. Whilst it is considered unlikely that typical road construction working methods would generate levels of vibration at local receptors above which cosmetic damage would be expected to be sustained, given the proximity of some NSR to the proposed scheme there is the potential that vibration impacts could cause complaints at the closest NSR. However, the level of impact at different receptors would be dependent upon a number of factors including the precise distance between the works and NSR, ground conditions and activities being undertaken at any given time. Based upon professional judgement at this stage, as a worst case and without mitigation in place, vibration impacts of up to **Moderate/Large** Adverse significance might be experienced by the nearest residents to the works.

17.4.10 Where heavy earthwork, piling, or other significant vibration producing operations are proposed in the vicinity of existing NSR, further consideration should be given to potential impacts once the main works Contractor is appointed and the construction requirements are developed. Potential mitigation measures are discussed in Section 17.5 (Mitigation).

Operation

Introduction

17.4.11 The modelled noise levels and the associated significance of impacts at the 11 sample NSR (identified in Table 17.7 and on Figure 17.2) are summarised in Tables 17.11 to 17.15. The results for all 107 NSR modelled, consisting of 103 residential dwellings and four other identified NSR (3 Hostel buildings at May Murray Memorial Camp and Dowally Church) are provided in Appendix A17.3 (Predicted Noise Levels at Noise Sensitive Receptors). The impacts reported include the mitigation embedded in the scheme design (see Paragraphs 17.5.2 and 17.5.3). In the following tables, where reference is made to the predicted daytime and night-time noise levels, the assessment has been undertaken at both the ground and first floors of all buildings. Noise contour change maps for the DM 2026 versus the DM 2041, the DM 2026 versus the DS 2026 and the DM 2026 versus the DS 2041 scenarios are provided on Figures 17.3 to 17.8. The assessment of noise impacts at known noise sensitive committed developments, ecological, archaeological and amenity spaces (i.e. core paths, recreational areas) have been considered separately due to the nature of these spaces and impacts are reported within Paragraphs 17.4.51 to 17.4.63, Appendix A17.4 (Noise Impacts on Committed Developments) and Appendix A17.5 (Noise Impacts on Amenity Areas).

17.4.12 It is important to note that the methodology in DMRB Noise and Vibration requires that the least beneficial change in noise level is reported. Accordingly, the DM 2026 noise levels in each of the tables may be different for the same sample NSR. This is because, for example, in the DM 2026

versus the DM 2041 scenario the least beneficial noise impact may occur at one receptor point of a property, whereas in the DM 2026 versus the DS 2026 or DS 2041 scenario a different receptor point of a property could experience the least beneficial noise impact.

Sample Noise Sensitive Receptors

Do-Minimum Scenario in the Baseline Year vs. Do-Minimum Scenario in the Future Assessment Year (Long-term Assessment)

17.4.13 The predicted noise levels at the sample NSR for the DM 2026 and the DM 2041 scenarios with the associated significance of impacts for the daytime period are presented in Table 17.11.

Table 17.11: Sample NSR – DM 2026 vs. DM 2041 – Day

ID	Property Name/ Representative Location	Predicted $L_{A10,18h}$ (dB) Noise Level (Façade) and Significance of Impact					
		Ground Floor			First Floor		
		DM 2026	DM 2041	Significance of Impact	DM 2026	DM 2041	Significance of Impact
R3.001	Warren Lodge	48.7	47.2	Slight Beneficial	64.6	63.0	Slight Beneficial
R3.002	St Colme's	51.6	51.5	Slight Beneficial	52.0	51.9	Slight Beneficial
R3.003	The Mill	46.5	47.2	Slight Adverse	47.8	48.5	Slight Adverse
R3.004	1 Dowally Cottage	70.6	72.0	Slight Adverse	70.8	72.2	Slight Adverse
R3.005	Guay Farmhouse	68.5	68.1	Slight Beneficial	69.9	69.5	Slight Beneficial
R3.006	The Schoolhouse	39.6	37.6	Slight Beneficial	41.8	39.7	Slight Beneficial
R3.007	The Knoll	57.6	56.9	Slight Beneficial	60.4	59.7	Slight Beneficial
R3.008	Morven	55.2	52.8	Slight Beneficial	58.1	56.2	Slight Beneficial
R3.009	Croftnascallaig Farmhouse	43.5	41.6	Slight Beneficial	45.3	43.3	Slight Beneficial
R3.010	Haugh of Kilmorich	61.4	60.6	Slight Beneficial	62.7	61.8	Slight Beneficial
R3.011	Westhaugh of Tulliemet	52.0	49.2	Slight Beneficial	53.7	50.8	Slight Beneficial

17.4.14 The results show that, should the proposed scheme not go ahead no sample NSR is considered to be significantly affected (i.e. an impact of Slight/Moderate Adverse or worse and an absolute noise level in excess of 59.5dB $L_{A10,18h}$). Moreover, with the exception of R3.003 and R3.004, all sample NSR are predicted to have a decrease in noise levels. These predicted noise level reductions are as a consequence of the replacement of the existing road surface with LNRS by 2041 should the proposed scheme not proceed, even though the traffic flow is predicted to increase. Two NSR are predicted to experience a Slight Adverse significance of impact, with the remaining properties experiencing a Slight Beneficial impact.

17.4.15 The analysis of night-time noise levels indicates that there are two sample NSR (1 Dowally Cottage and Guay Farmhouse) with noise levels in excess of 55dB $L_{night,outside}$, in the long-term without the proposed scheme. The night-time assessment results at these two sample NSR are shown in Table 17.12.

Table 17.12: Sample NSR – DM 2026 vs. DM 2041 – Night

ID	Property Name/ Representative Location	Predicted $L_{night,outside}$ (dB) Noise Level (Free-Field at Façade) and Significance of Impact					
		Ground Floor			First Floor		
		DM 2026	DM 2041	Significance of Impact	DM 2026	DM 2041	Significance of Impact
R3.004	1 Dowally Cottage	57.5	58.8	Slight Adverse	57.7	59.0	Slight Adverse
R3.005	Guay Farmhouse	55.6	55.3	Slight Beneficial	56.9	56.5	Slight Beneficial

17.4.16 Although there are two sample NSR with noise levels in excess of 55dB $L_{night,outside}$ these are not considered to be significant because for both sample NSR the significance of impact is not Slight/Moderate adverse or worse.

Do-Minimum Scenario in the Baseline Year vs. Do-Something Scenario in the Baseline Year (Short-term Assessment)

17.4.17 The predicted noise levels at the sample NSR for the DM 2026 and the DS 2026 scenarios with the associated significance of impacts for the daytime period are presented in Table 17.13.

Table 17.13: Sample NSR – DM 2026 vs. DS 2026 – Day (without NSR specific mitigation)

ID	Property Name/ Representative Location	Predicted $L_{A10,18h}$ (dB) Noise Level (Façade) and Significance of Impact					
		Ground Floor			First Floor		
		DM 2026	DS 2026	Significance of Impact	DM 2026	DS 2026	Significance of Impact
R3.001	Warren Lodge	48.7	49.4	Slight Adverse	67.9	68.3	Slight Adverse
R3.002	St Colme's	41.5	44.6	Moderate/Large Adverse	44.7	48.3	Moderate/Large Adverse
R3.003	The Mill	46.0	48.5	Slight/Moderate Adverse	47.2	49.6	Slight/Moderate Adverse
R3.004	1 Dowally Cottage	66.6	67.9	**Slight/Moderate** Adverse	67.1	68.9	Slight/Moderate Adverse
R3.005	Guay Farmhouse	47.1	47.7	Slight Adverse	49.9	50.5	Slight Adverse
R3.006	The Schoolhouse	45.8	47.5	Slight/Moderate Adverse	46.8	48.5	Slight/Moderate Adverse
R3.007	The Knoll	56.3	59.9	**Moderate/Large** Adverse	58.2	62.0	Moderate/Large Adverse
R3.008	Morven	54.8	55.0	Slight Adverse	58.1	58.8	Slight Adverse
R3.009	Croftnascallaig Farmhouse	43.5	44.4	Slight Adverse	45.3	46.2	Slight Adverse
R3.010	Haugh of Kilmorich	61.1	60.9	Slight Beneficial	62.7	63.3	Slight Adverse
R3.011	Westhaugh of Tulliemet	52.0	53.3	Slight/Moderate Adverse	53.7	54.6	Slight Adverse

17.4.18 The results show that at ground floor level and without mitigation there are six sample NSR with a significance of impact of Slight/Moderate Adverse or worse. However, only two of these NSR (1 Dowally Cottage and The Knoll) are predicted to have a DMRB Noise and Vibration predicted noise level (i.e. the least beneficial change in noise level) of greater than 59.5dB $L_{A10,18h}$. Accordingly, based on the least beneficial façade, only these NSR are considered to have significant impacts. Significant impacts at all façades, not only at the least beneficial façade, are considered in Section 17.5 (Mitigation).

