

17. Noise and Vibration

17.1 Introduction

- 17.1.1. This chapter describes the assessment of road traffic noise and vibration impacts expected from the Proposed Scheme.
- 17.1.2. The assessment has been carried out in line with the detailed assessment methodology of the Design Manual for Roads and Bridges Volume 11 Section 3 Part 7 (HD 213/11, Revision 1)ⁱ (referred to as DMRB 11:3:7) which incorporates the calculation and prediction methodology from the Department for Transport Memorandum “Calculation of Road Traffic Noise” (CRTN)ⁱⁱ.
- 17.1.3. The objective of the assessment is to gain an appreciation of the noise and vibration climate with the scheme (referred to as Do-Something) and without the scheme (referred to as Do-Minimum) in the first full year of operation (2026) and a future assessment year (2041), 15 years after opening. Noise level predictions have been produced based upon the proposed road alignment and detailed traffic modelling for each of these scenarios.

Study Area

- 17.1.4. DMRB 11:3:7 includes threshold criteria to determine which impacts require assessment. The threshold criteria are met when changes on a route would lead to a permanent change in magnitude of 1 dB $L_{A10,18h}$ in the short term or 3 dB $L_{A10,18h}$ in the long term. Routes which meet the threshold criteria are known as affected routes.
- 17.1.5. DMRB 11:3:7 initially defines the total study area for noise and vibration as being that which is within 1 km of any new or improved routes, and within 1 km of any existing routes which are being bypassed between the start and end points of the physical works relating to the Proposed Scheme.
- 17.1.6. Within the study area noise predictions are required within 600m of the carriageway edges of the identified routes and any other affected routes within the 1 km boundary. The area where noise predictions are required is termed ‘the calculation area’.
- 17.1.7. The calculation area has been enlarged locally to include a number of receptors beyond 600m from the Proposed Scheme or from affected routes in order to consider all receptors within some communities.
- 17.1.8. The assessment considers all noise sensitive receptors within the study area. DMRB 11:3:7 provides examples of noise sensitive receptors, including dwellings, hospitals, schools, community facilities, designated areas (e.g. National Scenic Area (NSA), National Park, Special Areas of Conservation (SAC), Special Protection Areas (SPA) and Sites of Special Scientific Interest (SSSI)) and public rights of way such as footpaths.
- 17.1.9. The calculation area has been shown to include 246 sensitive receptors. Of these, 232 are taken to be residential and 14 are taken to be non-residential. The non-residential receptors within the calculation area comprise 3 churches, a primary school, a community centre, eight heritage receptors and a Special Protection Area. A number of dwellings and other non-residential noise sensitive receptors between 600m and 1km of the Proposed Scheme have also been modelled. The study area is shown in Figure 17.1a-c.

- 17.1.10. An overall A9 Dualling wider network traffic noise assessment will be undertaken separately.

17.2 Approach and Methods

Legislation

- 17.2.1. A key piece of legislation relating to noise and the operation of new or improved roads in Scotland is the Noise Insulation (Scotland) Regulationsⁱⁱⁱ (the Regulations). A summary of the Regulations is presented below.

The Noise Insulation (Scotland) Regulations 1975

- 17.2.2. Under the circumstances specified in The Noise Insulation (Scotland) Regulations 1975 and the Memorandum of Advice and Instruction (Noise Insulation (Scotland) Regulations 1975)^{iv}, residential properties may qualify for an offer of noise insulation if:
- the use of any road causes, or is expected to cause, noise at a level not less than 68 dB $L_{A10,18h}$ at a position 1m in front of a qualifying facade
 - if the $L_{A10,18h}$ noise level resulting from the use of a new or altered road, is greater than the pre-construction noise level by at least 1 dB(A)
- 17.2.3. Noise levels should be calculated in accordance with the method given in the Memorandum of Advice and Instruction.
- 17.2.4. The relevant authority has a duty under the Regulations to offer insulation for residential properties with respect to a new road, or a road for which a new carriageway is proposed; and discretionary powers in relation to otherwise altered roads. The authority also has discretionary power to offer insulation against construction noise. The Regulations apply to habitable rooms and so exclude bathrooms, toilets, halls and smaller kitchens that do not include dining areas.
- 17.2.5. Some residential buildings are not eligible under the Regulations. These include any buildings liable to be acquired compulsorily or subject to a demolition order, and buildings first occupied after the “relevant date”; this being the date a new road was first opened to public traffic or an altered road was opened following completion of the alteration.
- 17.2.6. Furthermore, the following conditions are set out within the Memorandum of Advice and Instruction for testing the eligibility of a building. The building shall not be:
- more than 300 metres from the nearest point on the carriageway of the new or altered road
 - positioned such that there is no point on it from which a straight line can be drawn to a point on the new or altered road without passing through another building
 - positioned such that it lies outside the triangular area at the terminal point of a new or altered road, the apexes of which are 50m along the centre line of the existing road from the terminal points and the bases of which extend from points 300m on either side of the road the nearest point on the carriageway at right angles to the centre line of the carriageway

Local Policies and Plans

- 17.2.7. Chapter 19 describes local policies and plans, including planning advice note PAN 1/2011 Planning and Noise, and the Highland-wide Local Development Plan which both

contain relevant sections on noise assessment. Chapter 19 describes how the Proposed Scheme is compliant with the local policies and plans.

Consultation

- 17.2.8. Consultation was undertaken with Environmental Health Officers at the Highland Council in March and April 2016 to identify any noise issues or particular constraints within the study area and to agree the location of the baseline noise survey locations.

Assessment of Permanent Effects - Noise

- 17.2.9. Traffic noise is a major source of noise affecting people in many situations; including in their homes, both during the day time and during the night time. There is a growing body of evidence to link health effects with prolonged exposure to high noise levels; although further research is required in this area^v.
- 17.2.10. Noise changes may result from changes in:
- road alignment (vertical and horizontal)
 - sound generation (traffic flow, speed, composition and road surface type)
 - sound propagation (distance, ground topography, ground absorption, screening and reflection)
- 17.2.11. The index adopted in the UK for assessing road traffic noise during the daytime is the dB $L_{A10, 18h}$ level, defined as the arithmetic mean of the dB(A) noise levels exceeded for 10% of the time in each of the 18, one-hour periods between 6 a.m. and midnight on a typical weekday. This index is predicted using the method described in Calculation of Road Traffic Noise, supplemented by additional advice from DMRB 11:3:7.

Calculation Method: Calculation of Road Traffic Noise

- 17.2.12. The DOT/Welsh Office memorandum Calculation of Road Traffic Noise 1988 (CRTN) contains predictive algorithms which were developed from extensive measurement data, validated out to distances of about 300m. DMRB 11:3:7 Annex 4 provides further advice and approves the use of the CRTN calculation procedure for distances up to and beyond 600m from the road.
- 17.2.13. The CRTN method of predicting noise from a road consists of five main stages:
- division of the road scheme into a number of segments
 - calculation of the basic noise level (BNL), at a reference distance of 10 m away from the nearside carriageway edge, for each road segment
 - assessment, for each segment, of the noise level at the reception point taking into account distance, ground attenuation and screening
 - correction of the noise level at the reception point to take into account site layout features including reflections from buildings and facades, and the size of the source segments
 - combination of the contributions from all segments within view to give the predicted noise levels at the reception point for all roads
- 17.2.14. The calculation procedure of CRTN has been implemented for this assessment by the use of Noisemap Five Environmental noise modelling software, which calculates fully in accordance with the methodology of CRTN and the additional calculation advice from DMRB 11:3:7. NoiseMap software automatically uses the correct correction for road surface type according to the average speed given in the traffic data.

Assessment Methodology for Change in noise

- 17.2.15. DMRB 11:3:7 provides two assessment methodologies. This assessment follows the ‘detailed’ methodology and the following paragraphs describe the requirements of the assessment;
- 17.2.16. The methodology requires that noise predictions are made for all identified sensitive receptors within the calculation area for the following scenarios:
- Do-Minimum scenario in the baseline year.
 - Do-Minimum scenario in the future assessment (15th) year.
 - Do-Something scenario in the baseline year.
 - Do-Something scenario in the future assessment year.
- 17.2.17. The term Do-Minimum refers to the situation without the Proposed Scheme in operation and the term and Do-Something refers to the situation with the Proposed Scheme in operation.
- 17.2.18. Comparisons between these scenarios should be made as follows:
- i) Do-Minimum scenario in the baseline year against Do-Something scenario in the baseline year (short term scheme impacts).
 - ii) Do-Minimum scenario in the baseline year against Do-Something scenario in the future assessment year (long term scheme impacts).
 - iii) Do-Minimum scenario in the baseline year against Do-Minimum scenario in the future assessment year (long term Do-Minimum).
- 17.2.19. The least beneficial change (i.e. smallest decrease or largest increase) should be reported for each sensitive receptor.
- 17.2.20. DMRB 11:3:7 provides an additional threshold for the assessment of night time noise. A comparison for long term night-time noise impacts is required for receptors in the calculation area where night time levels exceed the interim target value of 55dB $L_{\text{night, outside}}$, defined in the WHO Night Noise Guidelines^{vi} for Europe, published in 2009 and set in Table 17.1.