17.4.19 It should be noted that a short-term night-time assessment of noise impacts in the year of opening is not required by DMRB Noise and Vibration.

Do-Minimum Scenario in the Baseline Year vs. Do-Something Scenario in the Future Assessment Year (Long-term Assessment)

17.4.20 The predicted noise levels at the sample NSR for the DM 2026 and the DS 2041 scenario with the associated significance of impacts for the daytime period are presented in Table 17.14.

Table 17.14: Sample NSR – DM 2026 vs. DS 2041 – Day (without NSR specific mitigation)

ID	Property Name/ Representative Location	Predicted $L_{A10,18h}$ (dB) Noise Level (Façade) and Significance of Impact					
		Ground Floor			First Floor		
		DM 2026	DS 2041	Significance of Impact	DM 2026	DS 2041	Significance of Impact
R3.001	Warren Lodge	48.7	49.6	Slight Adverse	67.5	68.2	Slight Adverse
R3.002	St Colme's	41.5	45.0	Slight/Moderate Adverse	44.7	48.6	Slight/Moderate Adverse
R3.003	The Mill	46.0	48.8	Slight Adverse	47.2	50.0	Slight Adverse
R3.004	1 Dowally Cottage	66.6	68.2	Slight Adverse	67.1	69.2	Slight Adverse
R3.005	Guay Farmhouse	47.1	47.9	Slight Adverse	49.9	50.8	Slight Adverse
R3.006	The Schoolhouse	45.8	47.8	Slight Adverse	46.8	48.8	Slight Adverse
R3.007	The Knoll	56.3	60.2	**Slight/Moderate** Adverse	58.2	62.3	Slight/Moderate Adverse
R3.008	Morven	54.8	55.3	Slight Adverse	58.1	59.2	Slight Adverse
R3.009	Croftnascallaig Farmhouse	43.5	44.6	Slight Adverse	45.3	46.4	Slight Adverse
R3.010	Haugh of Kilmorlich	61.1	61.3	Slight Adverse	62.7	63.7	Slight Adverse
R3.011	Westhaugh of Tulliemet	51.4	50.6	Slight Beneficial	53.0	52.1	Slight Beneficial

17.4.21 The results show that at ground floor level, without mitigation, there are two sample NSR with a significance of impact of Slight/Moderate Adverse or worse. However, only one NSR (The Knoll), is predicted to have a DMRB Noise and Vibration predicted noise level (i.e. the least beneficial change in noise level) of greater than 59.5dB $L_{A10,18h}$. Accordingly, based on the least beneficial façade, only The Knoll is considered to have a significant impact. Significant impacts at all façades, not only at the least beneficial façade, are considered in Section 17.5 (Mitigation).

17.4.22 The analysis of night-time noise levels indicates that there are two sample NSR (Warren Lodge and 1 Dowally Cottage) with noise levels in excess of $L_{night,outside}$ 55 dB, in the long-term without the proposed scheme. The night-time assessment results at these two dwellings are shown in Table 17.15.

Table 17.15: Sample NSR – DM 2026 vs. DS 2041 – Night (without NSR specific mitigation)

ID	Property Name/ Representative Location	Predicted $L_{night,outside}$(dB) Noise Level (Free Filed at Façade) and Significance of Impact					
		Ground Floor			First Floor		
		DM 2026	DS 2041	Significance of Impact	DM 2026	DS 2041	Significance of Impact
R3.001	Warren Lodge	37.8	38.6	Slight Adverse	54.7	55.4	Slight Adverse
R3.004	1 Dowally Cottage	53.9	55.4	Slight Adverse	54.4	56.3	Slight Adverse

17.4.23 Although there are two sample NSR with noise levels in excess of 55dB $L_{night,outside}$ these are not considered to be significant because for both sample NSR the significance of impact is not higher than Slight/Moderate Adverse.

Summary Tables for all NSR within 600m Calculation Area

Do-Minimum Scenario in the Baseline Year vs. Do-Minimum Scenario in the Future Assessment Year (Long-term Assessment)

17.4.24 In accordance with Table A1.2 DMRB Noise and Vibration, summaries of the magnitude of noise impacts at dwellings and other NSR for the daytime period at the ground and first floor for the DM 2026 scenario versus the DM 2041 scenario, are presented in Table 17.16. These tables include the predicted noise level change at all dwellings and other NSR (defined as `High' sensitivity in Table 17.2) within the 600m calculation area, and therefore provides a broader view of potential noise impacts than the sample NSR assessment tables (Tables 17.11 to 17.15).

Table 17.16: Summary – DM 2026 vs. DM 2041 – Daytime

Change in Noise Level $L_{A10,18h}$ dB		Magnitude of Impact	Ground Floor		First Floor	
			No. of Dwellings	No. of Other Sensitive Receptors	No. of Dwellings	No. of Other Sensitive Receptors
Increase (Adverse) in Noise Level	0.1 – 2.9	Negligible	22	1	21	1
	3.0 – 4.9	Minor	0	0	0	0
	5.0 – 9.9	Moderate	0	0	0	0
	10.0+	Major	0	0	0	0
No Change	0	No Change	1	0	2	0
Decrease (Beneficial) in Noise Level	0.1 – 2.9	Negligible	74	3	76	3
	3.0 – 4.9	Minor	6	0	4	0
	5.0 – 9.9	Moderate	0	0	0	0
	10.0+	Major	0	0	0	0

17.4.25 Table 17.16 shows the magnitude of impacts in accordance with DMRB Noise and Vibration. The results show that during the daytime period at ground floor and first floor levels, without the proposed scheme, no NSR is predicted to experience an increase in noise level of greater than negligible magnitude which is a Slight Adverse significance of impact. Accordingly, for the DM 2016 vs DM 2041 scenario there are no predicted to be no significant impacts at any NSR.

17.4.26 Six NSR at ground floor and four NSR at first floor are predicted to experience a decrease (beneficial) in noise level of minor magnitude. Accordingly, for the DM 2016 vs DM 2014 scenario a Slight/Moderate Beneficial significance of impact is predicted at these NSR.

17.4.27 The corresponding summary tables for the DM 2026 scenario versus the DM 2041 scenario, for the night-time period at the ground and first floor levels are presented in Table 17.17 and Table 17.18, respectively. In addition, the tables provide information on:

- the number of dwellings with noise levels below 55dB $L_{night,outside}$ in the DM 2026 scenario which increase to above 55dB $L_{night,outside}$ in the DM 2041 scenario;
- the number of dwellings with noise levels above 55dB $L_{night,outside}$ in both the DM 2026 and DM 2041 scenarios; and
- the number of dwellings with noise levels above 55dB $L_{night,outside}$ in the DM 2026 scenario which reduce to below 55dB $L_{night,outside}$ in the DM 2041 scenario.

17.4.28 It should be noted that n/a is reported when a condition cannot be met e.g. dwellings that have a night-time noise level less than 55dB $L_{night,outside}$ in the DM 2026 scenario cannot have a decrease in noise level if the DM 2041 noise level is greater than or equal to 55dB $L_{night,outside}$.

Table 17.17: Summary – Ground Floor DM 2026 vs. DM 2041 – Night

Change in Noise Level $L_{night,outside}$dB		Magnitude of Impact	No. of Dwellings	No. of Dwellings (DM 2026 < 55dB, DM 2041 ≥ 55dB)	No. of Dwellings (DM 2026 ≥ 55dB, DM 2041 ≥ 55dB)	No of Dwellings (DM 2026≥ 55dB, DM 2041 < 55dB)
Increase (Adverse) in Noise Level	0.1 – 2.9	Negligible	22	0	2	n/a
	3.0 – 4.9	Minor	0	0	0	n/a
	5.0 – 9.9	Moderate	0	0	0	n/a
	10.0+	Major	0	0	0	n/a
No Change	0	No Change	1	0	0	0
Decrease (Beneficial) in Noise Level	0.1 – 2.9	Negligible	80	n/a	1	0
	3.0 – 4.9	Minor	0	n/a	0	0
	5.0 – 9.9	Moderate	0	n/a	0	0
	10.0+	Major	0	n/a	0	0

Table 17.18: Summary – First Floor DM 2026 vs. DM 2041 – Night

Change in Noise Level $L_{night,outside}$dB		Magnitude of Impact	No. of Dwellings	No. of Dwellings (DM 2026 < 55dB, DM 2041 ≥ 55dB)	No. of Dwellings (DM 2026 ≥ 55dB, DM 2041 ≥ 55dB)	No of Dwellings (DM 2026≥ 55dB, DM 2041 < 55dB)
Increase (Adverse) in Noise Level	0.1 – 2.9	Negligible	21	0	3	n/a
	3.0 – 4.9	Minor	0	0	0	n/a
	5.0 – 9.9	Moderate	0	0	0	n/a
	10.0+	Major	0	0	0	n/a
No Change	0	No Change	2	0	0	0
Decrease (Beneficial) in Noise Level	0.1 – 2.9	Negligible	80	n/a	1	1
	3.0 – 4.9	Minor	0	n/a	0	0
	5.0 – 9.9	Moderate	0	n/a	0	0
	10.0+	Major	0	n/a	0	0

17.4.29 As can be seen in Table 17.17 and 17.18, during the night-time period, there are three NSR at ground floor level and five NSR at first floor level with a noise level in excess of 55dB $L_{night,outside}$, however, the significance of impact is not assessed as Slight/Moderate Adverse or worse. Accordingly, the predicted night-time noise levels are not considered to be significant.

Do-Minimum Scenario in the Baseline Year vs. Do-Something Scenario in the Baseline Year (Short-term Assessment)

17.4.30 In accordance with DMRB Noise and Vibration Table A1.1, a summary of the magnitude of noise impacts at all dwellings and other NSR (defined as `High' sensitivity in Table 17.2) within the 600m calculation area for the DM 2026 scenario versus the DS 2026 scenario, for the daytime period at ground and first floor are presented in Table 17.19. Note that in accordance with DMRB Noise and Vibration, assessment of night-time noise is not required for this 'short-term' assessment.

Table 17.19: Summary – DM 2026 vs. DS 2026 – Day (without NSR specific mitigation)

Change in Noise Level $L_{A10,18h}$ dB		Magnitude of Impact	Ground Floor		First Floor	
			No. of Dwellings	No. of Other Sensitive Receptors	No. of Dwellings	No. of Other Sensitive Receptors
Increase (Adverse) in Noise Level	0.1 – 0.9	Negligible	22	0	25	0
	1.0 – 2.9	Minor	67	3	63	4
	3.0 – 4.9	Moderate	2	1	4	0
	5.0+	Major	0	0	0	0
No Change	0	No Change	3	0	4	0
Decrease (Beneficial) in Noise Level	0.1 – 0.9	Negligible	7	0	5	0
	1.0 – 2.9	Minor	0	0	2	0
	3.0 – 4.9	Moderate	2	0	0	0
	5.0+	Major	0	0	0	0

17.4.31 A Slight/Moderate Adverse or worse significance of impact in the short-term is assessed at 69 dwellings and four other NSR where an increase (adverse) in noise level of minor magnitude or worse is predicted at ground floor level. Further analysis of the absolute noise levels at the least beneficial façade of these NSR (which can be found in Appendix A17.3) show that of these, 17 NSR have predicted noise levels in excess of 59.5dB $L_{A10,18h}$ and are therefore, unmitigated, considered to be significant. Significant impacts at all façades, not only at the least beneficial façade, are considered in Section 17.5 (Mitigation).

17.4.32 The results show that at ground floor level there are two dwellings that are predicted to have a decrease (beneficial) in noise level of moderate magnitude and so are predicted to have a significance of impact of Moderate/Large Beneficial or better in the short-term.

17.4.33 The 17 NSR where short-term adverse impacts are considered to be significant at ground level are presented in Table 17.20.

Table 17.20: NSR at Ground Floor Level Considered to be Significant (DM 2026 vs DS 2026 – Day (without mitigation))

NSR ID	NSR Name	Predicted $L_{A10,18h}$ (dB) Noise Level (Façade) and Significance of Impact		
		DM 2026	DS 2041	Significance of Impact
R3.004	1 Dowally Cottage	66.6	67.6	**Slight/Moderate** Adverse
R3.007	The Knoll	56.3	59.9	**Moderate/Large** Adverse
R3.026	Cherry Cottage	59.3	60.3	**Slight/Moderate** Adverse
R3.027	Vine Cottage	64.9	65.9	**Slight/Moderate** Adverse
R3.028	Briar Cottage	64.8	65.8	**Slight/Moderate** Adverse
R3.029	Smithy House	68.6	70.1	**Slight/Moderate** Adverse
R3.036	Tummelferry	58.7	59.9	**Slight/Moderate** Adverse
R3.037	2 Station Cottages	62.4	63.4	**Slight/Moderate** Adverse
R3.039	3 Station Cottages	61.6	62.6	**Slight/Moderate** Adverse
R3.041	Dalnabo Steading	64.2	65.5	**Slight/Moderate** Adverse
R3.042	Dalnabo Farm Cottage	70.4	71.7	**Slight/Moderate** Adverse
R3.043	Inch of Tulliemet Farm	66.5	69.0	**Slight/Moderate** Adverse
R3.044	Inch Cottage	65.7	67.6	**Slight/Moderate** Adverse
R3.046	Dalnabo Farmhouse	67.6	68.9	**Slight/Moderate** Adverse
R3.075	2 Dowally Cottage	60.1	61.2	**Slight/Moderate** Adverse
R3.076	Reviresco	58.6	60.1	**Slight/Moderate** Adverse
R3.081	Dowally Church	63.2	65.6	**Slight/Moderate** Adverse

17.4.34 At first floor level there are 67 dwellings and four other NSR that are predicted to have a significance of impact of Slight/Moderate Adverse or worse in the short-term. At first floor level there are two NSR that are predicted to have a significance of impact of Slight/Moderate Beneficial or better in the short-term.

Do-Minimum Scenario in the Baseline Year vs. Do-Something Scenario in the Future Assessment Year (Long-term Assessment)

17.4.35 In accordance with Table A1.2 DMRB Noise and Vibration, summaries of the magnitude of noise impacts at all dwellings and other NSR (defined as `High' sensitivity in Table 17.2) within the 600m calculation area for the DM 2026 scenario versus the DS 2041 scenario, for the daytime period at ground and first floor are presented in Table 17.21.

Table 17.21: Summary –DM 2026 vs. DS 2041 – Day (without NSR specific mitigation)

Change in Noise Level $L_{A10,18h}$ dB		Magnitude of Impact	Ground Floor		First Floor	
			No. of Dwellings	No. of Other Sensitive Receptors	No. of Dwellings	No. of Other Sensitive Receptors
Increase (Adverse) in Noise Level	0.1 – 2.9	Negligible	76	3	68	3
	3.0 – 4.9	Minor	2	1	5	1
	5.0 – 9.9	Moderate	0	0	0	0
	10.0+	Major	0	0	0	0
No Change	0	No Change	5	0	7	0
Decrease (Beneficial) in Noise Level	0.1 – 2.9	Negligible	19	0	23	0
	3.0 – 4.9	Minor	1	0	0	0
	5.0 – 9.9	Moderate	0	0	0	0
	10.0+	Major	0	0	0	0

17.4.36 A Slight/Moderate Adverse or worse significance of impact in the long-term is assessed at two dwellings and one other NSR where an increase (adverse) in noise level of minor magnitude is predicted at ground floor level. Further analysis of the absolute noise levels at the least beneficial façade of these NSR (which can be found in Appendix A17.3) show that one of these NSR (The Knoll) has a predicted noise level in excess of 59.5dB $L_{A10,18h}$ and is therefore considered to be significant. Significant impacts at all façades, not only at the least beneficial façade, are considered in Section 17.5 (Mitigation).