Table 17.1: WHO recommended night noise guidelines values

Target	$L_{\text{night, outside}}$ dB *
Interim target	55
Night noise guideline	40

* The A-weighted long-term continuous equivalent free-field sound level as defined in ISO 1996-2:1987, determined over all the night periods of a year; in which the night is eight hours (23:00 – 07:00 hours).

- 17.2.21. The magnitude of a noise change is perceived differently depending on whether it is a sudden change, or a change over a longer period of time. In the short term (e.g. on scheme opening – Year 1) a change in road traffic noise of 1dB $L_{A10, 18h}$ change is considered perceptible. In the long term (typically 15 years after project opening), a 3dB $L_{A10, 18h}$ change is considered perceptible. The results of the assessment at the sensitive receptors should be classified into noise change categories following the impact magnitude scales in Table 17.2 and Table 17.3 for short term and long term impacts respectively.

Table 17.2: Classification of Magnitude of Noise Impacts in the Short Term

Noise Change, dB L _{A10,18h}	Magnitude of impact (Short term)
0	No change
0.1 - 0.9	Negligible
1 - 2.9	Minor
3 – 4.9	Moderate
5+	Major

Table Source: DMRB 11:3:7, Table 3.1

Table 17.3: Classification of Magnitude of Noise Impacts in the Long Term

Noise Change, dB L _{A10,18h}	Magnitude of impact (Long term)
0	No change
0.1 - 2.9	Negligible
3 – 4.9	Minor
5 – 9.9	Moderate
10+	Major

Table Source: DMRB 11:3:7, Table 3.2

- 17.2.22. The resulting changes in noise levels in the short term and the long term should also be represented graphically for all sensitive receptors in the calculation area.

Assessment Methodology for Change in nuisance

- 17.2.23. The DMRB detailed study also requires a noise nuisance impact assessment to be undertaken. This section describes the requirements. The assessment is required for all dwellings in the calculation area, taking into account the guidance in Annex 6 of DMRB 11:3:7.
- 17.2.24. The change in people bothered by noise should be tabulated in bands showing the number of dwellings where the nuisance level changes by: no change, less than 10 percentage points, 10 to 20 percentage points, 20 to 30 percentage points, 30 to 40 percentage points, or greater than 40 percentage points.
- 17.2.25. All calculations should be based on the highest nuisance levels expected during the first 15 years after opening. When the scheme causes noise increases, this will normally be the nuisance level experienced soon after opening. For noise decreases and the Do-minimum situation, the highest nuisance experienced during the first 15 years after opening will normally be that in the 15th year.

Threshold for Noise Mitigation

- 17.2.26. The DMRB indicates that adverse noise impacts above the threshold values should be mitigated if possible. For the Proposed Scheme the thresholds for considering mitigation are set taking into account both the community response to noise, and the magnitude of the impact.

- 17.2.27. Community response to noise is described in the World Health Organisation (WHO) guidelines for community noise^{vii}. Two different guidelines are given;
- 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 $L_{Aeq, 16h}$ 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 $L_{Aeq, 16h}$.
- 17.2.28. In order to use these values for this assessment, it is necessary to convert the daytime $L_{Aeq, 16h}$ index into the $L_{A10, 18hr}$ index calculated for the assessment. There are two factors to take into account, the WHO guidelines;
- The index is different – the commonly used method of transposing from an $L_{Aeq, 16hr}$ to an $L_{A10, 18hr}$ is to add 2dB. This factor is taken from the DfT Transport Analysis Guidance, unit A3^{viii}.
 - The WHO guidelines refer to noise levels in freefield positions whereas the road traffic assessment uses levels assessed 1m from the wall or façade of the property. Calculation of Road Traffic noise advises that façade noise levels are 2.5dB higher than freefield levels.
- 17.2.29. Therefore, the WHO guidelines can be re-stated in terms of the façade $L_{A10, 18hr}$ levels reported by the noise assessment;
- To protect the majority of people from being **seriously annoyed** during the daytime, the outdoor sound level from steady, continuous noise should not exceed 59.5dB $L_{A10, 18hr}$ 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 54.5dB $L_{A10, 18hr}$.
- 17.2.30. Mitigation is investigated where impacts from the Proposed Scheme are above the DMRB assessment thresholds and where levels are above the threshold for serious annoyance (59.5dB $L_{A10, 18hr}$).

Table 17.4: Summary of Mitigation Thresholds

Assessment type	Smallest Increase	Lowest Noise Level with Scheme $L_{A10, 18hr}$
Short Term	1 dB	59.5
Long Term	3 dB	59.5

- 17.2.31. In addition, mitigation is considered on a case by case basis where the noise impacts are shown to be of at least moderate magnitude and levels are above the threshold for moderate annoyance (54.5dB $L_{A10, 18hr}$).

Table 17.5: Case-by-case Mitigation Thresholds

Assessment type	Smallest Increase	Lowest Noise Level with Scheme $L_{A10, 18hr}$
Short Term	3 dB	54.5
Long Term	5 dB	54.5

- 17.2.32. Impacts below these thresholds are not considered to be significant and mitigation is not proposed.

Calculation Noise Model: Data Sources, Limitations and Assumptions

- 17.2.33. As described above, the noise calculations have been undertaken using the commercially available NoiseMap software. The software builds a digital three dimensional model of the features which may affect the generation and propagation of noise. These features have been captured from the following data sources:
- Ordnance Survey Mastermap® data to define the alignments of existing roads and locations of houses and other structures
 - Ordnance Survey AddressBase Plus® for building classification, naming and façade receptor generation
 - Bluesky Lidar DTM and OS Terrain 50 data for ground topography
 - Three-dimensional topographical survey data provided by Atkins Highways and Transportation for details of cuttings, embankments and existing and proposed road heights.
- Other inputs into the programme also include:
- Type of intervening ground between each road segment and each receiver
 - Annual average weekday traffic flow (AAWT)
 - Percentage of heavy duty vehicles (HDV)
 - Average traffic speed
 - Nature of the road surface
- 17.2.34. It has been assumed that the road surface on much of the existing single carriageway highway network is conventional Hot Rolled Asphalt (HRA) with a texture depth of 2mm. In accordance with CRTN this provides a zero surface correction in noise calculations. A section of the A9 between the Moy rail bridge and the Lynebeg access road (the Moy 2+1) already incorporates a Lower Noise Road Surface (LNRS), as can be seen in Figure 17.8a-c.
- 17.2.35. Guidance is given within Annex 4 of DMRB on the corrections to apply for LNRS surfaces depending on the level of detail available. For this assessment it has been assumed that the new surface laid with the Proposed Scheme would have a correction of -3.5dB, in line with the standard assumption for this type of assessment. This surface must, therefore, have a high speed Road Surface Index (RSI_H) of at least -5dB. The extent of proposed LNRS for the Proposed Scheme is shown in Figure 17.9a-c.
- 17.2.36. It is assumed that the existing sections of A9 dual carriageway either side of this scheme would have been resurfaced with LNRS before the start of the construction of this scheme. These existing dual carriageway sections are assumed to have been surfaced with an LNRS with a high speed Road Surface Index (RSI_H) of at least -5dB, and a correction of -3.5dB has been used in the noise modelling for all scenarios for these sections of the A9.
- 17.2.37. Traffic was supplied for the assessment with both annual average hourly values and annual average 18-hour values. The annual average hourly values have been used in the noise assessment in the calculation area to allow the L_{A10,18h} and L_{night} noise levels to be determined from the relevant traffic data.
- 17.2.38. Identification of sensitive receptors is based on Ordnance Survey (OS) MasterMap and Address BasePlus data as provided in October 2015. The heights of buildings within the noise model have been assumed to be 8m in height.

- 17.2.39. Where applicable, noise levels at sensitive receptors have been predicted at a distance of 1m from the façade and include a 2.5 dB(A) façade correction. Calculations have been undertaken at a height of 1.5m for ground floor receptors and 4m for first floor receptors. It is assumed that each building storey is 2.5m in height.
- 17.2.40. The noise assessment assumes that the ground between the road and receptors is soft ground, representative of open grassland or other natural ground types.

Assessment of Permanent Effects - Vibration

- 17.2.41. Traffic vibration can either be ground-borne or airborne.

Ground-borne vibration

- 17.2.42. Ground-borne vibration arising from the interaction between vehicles' wheels and the road surface can be perceptible in nearby buildings if heavy vehicles pass over irregularities in the road. Extensive research on a wide range of buildings of various ages and types has found no evidence to indicate that traffic induced vibrations are a source of significant damage to buildings^{ix}. As significant ground-borne vibrations are only likely to be generated where there are irregularities in the road surface, this is not generally an important consideration for new roads, and this has not been assessed for the Proposed Scheme.
- 17.2.43. It is understood that there are no ground-borne vibration issues on existing routes in the study area, and ground-borne noise from existing routes has been scoped out of the assessment.

Airborne vibration

- 17.2.44. Airborne vibration can be produced by low frequency sound emitted by vehicle engines and exhausts and can occur to some extent along any type of road. Airborne vibration may result in detectable vibrations in building elements (e.g. windows and doors). The disturbance produced by airborne vibration is closely linked to traffic noise levels and can therefore be assessed based on noise predictions.
- 17.2.45. DMRB 11:3:7 describes that where there are unscreened buildings within 40m of an existing or proposed route option, an estimation of the degree of traffic induced airborne vibration should also be made.
- 17.2.46. The method describes that the assessment is based on the assessment for noise nuisance, except that the percentage of people bothered by vibration is 10% lower than the corresponding figure for noise. The annoyance is taken to be 0% where external noise levels are below 58dB $L_{A10, 18hr}$.
- 17.2.47. Traffic induced airborne vibration is most likely to affect properties that are within 40m of the Proposed Scheme and where the external noise level is in excess of 58dB $L_{A10, 18hr}$. Airborne vibration has been assessed at these properties, based on the noise nuisance assessment.
- 17.2.48. Airborne vibration has not been assessed at locations where external noise levels are below 58dB $L_{A10, 18hr}$ or which are further than 40m from the Proposed Scheme.

Assessment of Temporary Effects - Construction

- 17.2.49. The noise and vibration impacts associated with the construction of the Proposed Scheme have been assessed in accordance with the guidelines given BS 5228:2009

+A1:2014 Code of Practice for Noise and Vibration Control on Construction and Open Sites.

Construction Noise Assessment Method

- 17.2.50. Part 1 of BS5228^x, Noise, provides guidance on methods that can be used to predict and measure noise from construction activities and how to assess the impact on those exposed to it. In particular Annex F sets out the methods of estimating noise from construction sites which take into account distance, ground effects, reflections from surfaces, and screening by obstacles. The procedures described in Annex F have been used to estimate the noise from construction activities.
- 17.2.51. Annexes C and D of Part 1 of BS5228 provides generic source noise data for various items of plant used on open sites which can be used in the absence of measured data.
- 17.2.52. Part 1, Annex E ‘Significance of noise effects’ of BS5228 presents various methods of determining the significance of noise effects due to construction works. This includes the ABC method detailed in Annex E.3.2, where noise limits are set based on baseline noise levels, and which is shown below.

Table 17.6: Threshold of potential significant construction impacts at dwellings

Assessment category and threshold value period	Threshold value, in decibels (dB) ($L_{Aeq,T}$)		
	Category A ^A	Category B ^B	Category C ^C
Night-time (23.00-07.00)	45	50	55
Evenings (19.00-23.00) and weekends	55	60	65
Daytime (07.00-19.00) and Saturdays (07.00-13.00)	65	70	75
<p>NOTE 1 - A potential significant effect is indicated if the $L_{Aeq,T}$ noise level arising from the site exceeds the threshold level for the category appropriate to the ambient noise level.</p> <p>NOTE 2 - If the ambient noise level exceeds the Category C threshold values given in the table (i.e. the ambient noise level is higher than the above values), then a potential significant effect is indicated if the total $L_{Aeq,T}$ noise level for the period increases by more than 3 dB due to site noise.</p> <p>NOTE 3 - Applied to residential receptors only.</p>			
<p>^A) Category A: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are less than these values.</p> <p>^B) Category B: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are the same as Category A values.</p> <p>^C) Category C: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are higher than Category A values.</p>			

- 17.2.53. The ABC method has been used to assess the impacts of the construction activities. Using this method the impact of an activity has potential to be significant if the noise levels from the construction activities are shown to exceed the relevant threshold value.
- 17.2.54. The consideration of significance then needs to take account of factors such as the duration of the activity and the characteristics of the existing noise climate. BS5228 indicates for other impact assessment methods that effects may be significant for works exceeding a month in duration.

Construction Noise Assessment Limitations and Assumptions

- 17.2.55. The construction noise assessment assumes free-field conditions to allow comparison with the measured ambient noise levels.

- 17.2.56. At this stage, a detailed construction programme is not available. However, anticipated activities during construction are indicated in Section 5.16. From previous experience on similar developments, assumptions have been made for the main noise generating plant and equipment likely to be employed and their corresponding noise levels. An indicative assessment has been undertaken, based on this plant. The contractor may choose different numbers or types of equipment to construct the scheme.
- 17.2.57. It is assumed that the structures will require piled foundations, but these will be installed using non-percussive techniques.
- 17.2.58. It is assumed that for each activity, all items of equipment would operate simultaneously, in close proximity and at a location within the Proposed A9 alignment close to the receptor. The distance between the assumed plant location and the noise sensitive receptors (NSR) have been estimated from Proposed Scheme plans.
- 17.2.59. There will be occasions during the construction programme where the distances will be less than those assumed distances, however this would be for shorter durations of time and in practice not all plant would be operating at that closest location.
- 17.2.60. It has been assumed that all construction works will be undertaken during the weekday daytime and on Saturday (07:00–12:00), and these have been taken to be the assessment periods.
- 17.2.61. The assessment considers the amount of time over which each activity takes place. For instance, if a given activity takes place for 6 out of 12 hours, a correction of -3dB is to be applied to represent the 50% of the period when the activity takes place. Similarly, a correction of -6dB would be applicable if the activity would take place over 3 hours (25% of the period). For this assessment, corrections for each item of equipment have been estimated on the following basis:
- 30% - 50% for the main activities likely to stop and start during operation
 - 10% - 20% for minor activities likely to stop and start during operation
 - 5% for activities considered to play a minor part in the overall process
- 17.2.62. Appendix A17.1 shows the assumed plant and equipment for each activity, their corresponding noise levels and percentage on-times. The total noise level for each activity is also shown.
- 17.2.63. The construction assessment assumes that the ground between the construction works and the receptors is soft ground, representative of open grassland or other natural ground types.

Construction Vibration Assessment Method

- 17.2.64. Part 2 of BS5228^{xi}, Vibration, gives guidance on methods for measuring vibration and how to assess its effects on the environment and people. The main vibration impacts arise from piling activities or heavy construction vehicle movements near sensitive receptors. Annex B of BS5228 Part 2 gives guidance on the significance of vibration effects in terms of human response to vibration (see Table 17.7 below) and the level which gives a minimum risk of vibration induced cosmetic damage to buildings (see Table 17.8 below).

Table 17.7: Guidance on effects of vibration levels perceptible to humans

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

Table 17.8: Transient vibration levels for minimum risk of cosmetic damage to building structures

Building type	Peak component particle velocity in frequency range of predominant pulse	Building type
	4 Hz to 15 Hz	15 Hz and above
Reinforced or framed structures	50mm/s at 4 Hz and above	50mm/s at 4 Hz and above
Industrial and heavy commercial buildings		
Unreinforced or light framed structures	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above

17.2.65. Annex D of BS5228 Part 2 provides some historical measured vibration levels for various piling methods and Annex E gives empirical formulae for the prediction of the resultant peak particle velocity vibration levels for various types of piling.

Construction Vibration Assessment Limitations Assumptions

17.2.66. Annex E of Part 2 of BS5228 has been used to assess the maximum distance at which vibration levels from piling works may be perceptible. The methods show that piling methods other than percussive piling vibration are unlikely to be perceptible at distances beyond 150m.

17.2.67. Vibration levels from other construction activities, including demolition, are generally imperceptible at distances greater than around 20m. Construction vibration assessments have been scoped out for receptors greater than 20m from these activities.

17.2.68. It is assumed that the structures will require piled foundations, but these are installed using non-percussive techniques.

Construction Traffic Noise Assessment Method

17.2.69. Construction traffic has the potential to create noise disturbance. The assessment considers the likely transport routes and identifies locations where there may be disturbance from construction traffic in the study area.

17.2.70. Calculations of noise levels and impacts from construction traffic have not been undertaken, and the assessment is qualitative.

17.3 Baseline Conditions

- 17.3.1. In accordance with DMRB 11:3:7, the baseline has been defined as the situation expected to exist just before the Proposed Scheme opens. This is in the absence of any noise from construction operations and is currently assumed to be in the year 2026. The baseline conditions have been predicted based on detailed computer modelling as described in Section 17.2.
- 17.3.2. A baseline noise survey has also been undertaken to gather further information about the existing noise sources and noise levels in the study area and to allow a comparison with predicted noise levels. A baseline noise survey is useful to identify the non-road related noise sources which are not taken into account in the noise modelling; such as aircraft, industrial/commercial and other human activities.
- 17.3.3. The study area is rural in nature with some small settlements and some isolated dwellings. In this case the impacts of potential noise changes are likely to be felt at larger distances than would be the case for an urban setting. This is due to there being less screening of distant properties from the road and fewer extraneous noise sources (i.e. other roads/industrial operations etc.) masking the noise from the main road.