17.4.37 At first floor level there are five dwellings and one other NSR which are predicted to have a significance of impact of Slight/Moderate Adverse or worse.

17.4.38 The corresponding summary tables for the DM 2026 scenario versus the DS 2041 scenario, for the night-time period at the ground and first floor levels are presented in Table 17.22 and Table 17.23, respectively. These tables provide the magnitude of impacts for all dwellings within the 600m calculation area. In addition, the tables provide information on:

- the number of dwellings with noise levels below 55dB $L_{night,outside}$ in the DM 2026 scenario which increase to above 55dB $L_{night,outside}$ in the DS 2041 scenario;
- the number of dwellings with noise levels above 55dB $L_{night,outside}$ in both the DM 2026 and DS 2041 scenarios; and
- the number of dwellings with noise levels above 55dB $L_{night,outside}$ in the DM 2026 scenario which reduce to below 55dB $L_{night,outside}$ in the DS 2041 scenario.

Table 17.22: Summary – Ground Floor DM 2026 vs. DS 2041 – Night (without NSR specific mitigation)

Change in Noise Level $L_{night,outside}$dB		Magnitude of Impact	No. of Dwellings	No. of Dwellings (DM 2026 < 55dB, DS 2041 ≥ 55dB)	No. of Dwellings (DM 2026 ≥ 55dB, DS 2041 ≥ 55dB)	No of Dwellings (DM 2026≥ 55dB, DS 2041 < 55dB)
Increase (Adverse) in Noise Level	0.1 – 2.9	Negligible	76	1	1	n/a
	3.0 – 4.9	Minor	2	0	0	n/a
	5.0 – 9.9	Moderate	0	0	0	n/a
	10.0+	Major	0	0	0	n/a
No Change	0	No Change	5	0	0	0
Decrease (Beneficial) in Noise Level	0.1 – 2.9	Negligible	19	n/a	0	1
	3.0 – 4.9	Minor	1	n/a	0	0
	5.0 – 9.9	Moderate	0	n/a	0	0
	10.0+	Major	0	n/a	0	0

Table 17.23: Summary – First Floor DM 2026 vs. DS 2041 – Night (without NSR specific mitigation)

Change in Noise Level $L_{night,outside}$dB		Magnitude of Impact	No. of Dwellings	No. of Dwellings (DM 2026 < 55dB, DS 2041 ≥ 55dB)	No. of Dwellings (DM 2026 ≥ 55dB, DS 2041 ≥ 55dB)	No of Dwellings (DM 2026≥ 55dB, DS 2041 < 55dB)
Increase (Adverse) in Noise Level	0.1 – 2.9	Negligible	68	3	1	n/a
	3.0 – 4.9	Minor	4	0	0	n/a
	5.0 – 9.9	Moderate	0	0	0	n/a
	10.0+	Major	0	0	0	n/a
No Change	0	No Change	7	0	0	0
Decrease (Beneficial) in Noise Level	0.1 – 2.9	Negligible	24	n/a	2	1
	3.0 – 4.9	Minor	0	n/a	0	0
	5.0 – 9.9	Moderate	0	n/a	0	0
	10.0+	Major	0	n/a	0	0

17.4.39 As can be seen in Table 17.22 and Table 17.23 during the night-time period, there are three NSR at ground floor level and seven NSR at first floor level with a noise level in excess of 55dB $L_{night,outside}$. However, the increase (adverse) in noise levels are no greater than a negligible magnitude and so the

significance of impact is not assessed as Slight/Moderate adverse or worse. Accordingly, the predicted night-time noise levels are not considered to be significant.

Health and Educational Establishments

17.4.40 There are no identified health or education buildings within the calculation area.

Noise Nuisance

17.4.41 Table 17.24 summarises the comparison of noise nuisance, between two scenarios: DM 2026 scenario versus the DM 2041 scenario and the DM 2026 scenario versus the DS 2041 scenario, which illustrates the potential noise nuisance impacts at all dwellings.

Table 17.24: Summary of Traffic Noise Nuisance (without NSR specific mitigation)

Change in Traffic Induced Noise Nuisance		Number of Dwellings			
		Ground Floor		First Floor	
		DM2026 vs DM2041	DM2026 vs DS2041	DM2026 vs DM2041	DM2026 vs DS2041
Increase (Adverse) in Noise Nuisance	< 10%	21	11	21	9
	10 < 20%	0	17	0	18
	20 < 30%	0	70	0	68
	30 < 40%	0	2	0	4
	> 40%	0	0	0	0
No Change	0%	26	1	10	2
Decrease (Beneficial) in Noise Nuisance	< 10%	56	2	72	2
	10 < 20%	0	0	0	0
	20 < 30%	0	0	0	0
	30 < 40%	0	0	0	0
	> 40%	0	0	0	0

17.4.42 Table 17.24 shows that there is an increase in noise nuisance with the proposed scheme compared to without the proposed scheme.

17.4.43 Without the proposed scheme, at ground floor level there are 21 dwellings with an adverse change in noise nuisance, 26 dwellings are predicted to experience no change in noise nuisance and 56 dwellings are predicted to have a beneficial change in noise nuisance. These predicted decreases in noise nuisance are as a consequence of the replacement of the existing road surface with LNRS by 2041 should the proposed scheme not proceed, even though the traffic flow is predicted to increase. With the proposed scheme, 100 dwellings are predicted to have an increase in noise nuisance with the majority experiencing an increase in noise nuisance in the 20 – 30% increase noise nuisance band. One dwelling is predicted to experience no change in noise nuisance and two dwellings are predicted to have a beneficial change in noise nuisance. Similar impacts are predicted to occur at the first floor of these dwellings.

Vibration Nuisance

17.4.44 When determining vibration nuisance, Figures A6.1 and A6.2 of DMRB Noise and Vibration have been used to determine the percentage of people bothered by traffic vibration. This is based on the predicted noise levels and the percentage of people bothered (very much or quite a lot) by vibration nuisance for the DM 2026 scenario versus the DM 2041 scenario, and the DM 2026 scenario versus the DS 2041 scenario. These scenarios have been determined and summarised in Table 17.25 for all dwellings that are within 40m of all modelled roads with a predicted noise level greater than 58dB $L_{A10,18h}$.

Table 17.25: Summary of Traffic Induced Airborne Vibration Nuisance (without NSR specific mitigation)

Change in Traffic Induced Airborne Vibration Nuisance		Number of Dwellings			
		Ground Floor		First Floor	
		DM2026 vs DM2041	DM2026 vs DS2041	DM2026 vs DM2041	DM2026 vs DS2041
Increase (Adverse) in Vibration Nuisance	< 10%	9	1	9	0
	10 < 20%	0	6	0	7
	20 < 30%	0	10	0	11
	30 < 40%	0	0	0	0
	> 40%	0	0	0	0
No Change	0%	8	2	7	1
Decrease (Beneficial) in Vibration Nuisance	< 10%	4	2	5	2
	10 < 20%	0	0	0	0
	20 < 30%	0	0	0	0
	30 < 40%	0	0	0	0
	> 40%	0	0	0	0

17.4.45 With regard to airborne traffic induced vibration, there is an increase in the vibration nuisance with the proposed scheme compared to without the proposed scheme.

17.4.46 Without the proposed scheme at ground floor level there are nine dwellings with an adverse change in vibration nuisance, eight dwellings with no change in vibration nuisance and four dwellings with a beneficial change in airborne vibration nuisance. With the proposed scheme, 17 dwellings are predicted to have an increase in airborne vibration nuisance with the majority experiencing an increase in the 10 - 20% and 20 - 30% vibration nuisance bands. Two dwellings are predicted to experience no change in airborne vibration nuisance and two dwellings are predicted to experience a decrease in vibration nuisance. Similar impacts are predicted to occur at the first floor of these dwellings.

Noise Insulation

17.4.47 As noted in Paragraph 17.2.50, Regulation 3 of the NISR confers a duty on the roads authorities, in certain instances, to offer insulation to eligible residential properties affected by noise.