Baseline Noise Survey

- 17.3.4. A baseline noise survey was undertaken to monitor existing noise levels at a number of noise sensitive receptors in the study area between Monday 4th July 2016 and Thursday 7th July 2016.
- 17.3.5. The survey consisted of series of attended and unattended measurements and were a mix of Long Term and Short Term CRTN Shortened Measurement Procedure at various locations along the Proposed Scheme to determine the existing noise climate at a sample of noise sensitive locations. The results have been used to verify that the noise calculations are in general agreement with the measurements and to identify the baseline conditions for the construction noise assessment.
- 17.3.6. The weather conditions during the baseline noise survey were deemed appropriate for undertaking noise measurements.

Long Term

- 17.3.7. Long term measurement involves setting up a sound level meter and leaving it on site for a period of 24 hours. Measurements of this kind allow for averaging over a longer period as well as obtaining levels for night time noise. The $L_{A10, 18\text{hour}}$ is calculated by arithmetically averaging the all hourly LA10 measurements between the hours of 06:00 and 24:00.

Short Term: CRTN Shortened Procedure

- 17.3.8. This procedure involves taking three measurements over a 3 hour period during the daytime period. In each case a 15 minute period is used to be representative of the hour in which the measurement is taken. The L_{A10} measurements are arithmetically averaged for each location to obtain the $L_{A10, 3\text{hour}}$ for the road. 1dB is then subtracted from the $L_{A10, 3\text{hour}}$ to give the $L_{A10, 18\text{hour}}$. This is in line with the Calculation of Road Traffic Noise procedures, and is a valid method for evaluating $L_{A10, 18\text{hour}}$ (DMRB Annex 4).

Measurement Locations

- 17.3.9. Noise monitoring took place between Monday 04/07/16 and Thursday 07/07/16 at twelve locations along the A9 between Tomatin and Moy. The locations are shown on Figure 17.2a-c and summary results are set out in Table 17.9:
- 17.3.10. Road traffic noise was audible at all measurement locations. At those locations closest to the A9 road traffic noise from the A9 dominated the noise climate. At the locations further from the A9 road traffic noise was one component of the noise climate. Other components included natural sounds including birdsong and breezes blowing through vegetation as well as sounds from traffic on local roads, trains and aircraft. At some locations noise from neighbours and dogs was also audible.
- 17.3.11. A summary of the measured noise levels at the locations is shown below. Columns are included to show the measurement ID from the baseline survey and the assessment receptor ID number of the location where the noise measurement was set up.

Table 17.9: Summary of Measured Baseline Noise Levels

Location	Measurement ID	Receptor ID	Type	Distance to A9 (m)	Noise Level dB(A)			
					L _{Aeq} [*]	L _{A10, 18h}	L _{A90} ⁺	L _{Amax,f}
Porter's Lodge	A	1309	Long-Term	90	55.2	57.2	41.3	90.5
Bell House	B	1731	Long-Term	45	56.1	58.5	44.3	69.5
Dalmagarry Farm	C	1159	Long-Term	40	64.6	67.5	47.2	81.7
Suilven House	D	761	Long-Term	90	49.8	50.0	37.5	79.9
Tomatinard House	1	202	Short-Term	480	48.3	49.1	41.6	69.2
Spring Cottage	2	1033	Short-Term	430	44.7	45.6	38.3	63.2
Freeburn Cottage	3	1279	Short-Term	270	45.9	46.9	35.9	69.8
Tigh-An-Allt House	4	1544	Short-Term	120	52.8	55.7	46.1	69.6
The Old Schoolhouse	5	378	Short-Term	140	54.6	46.9	39.8	80.6
4 Lynebeg	6	715	Short-Term	175	46.3	45.5	39.6	69.6
Rowan Bank	7	522	Short-Term	240	49.4	46.5	37.7	73.1
Station House	8	736	Short-Term	210	46.3	45.5	39.6	69.6

*L_{Aeq 16hr} for Long-term measurements, logarithmic average of short terms L_{Aeq} samples for Short-term measurements.

+Arithmetic average of L_{A90} samples.

17.4 Potential Impacts

Operational Noise

- 17.4.1. Part of the potential impact of the Proposed Scheme comes from changes in traffic, whereas part of the potential impact comes from proposed changes in alignment and surfacing. This section first looks at changes in noise due to changes in traffic, and then looks at overall changes at receptors in the calculation area.

Change in Noise due to Change in Traffic

- 17.4.2. Tables 17.10 and 17.11 below shows the total 18 hour traffic flows for each of the main sections of road in the study area. With each set of traffic the Basic Noise Level (BNL), is shown, which is calculated using the procedures described in CRTN. The BNL is the $L_{A10,18h}$ noise level expected at a position 10m from the edge of the road.
- 17.4.3. The last column in the table is the difference between the BNL values and shows the change in noise due to changes in traffic on that road section.
- 17.4.4. For simplicity the calculated BNL is based on the 18 hour traffic data. As described above the assessment at receptors is calculated using the hourly traffic data, and the numbers in this section may be marginally different from those assessed using hourly traffic data. Further differences arise because the assessment at receptors also takes into account differences in alignment and surfacing which are not taken into account in this table.

Table 17.10: Noise Assessment Traffic Data – First full year of operation

Road Segment	First full year of operation Do-Minimum				First full year of operation Do-Something				Change in BNL dB $L_{A10,18h}$
	Traffic Flow 18h AAWT	% Heavy vehicles	Average Speed Km/h	BNL dB $L_{A10,18h}$	Traffic Flow 18h AAWT	% Heavy vehicles	Average Speed Km/h	BNL dB $L_{A10,18h}$	
A9 - South to Junction	12392	14.5%	90.9	74.2	14645	13.0%	104.0	75.8	1.6
A9 - Junction - B9154	13216	14.1%	81.1	73.7	15497	12.5%	100.7	75.7	2.0
A9 - B9154 - Lynebeg junction	13162	14.0%	80.7	73.6	15359	12.5%	101.8	75.7	2.1
A9 - Lynebeg - North A9	13164	14.0%	82.1	73.7	15334	12.5%	103.5	75.9	2.2
B9154 - A9 to Lynebeg	226	13.8%	60.8	-	152	12.6%	94.3	-	-
B9154 - Lynebeg - North	230	8.5%	57.3	-	212	11.8%	86.5	-	-
C1121 - A9 to Tomatin	1179	7.6%	59.7	60.3	1497	8.8%	58.8	61.5	1.2
Road south of Tomatin	223	17.3%	51.2	-	17	93.1%	36.4	-	-

- 17.4.5. Table 17.10 shows that changes in traffic on the A9 are expected to give rise to perceptible increases in noise of around 2dB.
- 17.4.6. Traffic flows on the B9154 and the road south of Tomatin village are significantly below 1000 vehicles per day, and the procedures in CRTN do not allow accurate calculation of noise levels for this route. It is noted that traffic speeds on the B9154 with the Proposed Scheme would increase, giving rise to an increase in noise levels, and flows on the road south of Tomatin would decrease, giving rise to a decrease in noise. Changes in noise on these roads have not been assessed.
- 17.4.7. The C1121 Tomatin Road to the A9 is expected to experience an increase in traffic, resulting in a perceptible increase in noise of around 1dB. This road is included in the calculation area.

Table 17.11: Noise Assessment Traffic Data – Design Year and Proposed Scheme

Road Segment	Design year Do-Minimum				Design year Do-Something				Change in BNL	
	Traffic Flow 18h AAWT	% Heavy vehicles	Average Speed Km/h	BNL	Traffic Flow 18h AAWT	% Heavy vehicles	Average Speed Km/h	BNL	Do Minimum	Scheme Effect
A9 - South to Junction	14108	13.9%	90.8	74.7	16330	12.7%	103.5	76.2	0.5	2.0
A9 - Junction - B9154	14110	13.9%	85.7	74.3	17352	12.3%	98.4	76.0	0.6	2.3
A9 - B9154 - Lynebeg junction	15011	13.5%	79.3	74.0	17203	12.3%	97.3	75.9	0.4	2.3
A9 - Lynebeg - North A9	15010	13.4%	81.5	74.2	17162	12.3%	101.6	76.2	0.5	2.5
B9154 - A9 to Lynebeg	253	12.8%	60.8	-	166	10.7%	91.5	-	-	-
B9154 - Lynebeg - North	231	6.9%	59.5	-	160	14.0%	98.0	-	-	-
C1121 - A9 to Tomatin	1339	7.0%	64.1	61.1	1667	8.1%	44.6	60.7	0.8	0.4
Road south of Tomatin	228	16.8%	51.2	-	17	93.1%	36.4	-	-	-

- 17.4.8. Table 17.11 shows two changes in BNL, the change in noise by the design year if the Proposed Scheme were not built, and the change in noise by the design year with the Proposed Scheme. Both changes are relevant to the first full year of operation, do minimum results from Table 17.10.
- 17.4.9. Changes in noise would be expected to be negligible if the Proposed Scheme were not built, less than 1dB in all cases.

- 17.4.10. Changes in noise by the design year with the Proposed Scheme in place would also be expected to be negligible, with noise levels being less than 3dB in all cases.
- 17.4.11. These tables show that the Proposed Scheme impacts are likely to be greatest in the first full year of operation of the scheme.
- 17.4.12. Noise calculations show that noise changes in the wider study area, other than the A9, are not significant (i.e. 1dB or more). Changes in noise on sections of the A9 outside the extents of the Proposed Scheme are considered in the assessments for other A9 Dualling projects.

Calculation Area Impacts, First full year of operation

- 17.4.13. The detailed assessment at the 246 receptors in the calculation area shows the following changes in noise, as shown in Table 17.12: and Figure 17.3a-f.

Table 17.12: Short-term (2026 First full year of operation) Changes in Traffic Noise

Change in noise level		Number of dwellings	Number of other sensitive receptors
Increase in noise levels, L _{A10, 18h}	0.1 – 0.9	20	0
	1 – 2.9	158	10
	3 – 4.9	3	0
	>=5	0	0
No change	=0	1	0
Decrease in noise level, L _{A10, 18h}	0.1 – 0.9	13	1
	1 – 2.9	35	3
	3 – 4.9	1	0
	>=5	1	0

- 17.4.14. Changes in noise associated with the opening of the Proposed Scheme are;
- Negligible change (smaller than 1dB) or no change at 34 dwellings and 1 other receptor.
 - Perceptible decreases in noise at 37 dwellings and 3 other receptors.
 - Perceptible increases in noise at 161 dwellings and 10 other receptors.
- 17.4.15. The majority of the increases in noise are in the area around Tomatin arising either from increases in traffic on the existing dual carriageway section of the A9 or from changes in traffic on the road through the village of Tomatin. The greatest increases in noise are between 3 and 4dB. Two of these are near Tomatin Distillery, one is near the existing dual carriageway section of the A9.
- 17.4.16. Of the perceptible increases in noise, the levels at 139 of the dwellings remains below 54.5dB. There are 16 dwellings where the noise level remains below 59.5dB and the increase in noise is smaller than 3dB. These 156 properties are below the threshold for mitigation, as defined in Section 7.2.
- 17.4.17. There are 5 properties with perceptible increases in noise where levels meet or exceed 59.5dB, and one property with an increase of 3.0dB where the levels meet or exceed

54.5dB. Therefore the need for noise mitigation at these six properties was considered, as described below.

- 17.4.18. Three of these six properties are in Tomatin village, and the changes in noise are predominantly from changes in traffic on the C1121 through Tomatin village as shown in Table 17.10. The greatest short term increase in noise at these properties is 2.0dB. For these properties mitigation is not proposed as the changes in noise are predominantly from traffic changes on the local road. Additionally, the noise impacts at these locations by the design year are negligible. One of these properties, Tomatinard House, is included in Table 17.13 and Table 17.16.
- 17.4.19. No works are being undertaken on the C1121, and these properties require vehicular access from their properties onto this road, making the installation of noise barriers impractical. Such noise barriers would also likely be visually intrusive. The traffic data shows that the average traffic speed is below 75km/hr, so benefits of lower noise surfaces cannot be taken into account. This makes resurfacing the C1121 with a lower noise surface impractical. No other noise mitigation options are considered feasible.
- 17.4.20. The remaining three of the six properties where noise mitigation was considered are in Tomatin village, near the existing dual carriageway section of the A9, and the increase in noise is due to additional traffic using this section of the road. One of these properties, Porters Lodge, is shown in Table 17.13, and mitigation in this area is considered in Section 17.5.
- 17.4.21. Of the other sensitive receptors, one building, Tomatin Church, meets the residential criteria for mitigation, but like the properties in Tomatin, the change in noise is predominantly from changes in traffic on the C1121 as shown in Table 17.10. Mitigation is not proposed. The edge of the SAC at The Slochd also meets the residential criteria for mitigation, however noise levels soon drop below the threshold as distance from the A9 is increased and no mitigation is proposed.
- 17.4.22. 37 residential properties are predicted to experience a perceptible decrease of noise of at least 1dB. These properties are along the route of the A9, and the perceptible decrease arises as a result of the Proposed Scheme using lower noise surfacing. The acoustic benefits of the lower noise surface are greater than the increases in noise expected from changes in traffic.
- 17.4.23. Pinewood, in Tomatin, shows a major decrease in noise. At this property noise levels decrease because local traffic now joins the A9 at the new junction and no longer passes the front of this property. Pinewood is shown in Table 17.13.
- 17.4.24. The changes in noise at the remaining 34 residential properties and 1 non-residential receptor are negligible.
- 17.4.25. Table 17.13: below shows the predicted noise impacts for a selection of receptors throughout the calculation area (refer to Figure 17.1a-c). These receptors have been selected to represent most of the communities and the reported range of impacts. Predicted noise levels for all receptors in the calculation area are provided in Appendix A17.2. In Table 17.13 DM is Do Minimum, the situation without the Proposed Scheme and DS is Do Something, the situation with the Proposed Scheme.

Table 17.13: Short-term (2026 First full year of operation) Changes in Traffic Noise (Sample Receptors)

Sample Receptor ID	Sample Receptor Address	DM First full year of operation dB L _{A10, 18h}	DS First full year of operation dB L _{A10, 18h}	Noise Change dB L _{A10, 18h}	Impact Magnitude
1797	Tuimbhig, Tomatin, IV13 7XY	56.7	58.1	1.4	Minor increase
406	Archers Cottage, Tomatin, IV13 7XY	49.6	50.9	1.3	Minor increase
202	Tomatinard House, Tomatin, IV13 7YN	59.2	61.0	1.8	Minor increase
354	The Heights, Tomatin, IV13 7YN	52.4	54.0	1.6	Minor increase
1033	Spring Cottage, Station Road, Tomatin, IV13 7YR	52.9	54.6	1.7	Minor increase
1309	Porter's Lodge, Tomatin, IV13 7YP	58.8	61.7	2.9	Minor increase
1314	5 Distillery Cottages, Distillery Access Road, Tomatin, IV13 7YT	49.3	49.7	0.4	Negligible
1223	Pinewood, Tomatin, IV13 7YP	56.8	51.7	-5.1	Major decrease
1551	Altdhubhag, Allt Dubhag Road, Tomatin, IV13 7YP	59.6	58.0	-1.6	Minor decrease
1638	Woodland House, Allt Dubhag Road, Tomatin, IV13 7YP	60.7	59.6	-1.1	Minor decrease
1731	The Bellhouse, Allt Dubhag Road, Tomatin, IV13 7YP	65.4	64.1	-1.3	Minor decrease
1538	Gardener's Cottage, Tigh-An-Allt, Allt Dubhag Road, Tomatin, IV13 7YP	59.2	57.6	-1.6	Minor decrease
1572	Invereen, Allt Dubhag Road, Tomatin, IV13 7YP	40.0	38.4	-1.6	Minor decrease
1159	The Sheiling, Dalmagarry, Shennachie Road, Tomatin, IV13 7YD	59.2	55.9	-3.3	Moderate decrease
378	The Old Schoolhouse, Moy School Road, Tomatin, IV13 7YE	57.2	55.6	-1.6	Minor decrease
992	Allt-Na-Slanaichd, Lynebeg Road, Tomatin, IV13 7YE	43.9	42.6	-1.3	Minor decrease

Sample Receptor ID	Sample Receptor Address	DM First full year of operation dB L _{A10, 18h}	DS First full year of operation dB L _{A10, 18h}	Noise Change dB L _{A10, 18h}	Impact Magnitude
782	Moybeg Cottage, Lynebeg Road, Tomatin, IV13 7YE	52.6	51.1	-1.5	Minor decrease
965	Fearnach, Lynebeg Road, Tomatin, IV13 7YE	44.8	44.1	-0.7	Negligible
723	Forester's House, Lynebeg Road, Tomatin, IV13 7YE	52.4	52.5	0.1	Negligible
1018	Keepers Cottage, Keeper's Cottage, Lynemore, Lynebeg Road, Tomatin, IV13	53.3	52.6	-0.7	Negligible
522	Rowan Bank, Lynebeg Road, Tomatin, IV13 7YE	54.9	53.0	-1.9	Minor decrease
746	Old Inn, Moy Station Road, Tomatin, IV13 7YF	46.4	44.8	-1.6	Minor decrease
761	Suilven, Moy Station Road, Tomatin, IV13 7YF	59.2	56.4	-2.8	Minor decrease

- 17.4.26. The properties which are further than 600m from the Proposed Scheme fall into two groups. Those properties that are south and east of Tomatin generally show a perceptible increase in noise because of changes in noise on the existing dual carriageway section of the A9, generally between 1 and 2dB. Additionally, those properties that are further than 600m from the Proposed Scheme within its extents, for example those on Moy Mains Road (to the north west of Loch Moy), show perceptible decreases in noise as a result of the lower noise surfacing, generally between 1 and 2dB.