17.4.48 The indicative assessment, as defined in Paragraph 17.2.50, has indicated that there are six dwellings which may be eligible for noise insulation:

- 1 Dowally Cottage;
- The Knoll;
- East Dowally Farm Cottage;
- 2 Dowally Cottage;
- Reviresco; and
- Bracken Cottage.

Qualitative Assessment (for NSR between 600m – 1km)

17.4.49 In the short-term assessment, the vast majority of NSR that are located outwith the 600m calculation area but within the 1km study area would be predicted to be experience an impact of Slight Beneficial or Slight Adverse significance. However, for NSR located outwith the 600m calculation area but within the 1km study area, which are past the end of the proposed scheme to 1km south or north along the existing A9 may experience impacts of Slight/Moderate Adverse significance. It should be noted that given these NSR would be at least 600m from the A9 then absolute noise levels as a consequence of the proposed scheme would be predicted to be low and would therefore not be significant.

17.4.50 In the long-term assessment, all NSR that are located outwith the 600m calculation area but within the 1km study area would be predicted to experience impacts of Slight Beneficial or Slight Adverse significance. This is a consequence of all existing stretches of the A9 being resurfaced with low noise road surfacing in the future assessment year

Committed Development

17.4.51 Committed Developments are extant planning applications that have been received or determined by the local planning authority in the last three years.

17.4.52 With regards to committed development, the potential noise impact on four noise sensitive committed development areas have been assessed. Full details of the potential noise impacts are provided in Appendix A17.4 (Noise Impacts on Committed Developments). This appendix provides tables reporting the percentage of the committed development area subject to a change in free-field noise level.

17.4.53 In the long-term without the proposed scheme, all committed developments are predicted to have a decrease in noise levels.

17.4.54 With the proposed scheme, two committed developments (Tay View Lodges, Guay (planning application number 15/00937/FLL) and Land 30 Metres North of St Colme's (planning application number 17/01574/IPL)), are predicted to experience a potential significance of impact of **Slight/Moderate** Adverse across up to 1.0% of the development sites, in the short-term. All other committed developments are not predicted to experience a potential significance of impact of **Slight/Moderate** Adverse or worse.

Amenity Areas

17.4.55 There are 16 amenity areas (e.g. SSSI, SAC) and 47 amenity lines (e.g. Core Paths, Rights of Way) which have been identified within the calculation area. Details of the potential noise impacts are provided in Appendix A17.5 (Noise Impacts on Amenity Areas).

17.4.56 As with the committed developments, Appendix A17.5 (Noise Impacts on Amenity Areas) provides a summary table reporting the percentage area/length of each amenity area/line subject to a change in free-field noise level.

17.4.57 In the long-term without the proposed scheme all amenity areas and amenity lines are predicted to be exposed to a noise level decrease or an increase of less than 3dB.

17.4.58 The noise impacts on amenity areas/lines in the short-term, with the proposed scheme, are summarised in Table 17.26. It should be noted that this table highlights the least beneficial impacts of the proposed scheme, as the change in noise level over the total area/length will vary. Therefore, this table should be read in conjunction with the tables in Appendix A17.5 (Noise Impacts on Amenity Areas) to gain a full understanding of the potential impacts.

Table 17.26: Summary of noise impacts on amenity areas in the short-term with the proposed scheme (with mitigation)

Amenity Area Noise Impact Assessment	Number of Amenity Areas/Lines								
	Increase in Noise Level				No Change	Decrease in Noise Level			
	x ≥ 5dB	3 ≤ x < 5dB	1 ≤ x < 3dB	0 < x < 1dB	X = 0dB	-1 < x < 0dB	-3 < x ≤ -1dB	-5 < x ≤ -3dB	X ≤ -5dB
Amenity Areas	1	1	5	6	0	0	2	1	0
Amenity Lines	12	4	19	5	0	6	1	0	0

17.4.59 In the short-term with the proposed scheme, nine amenity areas are predicted to be exposed to a noise level decrease or an increase of less than 1dB. There are five amenity areas that are predicted to be at least partially exposed to a noise level increase of between 1 – 3dB. One amenity area is predicted to be partially exposed to a change in noise level increase in excess of 5dB.

17.4.60 In the short-term with the proposed scheme, 11 amenity lines are predicted to be exposed to a decrease in noise level or an increase of less than 1dB. There are 19 amenity lines that are predicted to be at least partially exposed to a noise level increase of between 1 – 3dB. There are four amenity lines that are predicted to be at least partially exposed to a noise level increase of between 3 – 5 dB and there are 12 amenity lines that are predicted to be at least partially exposed to a noise level increase of between 5 – 10dB.

17.4.61 Table 17.27 summarises similar impacts in the long-term, with the proposed scheme.

Table 17.27: Summary of noise impacts on amenity areas in the long-term with the proposed scheme (with mitigation)

Amenity Area Noise Impact Assessment	Number of Amenity Areas/Lines								
	Increase in Noise Level				No Change	Decrease in Noise Level			
	x ≥ 10dB	5 ≤ x < 10dB	3 ≤ x < 5dB	0 < x < 3dB	X = 0dB	-3 < x < 0dB	-5 < x ≤ -3dB	-10 < x ≤ -5dB	X ≤ -10dB
Amenity Areas	0	1	0	12	0	2	1	0	0
Amenity Lines	0	9	5	21	0	12	0	0	0

17.4.62 In the long-term with the proposed scheme 15 amenity areas are predicted to be exposed to a decrease in noise level or an increase of less than 3dB. A single amenity area is predicted to be at least partially exposed to a noise level increase of between 5 – 10dB. No amenity areas are predicted to be exposed to an increase in noise level in excess of 10dB.

17.4.63 In the long-term with the proposed scheme 33 amenity lines (e.g. core paths, cycle paths) are predicted to be exposed to a decrease in noise level or an increase of less than 3dB. There are five amenity lines that are predicted to be at least partially exposed to a noise level increase of between 3 – 5dB. There are nine amenity lines that are predicted to be at least partially exposed to a noise level increase of between 5 – 10dB. No amenity lines are predicted to be exposed to an increase in noise level in excess of 10dB.

17.5 Mitigation

17.5.1 Mitigation measures for the proposed scheme in relation to noise and vibration are detailed below and take into account best practice, legislation, guidance and professional experience. This chapter makes reference to overarching standard measures applicable across A9 dualling projects ('SMC' mitigation item references), and also to noise-specific mitigation ('P03' mitigation item references). Those that specifically relate to noise and vibration are assigned a 'NV' reference.

Embedded Mitigation

17.5.2 The proposed scheme requires the construction of cuttings and embankments (collectively referred to as 'earthworks'). Earthworks of the proposed scheme have been included within the 3D noise model. Although no earthworks were included within the design specifically to provide mitigation to NSR, the proposed earthworks in some locations will offer a greater degree of noise attenuation than if they were not included.

17.5.3 In addition, as part of the proposed scheme, all mainline and slip roads will be surfaced with a low noise road surfacing material. According to DMRB Noise and Vibration this can reduce noise levels by approximately 3.5dB $L_{A10,18h}$ when compared with conventional hot rolled asphalt surfacing of 2mm texture depth, although this is only valid for sections of the proposed scheme with traffic speeds of at least 75km/h. For sections of the proposed scheme with traffic speeds below 75km/h, for example some sections of slip roads, noise levels would only be reduced by approximately 1dB $L_{A10,18h}$.

Standard Mitigation

17.5.4 A Construction Environmental Management Plan (CEMP) will be prepared by the Contractor (**Mitigation Item SMC-S1)**. The CEMP will set out how the Contractor intends to operate the construction site, including construction-related mitigation measures. The relevant section(s) of the

CEMP will be in place prior to the start of construction work and will cover a range of aspects including noise and vibration.

17.5.5 Prior to construction a suitably qualified Environmental Clerk of Works (EnvCoW) will be appointed by the Contractor (**Mitigation Item SMC-S2)**. The EnvCoW(s) will report to the Environmental Coordinator and be present on site, as required, during the construction period to monitor the implementation of the mitigation measures identified and ensure that activities are carried out in such a manner to prevent or reduce impacts on the environment. This would involve the ENVCoW(s) ensuring the contractor is adhering to the mitigation measures set out in **Mitigation Item SMC-NV2**.

17.5.6 As previously stated, at this stage of the proposed scheme, detailed methods and programming of work and type of plant likely to be employed during the construction phase is not fully known. A scheme of noise and vibration monitoring will therefore be agreed with the PKC Environmental Health Department, and noise and vibration limits will be contained within the CEMP (refer to **Mitigation Item SMC-S1**). The contractor will be required to develop and implement a Noise and Vibration Management Plan to meet these requirements. The assessment will include the design of any necessary NSR specific construction mitigation over and above the standard mitigation included within this ES chapter (**Mitigation Item SMC-NV1**).

17.5.7 The following mitigation measures, as recommended in BS 5228:2009+A1:2014, would be employed to minimise the noise impacts during the construction phase:

Community Relations

17.5.8 In accordance with Table 1 of Chapter 21 (Schedule of Environmental Commitments), throughout the construction period the Contractor will contribute towards the overall communications strategy for the A9 Dualling Programme (**Mitigation Item SMC-S3**), which will assist in mitigation of noise and vibration, for example by providing forewarning of impending noisy activities and a feedback mechanism for any concerns to be raised. As part of the communications strategy the Contractor will appoint a community liaison officer supported by a liaison team as necessary who will:

- liaise with the following: relevant local authorities; other statutory bodies and regulatory authorities; community councils and relevant community groups; and businesses and residents in local communities affected by the construction works;
- notify occupiers of nearby properties a minimum of two weeks in advance of the nature and anticipated duration of planned construction works that may affect them;
- support the production of project communications such as the project website and newsletters; and
- establish a dedicated freephone telephone helpline together with a dedicated email address and postal address for enquiries and complaints during the construction phase. The relevant contact numbers, email and postal addresses will as a minimum be displayed on signs around the construction site and will be published on the project website. Enquiries and complaints will be logged in a register and appropriate action will be taken in response to any complaints.

Training of Employees

17.5.9 The Contractor will ensure that all site workers receive adequate environmental training relevant to their role prior to working on the construction site, including specific environmental project inductions and 'toolbox talks' on best practice construction methods as appropriate **(Mitigation Item SMC-S4)**, which would be anticipated to include those relating to noise and vibration control, by employing techniques to keep site noise to a minimum, and would be effectively supervised to ensure that best working practice in respect of noise reduction is followed.

Execution of Works

17.5.10 Best Practicable Means will be used to limit the level of noise to which operators and others in the vicinity of site operations would be exposed (**Mitigation Item SMC-NV2**). This includes the following:

- the hours of working will be planned and account will be taken of the effects of noise upon persons in areas surrounding site operations and upon persons working on site, taking into account the

nature of land use in the areas concerned, the duration of work and the likely consequence of any lengthening of work periods;

- any work outside of normal working hours will be agreed with the relevant local authority;
- where reasonably practicable, quiet working methods will be employed, including use of the most suitable plant, reasonable hours of working for noisy operations, and economy and speed of operations;
- permanent noise mitigation measures such as acoustic screens and earthwork bunds are to be constructed as early as practical;
- noise will be controlled at source, for example, by modification of existing plant/equipment, its use and location and ensuring maintenance of all noise-generating equipment;
- the spread of noise will be limited, i.e. by distance between source and receiver and/or screening;
- on-site noise levels will be monitored regularly, particularly if changes in machinery or project designs are introduced, by a suitably qualified person appointed specifically for the purpose. A method of noise measurement will be agreed prior to the commencement of site works;
- on those parts of a site where high levels of noise are likely to be a hazard to persons working on the site, prominent warning notices will be displayed and, where necessary, ear protectors will be provided;
- proper use of plant with respect to minimising noise emissions and regular maintenance in line with plant manuals;
- where practicable, vehicles and mechanical plant used for the purpose of the works will be fitted with effective exhaust silencers and will be maintained in good, efficient working order;
- where appropriate, inherently quiet plant will be selected. All major compressors will be 'sound reduced' models fitted with properly lined and sealed acoustic covers which will be kept closed whenever the machines are in use and all ancillary pneumatic percussive tools will be fitted with mufflers or silencers of the type recommended by the manufacturers;
- machines in intermittent use will be shut down in the intervening periods between work or throttled down to a minimum;
- all ancillary plant such as generators, compressors and pumps will be positioned so as to cause minimum noise disturbance. If necessary, acoustic barriers or enclosures will be provided; and
- adherence to the codes of practice for construction working and piling given in British Standard BS 5228:2009+A1:2014 and the guidance given therein minimising noise emissions from the site.

17.5.11 In addition, PKC will be consulted regarding any proposed working outwith normal working hours.

17.5.12 Furthermore, where, following application of proposed mitigation and any Section 61 consents under the Control of Pollution Act 1974, noise levels are expected to still exceed the trigger levels defined in Annex E.4 of BS 5228 and any Section 61 consents under the Control of Pollution Act 1974, a scheme for the installation of noise insulation or the reasonable costs thereof, or a scheme to facilitate temporary rehousing of occupants, as appropriate, would need to be implemented.

Specific Mitigation

17.5.13 As stated in Paragraph 17.2.44, mitigation will be implemented, where reasonably practicable, where the potential impact is Slight/Moderate Adverse or worse and the predicted façade noise level exceeds 59.5dB $L_{A10,18h}$ at ground floor level during the daytime period, and/or 55.0dB $L_{night,outside}$ during the night-time period, at ground and/or first floor level. Tables 17.28, 17.29 and 17.30 show the number of residential buildings that may qualify for mitigation.

17.5.14 It should be noted that the DMRB Noise and Vibration assessment reports a single value noise level at the least beneficial façade of a property. However, mitigation is considered at all façade receptor points where an exceedance of the noise mitigation threshold criteria occurs.

Table 17.28: Mitigation criteria qualification (short-term day)

Number of Residential Buildings		
DS 2026 – DM 2026 Noise Level Change ≥ 1dB(A)	**DS 2026 Noise Level > 59.5dB ($L_{A10,18h}$)**	**Both Criteria Fulfilled**
68	53	23

Table 17.29: Mitigation Criteria Qualification (Long-term Day)

Number of Residential Buildings		
DS 2041 – DM 2026 Noise Level Change ≥ 3dB(A)	**DS 2041 Noise Level > 59.5dB ($L_{A10,18h}$)**	**Both Criteria Fulfilled**
2	50	1

Table 17.30: Mitigation criteria qualification (Long-term Night)

Number of Residential Buildings		
Ground Floor		
DS 2041 – DM 2026 Noise Level Change ≥ 3dB(A)	**DS 2041 Noise Level > 55.0dB ($L_{night,outside}$)**	**Both Criteria Fulfilled**
2	13	0
First Floor		
DS 2041 – DM 2026 Noise Level Change ≥ 3dB(A)	**DS 2041 Noise Level > 55.0dB ($L_{night,outside}$)**	**Both Criteria Fulfilled**
4	19	0

17.5.15 Where a NSR meets with the mitigation criteria, even with the embedded mitigation outlined above, then additional NSR specific mitigation has been proposed. Table 17.31 provides the specific mitigation measures which are also shown on Figure 17.9. It should be noted that these requirements (i.e. location, height and length) are based on the DMRB Stage 3 design.

Table 17.31: NSR specific mitigation

Mitigation Item	Approximate Chainage/Location	Minimum Height (m)	Minimum Length (m)	Type of Mitigation
P03-NV3	ch1500-1600 around garden boundary of Ledpetty Lodge	1.8	41	Noise barrier, bund or drystone wall
P03-NV4	ch2900-3000	1.4	61	Noise barrier, bund or drystone wall
P03-NV5	ch4070-4220	1.5	139	Stone mortar wall
P03-NV6	ch5200-5300	1.5	96	Noise barrier, bund or drystone wall
P03-NV7	ch5260-5300	2.4	24	Noise barrier, bund or drystone wall
P03-NV8	Beyond northern end of proposed scheme (including Inch of Tulliemet, Dalnabo Farm Cottage, Vine Cottage and Briar Cottage)	n/a	1022	Application of LNRS to existing A9 carriageways

17.5.16 As a minimum, **Mitigation Items P03-NV4**, **P03-NV6** and **P03-NV7** can take the form of a stone wall, an earth bund or a close boarded timber fence, or a combination thereof. For any noise barrier fences, these would need to be of a minimum mass per unit area of 15kg/m^2 with no holes or gaps. Timber fences must be overlapped to allow for shrinkage.