Calculation Area Impacts, by the Design Year

- 17.4.27. For the design year noise impacts, a comparison is made between the noise levels with the scheme in the 15th year from opening and the noise levels without the scheme in the baseline year.
- 17.4.28. Table 17.14: presents the noise results in terms of the DMRB long term noise change magnitude levels for daytime with the Proposed Scheme in place.

Table 17.14: Changes in Traffic Noise by the Design Year with the Proposed Scheme (Daytime)

Change in noise level	Number of dwellings	Number of other sensitive receptors
Increase in noise levels, L _{A10, 18h}	0.1 – 2.9	181
	3 – 4.9	7
	5 – 9.9	0
	>=10	0

Change in noise level		Number of dwellings	Number of other sensitive receptors
No change	=0	0	0
Decrease in noise level, L _{A10, 18h}	0.1 – 2.9	43	4
	3 – 4.9	1	0
	5 – 9.9	0	0
	>=10	0	0

- 17.4.29. There are seven residential properties which are shown to receive a perceptible increase in noise during the day. The noise levels at five of these properties are below 54.5dB, and therefore below the threshold for mitigation. The increase in noise at the remaining two properties is between 3.0 and 3.5dB. One property has noise levels above 59.5dB and meets the mitigation threshold, whereas the other has noise levels between 54.5 and 59.5dB and does not meet the threshold. The property meeting the mitigation threshold, Porters Lodge, is shown in Table 17.16. Both properties are in the same area, and mitigation for this is considered in Section 17.5.
- 17.4.30. One property is shown to receive a perceptible decrease in noise, Pinewood (Tomatin) as described in the first full year of operation impact assessment. This noise change at Pinewood is shown in Table 17.16 below.
- 17.4.31. Table 17.15 presents the noise results in terms of the DMRB long term noise change magnitude levels for night-time with the Proposed Scheme in place. Night-time impacts are only reported where the predicted noise level is greater than 55 dB L_{night, outside} in any scenario. The changes in noise are represented in Figure 17.4a-f.

Table 17.15: Changes in Traffic Noise by the Design Year with the Proposed Scheme (Night-time, receptors >=55dB)

Change in noise level		Number of dwellings	Number of other sensitive receptors
Increase in noise levels, L _{night}	0.1 – 2.9	43	3
	3 – 4.9	0	0
	5 – 9.9	0	0
	>=10	0	0
No change	=0	0	0
Decrease in noise level, L _{night}	0.1 – 2.9	1	0
	3 – 4.9	0	0
	5 – 9.9	0	0
	>=10	0	0

- 17.4.32. There are 46 receptors where the night time noise level is greater than 55dB, and the changes in noise at all of these properties is smaller than 3dB and is negligible.
- 17.4.33. Table 17.14: shows that noise changes as a result of the Proposed Scheme in the long term are predicted to be negligible at all other noise sensitive receptors. The results at the selected receptors shown above (Table 17.13) are repeated for the design year

impacts. Predicted noise levels for all receptors in the calculation area are provided in Appendix A17.2. In Table 17.16 DM is Do Minimum (the situation without the scheme) and DS is Do Something (the situation with the scheme).

Table 17.16: Changes in Traffic Noise by the Design Year with the Proposed Scheme (daytime, Sample receptors)

Sample Receptor ID	Sample Receptor Address	DM First full year of operation dB L _{A10, 18h}	DS Design year dB L _{A10, 18h}	Noise Change dB L _{A10, 18h}	Impact Magnitude
1797	Tuimhig, Tomatin, IV13 7XY	56.7	58.6	1.9	Negligible
406	Archers Cottage, Tomatin, IV13 7XY	49.6	51.2	1.6	Negligible
202	Tomatinard House, Tomatin, IV13 7YN	59.2	61.4	2.2	Negligible
354	The Heights, Tomatin, IV13 7YN	52.4	54.4	2.0	Negligible
1033	Spring Cottage, Station Road, Tomatin, IV13 7YR	52.9	55.0	2.1	Negligible
1309	Porter's Lodge, Tomatin, IV13 7YP	58.8	62.1	3.3	Minor increase
1314	5 Distillery Cottages, Distillery Access Road, Tomatin, IV13 7YT	49.3	50.1	0.8	Negligible
1223	Pinewood, Tomatin, IV13 7YP	56.8	52.1	-4.7	Minor decrease
1551	Altdhubhag, Allt Dubhag Road, Tomatin, IV13 7YP	59.6	58.4	-1.2	Negligible
1638	Woodland House, Allt Dubhag Road, Tomatin, IV13 7YP	60.7	60.0	-0.7	Negligible
1731	The Bellhouse, Allt Dubhag Road, Tomatin, IV13 7YP	65.4	64.5	-0.9	Negligible
1538	Gardener's Cottage, Tigh-An-Allt, Allt Dubhag Road, Tomatin, IV13 7YP	59.2	58.0	-1.2	Negligible
1572	Invereen, Allt Dubhag Road, Tomatin, IV13 7YP	40.0	38.8	-1.2	Negligible
1159	The Sheiling, Dalmagarry, Shennachie Road, Tomatin, IV13 7YD	59.2	56.3	-2.9	Negligible
378	The Old Schoolhouse, Moy School Road, Tomatin, IV13 7YE	57.2	56.0	-1.2	Negligible
992	Allt-Na-Slanaichd, Lynebeg Road, Tomatin, IV13 7YE	43.9	43.0	-0.9	Negligible
782	Moybeg Cottage, Lynebeg Road, Tomatin, IV13 7YE	52.6	51.5	-1.1	Negligible

Sample Receptor ID	Sample Receptor Address	DM First full year of operation dB L _{A10, 18h}	DS Design year dB L _{A10, 18h}	Noise Change dB L _{A10, 18h}	Impact Magnitude
965	Fearnach, Lynebeg Road, Tomatin, IV13 7YE	44.8	44.5	-0.3	Negligible
723	Forester's House, Lynebeg Road, Tomatin, IV13 7YE	52.4	53.0	0.6	Negligible
1018	Keepers Cottage, Keeper's Cottage, Lynemore, Lynebeg Road, Tomatin, IV13	53.3	53.0	-0.3	Negligible
522	Rowan Bank, Lynebeg Road, Tomatin, IV13 7YE	54.9	53.4	-1.5	Negligible
746	Old Inn, Moy Station Road, Tomatin, IV13 7YF	46.4	45.2	-1.2	Negligible
761	Suilven, Moy Station Road, Tomatin, IV13 7YF	59.2	56.8	-2.4	Negligible

Calculation Area Impacts, by the Design Year Without the Proposed Scheme

- 17.4.34. A parallel comparison is also made for the Do-Minimum situation in the long term assuming that the Proposed Scheme did not go ahead (i.e. noise change between Do-Minimum 2026 and Do-Minimum 2041).
- 17.4.35. Table 17.17 presents the noise results in terms of the DMRB long term noise change magnitude levels for daytime by the design year without the Proposed Scheme in place. Table 17.18 presents the noise results in terms of the DMRB long term noise change magnitude levels for night-time by the design year without the Proposed Scheme in place. Night-time impacts are only reported where the predicted noise level is greater than 55 dB L_{night,outside} in any scenario.

Table 17.17: Changes in Traffic Noise by the Design Year without the Proposed Scheme (Daytime)

Change in noise level		Number of dwellings	Number of other sensitive receptors
Increase in noise levels, L _{A10, 18h}	0.1 – 2.9	232	14
	3 – 4.9	0	0
	5 – 9.9	0	0
	>=10	0	0
No change	=0	0	0
Decrease in noise level, L _{A10, 18h}	0.1 – 2.9	0	0
	3 – 4.9	0	0
	5 – 9.9	0	0
	>=10	0	0

Table 17.18: Changes in Traffic Noise by the Design Year without the Proposed Scheme (Night-time, receptors ≥ 55 dB)

Change in noise level		Number of dwellings	Number of other sensitive receptors
L _{night}	0.1 – 2.9	86	3
	3 – 4.9	0	0
	5 – 9.9	0	0
	≥ 10	0	0
No change	=0	0	0
Decrease in noise level, L _{night}	0.1 – 2.9	0	0
	3 – 4.9	0	0
	5 – 9.9	0	0
	≥ 10	0	0

17.4.36. The results of the assessment shows that should the Proposed Scheme not go ahead all changes in noise would be negligible increases in noise, both during the day and at night. These impacts can also be seen in the noise map in Figure 17.5a-f, and the results at the selected receivers are also shown in Table 17.19 below for the without scheme design year impacts. Predicted noise levels for all receptors in the calculation area are provided in Appendix A17.2. In Table 17.19 DM is Do Minimum, the situation without the Proposed Scheme.