17.5.17 With the additional NSR specific mitigation (**Mitigation Item P03-NV3** to **P03-NV8**), there are no NSR that have exceedances of the mitigation threshold criteria.

17.6 Residual Impacts

Construction

17.6.1 Assuming that the appropriate noise mitigation measures (**Mitigation Items SMC-S1** to **SMC-S4 and SMC-NV1 to SMC-NV2**) are employed, it is anticipated that any potentially significant adverse impacts associated with construction of the proposed scheme are unlikely to arise and any that do would be short-term in nature. Should the level of noise reduction required at any NSR not be practicable then the consideration of noise insulation or temporary rehousing as detailed in paragraph 17.5.12 would need to be implemented, where applicable.

Operation

17.6.2 DMRB Noise and Vibration guidance recommends that a full assessment be undertaken of the residual operational noise impacts where noise mitigation is included. Accordingly, Appendix A17.6 (Operational Residual Noise Impacts) contains the predicted noise levels at sample NSR locations and Health & Education buildings which have been predicted to experience a change in noise level due to the additional NSR specific mitigation. The appendix also includes the residual DMRB Noise and Vibration summary tables for all NSR within the 600m calculation area, noise nuisance tables, vibration nuisance tables and noise insulation assessment.

Residual Noise Impacts at Mitigated NSR

17.6.3 As a result of **Mitigation Items P03-NV3** to **P03-NV8** the predicted noise levels at a number of NSR will be reduced. Table 17.32 provides the difference in the predicted noise levels in the short-term at ground floor level for the 23 residential NSR and one other NSR which met the mitigation criteria. The mitigation item(s) that corresponds to each NSR is also provided. As has been stated previously, DMRB requires that the least beneficial change in noise level is reported and it therefore should be appreciated that mitigated and unmitigated noise levels are not necessarily for the same receptor point at an NSR, as the least beneficial façade may be different after mitigation. Accordingly, for the purposes of comparison and where necessary, the noise levels have been presented for the façades with the least beneficial impact both with and without mitigation, where they are different.

17.6.4 DMRB requires the least beneficial change in noise level be reported. Accordingly, in some instances the least beneficial change in noise level may not appear to meet the mitigation criteria. Where this occurs information has also been provided which shows the change in noise level of the receptor (RID) that has the highest exceedance of the mitigation criteria. In order to allow for comparison, the least beneficial change in noise level with and without mitigation has been denoted with an asterisk in Table 17.32.

Table 17.32: Comparison of mitigated and unmitigated noise levels at NSR in the short-term

NSR ID	NSR Name / Mitigation Item	Scenario	RID	DM 2026 $L_{A10,18h}$ Noise Level (dB)	DS 2026 $L_{A10,18h}$ Noise Level (dB)	Significance of Impact
R3.002	St Colme's / P03-NV4	DM 2026 Vs DS 2026 (Unmitigated)*	454*	41.5*	44.6*	Moderate/Large adverse*
		DM 2026 Vs DS 2026 (Mitigated)*	454*	41.5*	44.6*	Moderate/Large Adverse*
		DM 2026 Vs DS 2026 (Unmitigated)	461	60.3	61.4	**Slight/Moderate Adverse**
		DM 2026 Vs DS 2026 (Mitigated)	461	60.3	61.2	Slight Adverse
R3.004	1 Dowally Cottage/ P03-NV5	DM 2026 Vs DS 2026 (Unmitigated)*	1623*	66.6*	67.6*	**Slight/Moderate Adverse***
		DM 2026 Vs DS 2026 (Mitigated)	1623	66.6	66.3	Slight Adverse
		DM 2026 Vs DS 2026 (Mitigated)*	1616*	65.2	65.8	Slight Adverse
R3.007	The Knoll/ P03-NV6, P03-NV7	DM 2026 Vs DS 2026 (Unmitigated)*	2334*	56.3*	59.9*	**Moderate/Large Adverse***
		DM 2026 Vs DS 2026 (Mitigated)*	2334*	56.3*	58.9*	Slight/Moderate Adverse*
R3.026	Cherry	DM 2026 Vs DS 2026 (Unmitigated)*	4357*	59.3*	60.3*	**Slight/Moderate Adverse***

NSR ID	NSR Name / Mitigation Item	Scenario	RID	DM 2026 $L_{A10,18h}$ Noise Level (dB)	DS 2026 $L_{A10,18h}$ Noise Level (dB)	Significance of Impact
	Cottage/ P03-NV8	DM 2026 Vs DS 2026 (Mitigated)	4357	59.3	58.5	Slight Beneficial
		DM 2026 Vs DS 2026 (Mitigated)*	4361*	70.6*	70.9*	Slight Adverse*
R3.027	Vine Cottage/ P03-NV8	DM 2026 Vs DS 2026 (Unmitigated)*	4286*	64.9*	65.9*	**Slight/Moderate Adverse***
		DM 2026 Vs DS 2026 (Mitigated)	4286	64.9	62.8	Slight/Moderate Beneficial
		DM 2026 Vs DS 2026 (Mitigated)*	4284*	59.0*	59.2*	Slight Adverse*
R3.028	Briar Cottage/ P03-NV8	DM 2026 Vs DS 2026 (Unmitigated)*	4258*	64.8*	65.8*	**Slight/Moderate Adverse***
		DM 2026 Vs DS 2026 (Mitigated)	4258	64.8	62.6	Slight/Moderate Beneficial
		DM 2026 Vs DS 2026 (Mitigated)*	4252*	65.8*	66.2*	Slight Adverse*
R3.029	Smithy House/ P03-NV8	DM 2026 Vs DS 2026 (Unmitigated)*	4442*	68.6*	70.1*	**Slight/Moderate Adverse***
		DM 2026 Vs DS 2026 (Mitigated)	4442	68.6	67.3	Slight/Moderate Beneficial
		DM 2026 Vs DS 2026 (Mitigated)*	4444*	60.9*	61.1*	Slight Adverse*
R3.030	Hilltop/ P03-NV8	DM 2026 Vs DS 2026 (Unmitigated)*	4529*	57.7*	59.3*	Slight/Moderate Adverse*
		DM 2026 Vs DS 2026 (Mitigated)	4529	57.7	56.6	Slight/Moderate Beneficial
		DM 2026 Vs DS 2026 (Mitigated)*	4534*	49.9*	49.1*	Slight Beneficial*
		DM 2026 Vs DS 2026 (Unmitigated)	4528	58.8	60.3	**Slight/Moderate Adverse**
		DM 2026 Vs DS 2026 (Mitigated)	4528	58.8	57.8	Slight/Moderate Beneficial
R3.036	Tummelferry/ P03-NV8	DM 2026 Vs DS 2026 (Unmitigated)*	4037*	58.7*	59.9*	**Slight/Moderate Adverse***
		DM 2026 Vs DS 2026 (Mitigated)	4037	58.7	58.7	Neutral
		DM 2026 Vs DS 2026 (Mitigated)*	4031*	57.5*	58.6*	Slight/Moderate Adverse*
R3.037	2 Station Cottages/ P03-NV8	DM 2026 Vs DS 2026 (Unmitigated)*	3981*	62.4*	63.4*	**Slight/Moderate Adverse***
		DM 2026 Vs DS 2026 (Mitigated)*	3981*	62.4*	60.9*	Slight/Moderate Beneficial*
R3.039	3 Station Cottages/ P03-NV8	DM 2026 Vs DS 2026 (Unmitigated)*	3986*	61.6*	62.6*	**Slight/Moderate Adverse***
		DM 2026 Vs DS 2026 (Mitigated)	3986	61.6	59.9	Slight/Moderate Beneficial
		DM 2026 Vs DS 2026 (Mitigated)*	3989*	50.8*	50.3*	Slight Beneficial*
R3.041	Dalnabo Steading/ P03-NV8	DM 2026 Vs DS 2026 (Unmitigated)*	4112*	64.2*	65.5*	**Slight/Moderate Adverse***
		DM 2026 Vs DS 2026 (Mitigated)	4112	64.2	62.6	Slight/Moderate Beneficial
		DM 2026 Vs DS 2026 (Mitigated)*	4117*	47.5*	46.0*	Slight/Moderate Beneficial*
R3.042	Dalnabo Farm Cottage/ P03-NV8	DM 2026 Vs DS 2026 (Unmitigated)*	4128*	70.4*	71.7*	**Slight/Moderate Adverse***
		DM 2026 Vs DS 2026 (Mitigated)	4128	70.4	68.5	Slight/Moderate Beneficial
		DM 2026 Vs DS 2026 (Mitigated)*	4130*	59.5*	58.0*	Slight/Moderate Beneficial*
R3.043	Inch of Tulliemet/ P03-NV8	DM 2026 Vs DS 2026 (Unmitigated)*	3801*	66.5*	69.0*	**Slight/Moderate Adverse***
		DM 2026 Vs DS 2026 (Mitigated)*	3801*	66.5*	65.7*	Slight Beneficial*
R3.044	Inch Cottage/ P03-NV8	DM 2026 Vs DS 2026 (Unmitigated)*	3778*	65.7*	67.6*	**Slight/Moderate Adverse***
		DM 2026 Vs DS 2026 (Mitigated)	3778	65.7	64.2	Slight/Moderate Beneficial
		DM 2026 Vs DS 2026 (Mitigated)*	3781*	46.7*	45.4*	Slight/Moderate Beneficial*
R3.045	Tummel View/ P03-NV8	DM 2026 Vs DS 2026 (Unmitigated)*	4042*	54.9*	56.3*	Slight/Moderate Adverse*
		DM 2026 Vs DS 2026 (Mitigated)	4042	54.9	53.2	Slight/Moderate Beneficial
		DM 2026 Vs DS 2026 (Mitigated)*	4047*	50.3*	49.7*	Slight Beneficial*
		DM 2026 Vs DS 2026 (Unmitigated)	4045	59.4	60.6	**Slight/Moderate Adverse**
		DM 2026 Vs DS 2026 (Mitigated)	4528	59.4	57.7	Slight/Moderate Beneficial
R3.046	Dalnabo Farmhouse/ P03-NV8	DM 2026 Vs DS 2026 (Unmitigated)*	4096*	67.6*	68.9*	**Slight/Moderate Adverse***
		DM 2026 Vs DS 2026 (Mitigated)	4096	67.6	65.7	Slight/Moderate Beneficial
		DM 2026 Vs DS 2026 (Mitigated)*	4100*	54.8*	54.3*	Slight Beneficial*
R3.062	Ledpetty	DM 2026 Vs DS 2026 (Unmitigated)*	264*	53.5*	56.0*	Slight/Moderate Adverse*