Table 17.19: Changes in Traffic Noise by the Design Year without the Scheme (daytime, Sample receptors)

Sample Receptor ID	Sample Receptor Address	DM First full year of operation dB L _{A10, 18h}	DM Design year dB L _{A10, 18h}	Noise Change dB L _{A10, 18h}	Impact Magnitude
1797	Tuimbhig, Tomatin, IV13 7XY	56.7	57.2	0.5	Negligible
406	Archers Cottage, Tomatin, IV13 7XY	49.6	50.1	0.5	Negligible
202	Tomatinard House, Tomatin, IV13 7YN	59.2	59.8	0.6	Negligible
354	The Heights, Tomatin, IV13 7YN	52.4	52.9	0.5	Negligible
1033	Spring Cottage, Station Road, Tomatin, IV13 7YR	52.9	53.4	0.5	Negligible
1309	Porter's Lodge, Tomatin, IV13 7YP	58.8	59.3	0.5	Negligible
1314	5 Distillery Cottages, Distillery Access Road, Tomatin, IV13 7YT	49.3	49.8	0.5	Negligible
1223	Pinewood, Tomatin, IV13 7YP	56.8	57.3	0.5	Negligible

Sample Receptor ID	Sample Receptor Address	DM First full year of operation dB L _{A10, 18h}	DM Design year dB L _{A10, 18h}	Noise Change dB L _{A10, 18h}	Impact Magnitude
1551	Altdhubhag, Allt Dubhag Road, Tomatin, IV13 7YP	59.6	60.0	0.4	Negligible
1638	Woodland House, Allt Dubhag Road, Tomatin, IV13 7YP	60.7	61.1	0.4	Negligible
1731	The Bellhouse, Allt Dubhag Road, Tomatin, IV13 7YP	65.4	65.9	0.5	Negligible
1538	Gardener's Cottage, Tigh-An-Allt, Allt Dubhag Road, Tomatin, IV13 7YP	59.2	59.6	0.4	Negligible
1572	Invereen, Allt Dubhag Road, Tomatin, IV13 7YP	40.0	40.5	0.5	Negligible
1159	The Sheiling, Dalmagarry, Shennachie Road, Tomatin, IV13 7YD	59.2	59.6	0.4	Negligible
378	The Old Schoolhouse, Moy School Road, Tomatin, IV13 7YE	57.2	57.6	0.4	Negligible
992	Allt-Na-Slanaichd, Lynebeg Road, Tomatin, IV13 7YE	43.9	44.3	0.4	Negligible
782	Moybeg Cottage, Lynebeg Road, Tomatin, IV13 7YE	52.6	53.1	0.5	Negligible
965	Fearnach, Lynebeg Road, Tomatin, IV13 7YE	44.8	45.2	0.4	Negligible
723	Forester's House, Lynebeg Road, Tomatin, IV13 7YE	52.4	52.9	0.5	Negligible
1018	Keepers Cottage, Keeper's Cottage, Lynemore, Lynebeg Road, Tomatin, IV13	53.3	53.7	0.4	Negligible
522	Rowan Bank, Lynebeg Road, Tomatin, IV13 7YE	54.9	55.3	0.4	Negligible
746	Old Inn, Moy Station Road, Tomatin, IV13 7YF	46.4	46.8	0.4	Negligible
761	Suilven, Moy Station Road, Tomatin, IV13 7YF	59.2	59.6	0.4	Negligible

Noise Nuisance Calculations

- 17.4.37. As described in Section 17.2 an assessment of the change in nuisance is required for residential receptors. The assessment considers the worst case change in nuisance by the design year for the situations with and without the Proposed Scheme. The results are presented in Table 17.20.

Table 17.20: Traffic Noise Nuisance Assessment

Change in nuisance level		Number of dwellings – without scheme	Number of dwellings – with scheme
Increase in nuisance level	>0 - <10 %	232	10
	10 - <20 %	0	14
	20 - <30 %	0	161
	30 - <40 %	0	3
	>=40 %	0	0
No change	=0 %	0	0
Decrease in nuisance level	>0 - <10 %	0	44
	10 - <20 %	0	0
	20 - <30 %	0	0
	30 - <40 %	0	0
	>=40 %	0	0

- 17.4.38. Table 17.20 shows that 178 residential locations are predicted to receive an increase in noise nuisance greater than 10%, which is predominantly from the changes in noise on scheme opening. The three dwellings with the greatest increase in nuisance (30-40%) are the properties with the highest change in noise on scheme opening.
- 17.4.39. 44 properties are shown to have a decrease in nuisance due to the lower noise surfacing reducing noise levels at these properties.
- 17.4.40. If the Proposed Scheme were not built all dwellings would receive an increase in nuisance of less than 10%.

Noise Insulation Regulations

- 17.4.41. The noise calculation method used for this assessment is not the same as the method described in the Noise Insulation (Scotland) Regulations, although there are a number of similarities between the two calculation methods.
- 17.4.42. In order to get an initial understanding of properties which may qualify for insulation, the results of this assessment have been compared against the noise criteria described in the Noise Insulation Regulations.
- 17.4.43. This indicative assessment shows that there are no properties which may be eligible for noise insulation as a result of the Proposed Scheme. No properties receive noise levels above 67.5dBA. There is only one property shown to have a noise level in excess of 65dB(A), in Tomatin village, near the existing dual carriageway section of the A9.

Operational Vibration

Ground-borne vibration

- 17.4.44. Ground-borne vibration has been scoped out of the assessment, as described in Section 17.2.

Airborne vibration

- 17.4.45. As described in Section 17.2 the assessment of airborne vibration is limited to properties within 40m of the Proposed Scheme and where noise levels are in excess of 58dB L_{A10, 18hr}.
- 17.4.46. There are only six dwellings that are within 40m of the Proposed Scheme, and none are closer than 30m from the Proposed Scheme. Only two of these properties are within 40m of the A9, the others being within 40m of a slip road or junction. The noise levels at these six properties are in excess of 58dB L_{A10, 18hr}. The airborne vibration nuisance assessment is shown in Table 17.21.

Table 17.21: Traffic Induced Airborne Vibration Nuisance Assessment

Change in nuisance level		Number of dwellings – without scheme	Number of dwellings – with scheme
Increase in nuisance level	>0 - <10 %	0	0
	10 - <20 %	0	0
	20 - <30 %	0	0
	30 - <40 %	0	0
	>=40 %	0	0
No change	=0 %	6	6
Decrease in nuisance level	>0 - <10 %	0	0
	10 - <20 %	0	0
	20 - <30 %	0	0
	30 - <40 %	0	0
	>=40 %	0	0

- 17.4.47. Table 17.21 shows that there is no change in airborne vibration at any of these properties.

Cumulative Operational Effects

- 17.4.48. The vibration assessment shows that there is no predicted change in vibration and therefore there cannot be any cumulative noise and vibration effects.
- 17.4.49. Cumulative effects relating to other environmental parameters are considered in Chapter 20.

Temporary Effects - Construction

Construction noise

- 17.4.50. Chapter 5 describes the construction activities expected for the Proposed Scheme. As described in Section 17.2 plant and equipment for each activity have been assumed based on previous similar projects and as described in paragraph 17.2.61. Table 17.22 shows the assumed noise level for each activity, and full details of this can be seen in Appendix A17.1.

Table 17.22: Noise levels for construction activities

Construction Phase	Construction activity	Source noise level $L_{Aeq,1\text{ hr}}$ at 10m distance
Advance Works	Utility Diversions	77.0
Road Works	Site Set-up	80.8
	Earthworks	84.5
	Road Formation	83.5
	Signs, Lighting, Safety Barriers	80.9
	Rock Cutting	89.9
Structures	Sub-structure	82.7
	Super-structure	79.6
	Underpass	77.9
	Culvert	82.9
	Demolition	89.2
Environmental	Landscape	81.4
	Watercourse	84.7

- 17.4.51. The activity with the highest noise level is Rock Cutting, with a noise level of 89.9 at 10m.
- 17.4.52. Construction noise levels from each phase of the Proposed Scheme construction have been determined at 14 assessment locations that are considered representative of all dwellings or other sensitive receptors with a likely direct line of sight to the construction activities, as shown in Table 17.23, with distances given to those activities, generally within around 500m.