NSR ID	NSR Name / Mitigation Item	Scenario	RID	DM 2026 $L_{A10,18h}$ Noise Level (dB)	DS 2026 $L_{A10,18h}$ Noise Level (dB)	Significance of Impact
	Lodge/ P03-NV3	DM 2026 Vs DS 2026 (Mitigated)*	264*	53.5*	55.6*	Slight/Moderate Adverse*
		DM 2026 Vs DS 2026 (Unmitigated)	260	58.4	60.6	**Slight/Moderate** Adverse
		DM 2026 Vs DS 2026 (Mitigated)	260	58.4	59.4	Slight/Moderate Adverse
R3.065	Gorchan House/ P03-NV6	DM 2026 Vs DS 2026 (Unmitigated)*	2300*	56.1*	58.4*	Slight/Moderate Adverse*
		DM 2026 Vs DS 2026 (Mitigated)*	2300*	56.1*	57.5*	Slight/Moderate Adverse*
		DM 2026 Vs DS 2026 (Unmitigated)	2301	58.4	60.0	**Slight/Moderate** Adverse
		DM 2026 Vs DS 2026 (Mitigated)	2301	58.4	59.4	Slight/Moderate Adverse
R3.076	Reviresco	DM 2026 Vs DS 2026 (Unmitigated)*	1579*	58.6*	60.1*	**Slight/Moderate** Adverse*
		DM 2026 Vs DS 2026 (Mitigated)	1579	58.6	57.4	Slight/Moderate Beneficial
		DM 2026 Vs DS 2026 (Mitigated)*	1570	57.3	58.6	Slight/Moderate Adverse
R3.075	2 Dowally Cottage/ P03-NV5	DM 2026 Vs DS 2026 (Unmitigated)*	1630*	60.1*	61.5*	**Slight/Moderate** Adverse*
		DM 2026 Vs DS 2026 (Mitigated)	1630	60.1	59.9	Slight Beneficial
		DM 2026 Vs DS 2026 (Mitigated)*	1631	59.2	59.8	Slight Adverse*
R3.081	Dowally Church/ P03-NV5	DM 2026 Vs DS 2026 (Unmitigated)*	1688*	63.2*	65.6*	**Slight/Moderate** Adverse*
		DM 2026 Vs DS 2026 (Mitigated)	1688	63.2	63.9	Slight Adverse
		DM 2026 Vs DS 2026 (Mitigated)*	1679*	47.1*	48.8*	Slight/Moderate Adverse*
R3.083	Gleann Feidh/ P03-NV5	DM 2026 Vs DS 2026 (Unmitigated)*	1747*	55.3*	57.0*	Slight/Moderate Adverse*
		DM 2026 Vs DS 2026 (Mitigated)	1747	55.3	56.4	Slight/Moderate Adverse
		DM 2026 Vs DS 2026 (Mitigated)*	1756*	42.2*	43.7*	Slight/Moderate Adverse*
		DM 2026 Vs DS 2026 (Unmitigated)	1752	58.7	60.2	**Slight/Moderate** Adverse
		DM 2026 Vs DS 2026 (Mitigated)	1752	58.7	59.4	Slight Adverse
R3.084	Dowally Craft Centre House/ P03-NV5	DM 2026 Vs DS 2026 (Unmitigated)*	1814*	52.6*	55.0*	Slight/Moderate Adverse*
		DM 2026 Vs DS 2026 (Mitigated)*	1814*	52.6*	54.1*	Slight/Moderate Adverse*
		DM 2026 Vs DS 2026 (Unmitigated)	1822	61.6	63.7	**Slight/Moderate** Adverse
		DM 2026 Vs DS 2026 (Mitigated)	1822	61.6	62.3	Slight Adverse

17.6.5 Table 17.33 provides the corresponding noise levels in the long-term at ground floor level for the NSR which met the long-term mitigation criteria.

Table 17.33: Comparison of mitigated and unmitigated noise levels at NSR in the long-term

NSR ID	NSR Name	Scenario	RID	DM 2026 $L_{A10,18h}$ Noise Level (dB)	DS 2041 $L_{A10,18h}$ Noise Level (dB)	Significance of Impact
R3.007	The Knoll	DM 2026 Vs DS 2041 (Unmitigated)*	2334*	56.3*	60.2*	**Slight/Moderate** Adverse*
		DM 2026 Vs DS 2041 (Mitigated)*	2334*	56.3*	59.2*	Slight/Moderate Adverse*

Residual Impacts at all NSR

Do-Minimum Scenario in the Baseline Year vs. Do-Something Scenario in the Baseline Year (Short-term Assessment)

17.6.6 With the mitigation proposed in Section 17.5 (Mitigation), the predicted daytime noise levels (i.e. least beneficial change in noise level) at ground floor level for the short-term assessment indicate that no NSR are predicted to have a significant adverse residual noise impact.

Do-Minimum Scenario in the Baseline Year vs. Do-Something Scenario in Future Assessment Year (Long-term Assessment)

17.6.7 The daytime noise levels at ground floor level in the long-term assessment indicate that there are no NSR which are predicted to experience a significant adverse residual noise impact. Furthermore, the night-time noise levels at ground and first floor levels in the long-term assessment indicate that there are no NSR which are predicted to experience a significant adverse residual noise impact.

17.7 Statement of Significance

17.7.1 With the proposed scheme in place, and taking into account mitigation measures as described in Section 17.5 (Mitigation), there are no NSR which are considered to have significant noise or vibration impacts. There are no other noise or vibration impacts considered to be significant in accordance with the EIA Regulations.

17.8 References

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