Table 17.23: Construction noise and vibration receptors and distances

Receptor ID	Receptor Address	Distances to various receptors								
		Distance to A9 (m)	Distance to Tomatin LILO	Distance to Tomatin GSJ	Distance to Dalraddy Burn/ Underpass	Distance to Moy LILO	Distance to Moy Rail Bridge	Distance to Lynbeg LILO	Distance to Lynbeg Rail underpass	Distance to access/other roads
1309	Porter's Lodge, Tomatin, IV13 7YP	110	-	110	-	-	-	-	-	10
1223	Pinewood, Tomatin, IV13 7YP	200	-	165	-	-	-	-	-	30
1551	Altdhubhag, Allt Dubhag Road, Tomatin, IV13 7YP	110	-	-	-	-	-	-	-	80

Receptor ID	Receptor Address	Distance to A9 (m)	Distance to Tomatin LLO	Distance to Tomatin GSJ	Distance to Dalraddy Burn/ Underpass	Distance to Moy LLO	Distance to Moy Rail Bridge	Distance to Lynbeg LLO	Distance to Lynbeg Rail underpass	Distance to access/other roads
1638	Woodland House, Allt Dubhag Road, Tomatin, IV13 7YP	60	-	-	-	-	-	-	-	-
1731	The Bellhouse, Allt Dubhag Road, Tomatin, IV13 7YP	40	-	-	-	-	-	-	-	-
1538	Gardener's Cottage, Tigh-An-Allt, Allt Dubhag Road, Tomatin, IV13 7YP	90	-	-	-	-	-	-	-	40
1159	The Sheiling, Dalmagarry, Shennachie Road, Tomatin, IV13 7YD	50	-	-	25	330	-	-	-	10
378	The Old Schoolhouse, Moy School Road, Tomatin, IV13 7YE	140	-	-	-	-	400	-	-	-
992	Allt-Na-Slanaichd, Lynebeg Road, Tomatin, IV13 7YE	190	-	-	-	-	-	190	40	-
965	Fearnach, Lynebeg Road, Tomatin, IV13 7YE	170	-	-	-	-	-	180	40	-
782	Moybeg Cottage, Lynebeg Road, Tomatin, IV13 7YE	100	-	-	-	-	-	120	90	70
723	Forester's House, Lynebeg Road, Tomatin, IV13 7YE	140	-	-	-	-	-	230	370	10
1018	Keepers Cottage, Keeper's Cottage, Lynemore, Lynebeg Road, Tomatin, IV13	210	-	-	-	-	-	300	600	20
761	Suilven, Moy Station Road, Tomatin, IV13 7YF	90	-	-	-	-	-	300	530	-

17.4.53. The baseline monitoring described in Section 7.3 has been used to determine the ambient noise level and BS5228 category, as described in Table 17.24.

Table 17.24: Predicted daytime construction noise impact significance at existing noise sensitive receptors

Receptor ID	Receptor Address	Nearest Measurement ID	Ambient value (rounded to nearest 5dB)	BS5228 category
1309	Porter's Lodge, Tomatin, IV13 7YP	A	55	A
1223	Pinewood, Tomatin, IV13 7YP	3	45	A
1551	Altdhubhag, Allt Dubhag Road, Tomatin, IV13 7YP	B	55	A

Receptor ID	Receptor Address	Nearest Measurement ID	Ambient value (rounded to nearest 5dB)	BS5228 category
1638	Woodland House, Allt Dubhag Road, Tomatin, IV13 7YP	B	55	A
1731	The Bellhouse, Allt Dubhag Road, Tomatin, IV13 7YP	B	55	A
1538	Gardener's Cottage, Tigh-An-Allt, Allt Dubhag Road, Tomatin, IV13 7YP	4	50	A
1159	The Sheiling, Dalmagarry, Shennachie Road, Tomatin, IV13 7YD	C	65	B
378	The Old Schoolhouse, Moy School Road, Tomatin, IV13 7YE	5	55	A
992	Allt-Na-Slanaichd, Lynebeg Road, Tomatin, IV13 7YE	5	55	A
965	Fearnach, Lynebeg Road, Tomatin, IV13 7YE	7	50	A
782	Moybeg Cottage, Lynebeg Road, Tomatin, IV13 7YE	D	50	A
723	Forester's House, Lynebeg Road, Tomatin, IV13 7YE	6	45	A
1018	Keepers Cottage, Keeper's Cottage, Lynemore, Lynebeg Road, Tomatin, IV13	6	45	A
761	Suilven, Moy Station Road, Tomatin, IV13 7YF	D	50	A

17.4.54. Most of the receptors are in BS5228 category A, with one receptor, at Dalmagarry, in category B.

17.4.55. Combining the information from Tables 17.22 and 17.24 allows the maximum distance for a significant effect to be determined, by reference to the construction activity with the highest noise level, rock cutting.

Table 17.25: Maximum distance for potentially significant effect

BS5228 Category	Time period	Significance Threshold	Attenuation to reduce 90dB to significance threshold	Distance needed for attenuation
A	Daytime (07:00 to 19:00)	65	25	150
A	Evening/Weekend	55	35	300
A	Night	45	45	750
B	Daytime (07:00 to 19:00)	70	20	75
B	Evening/Weekend	60	30	200
B	Night	50	40	500

- 17.4.56. Table 17.25 shows that for activities during the weekday, any activity more than 150m away is unlikely to give rise to a significant effect. For activities taking place on a Saturday afternoon, any activity more than 300m is unlikely to give rise to a significant effect.
- 17.4.57. Therefore, activities further than 300m from any receptor do not need to be considered any further in the assessment as they are unlikely to give rise to a significant effect.
- 17.4.58. The construction noise levels have been calculated for a typical period in dB $L_{Aeq,1hr}$ for each construction activity at each of the representative receptors. The levels are considered representative of working periods longer than 1hr. The results for construction activities at these closest distances are detailed in Table 17.26 (for the A9 construction) and Table 17.27 (for junctions, structures, water courses and access/other roads).

Table 17.26: Predicted construction noise levels at existing noise sensitive receptors

Receptor ID	Receptor Address	Noise level for A9 construction activity (dB $L_{Aeq,1hr}$)						
		Utility Diversion	Site Set-up	Earthworks	Road Formation and surfacing	Signs, Lighting, Safety Barriers	Rock Cutting	Landscaping
1309	Porter's Lodge, Tomatin, IV13 7YP	53	57	61	60	57	-	57
1223	Pinewood, Tomatin, IV13 7YP	46	50	54	53	50	-	50
1551	Alldhubhag, Allt Dubhag Road, Tomatin, IV13 7YP	53	57	61	60	57	-	57
1638	Woodland House, Allt Dubhag Road, Tomatin, IV13 7YP	60	64	68	67	64	-	64
1731	The Bellhouse, Allt Dubhag Road, Tomatin, IV13 7YP	64	68	72	71	68	-	68
1538	Gardener's Cottage, Tigh-An-Allt, Allt Dubhag Road, Tomatin, IV13 7YP	55	59	63	62	59	-	59
1159	The Sheiling, Dalmagarry, Shennachie Road, Tomatin, IV13 7YD	62	66	70	69	66	-	66
378	The Old Schoolhouse, Moy School Road, Tomatin, IV13 7YE	50	54	58	57	54	-	54
992	Allt-Na-Slanaichd, Lynebeg Road, Tomatin, IV13 7YE	47	51	55	54	51	-	51
965	Fearnach, Lynebeg Road, Tomatin, IV13 7YE	48	52	56	55	52	-	52
782	Moybeg Cottage, Lynebeg Road, Tomatin, IV13 7YE	54	58	62	61	58	-	58
723	Forester's House, Lynebeg Road, Tomatin, IV13 7YE	50	54	58	57	54	-	54

Receptor ID	Receptor Address	Noise level for A9 construction activity (dB L _{Aeq,1 hr})						
		Utility Diversion	Site Set-up	Earthworks	Road Formation and surfacing	Signs, Lighting, Safety Barriers	Rock Cutting	Landscaping
1018	Keepers Cottage, Keeper's Cottage, Lynemore, Lynebeg Road, Tomatin, IV13	46	50	54	53	50	-	50
761	Suilven, Moy Station Road, Tomatin, IV13 7YF	55	59	63	62	59	-	59

Table 17.27: Predicted construction noise levels at existing noise sensitive receptors

Receptor ID	Receptor Address	Noise level for other construction activities (dB L _{Aeq,1 hr})						
		Sub-structure	Super-structure	Underpass	Demolition	Watercourse	Access - Earthworks	Access - Road formation
1309	Porter's Lodge, Tomatin, IV13 7YP	59	56	-	-	-	85	84
1223	Pinewood, Tomatin, IV13 7YP	55	52	-	-	-	75	74
1551	Alldhubhag, Allt Dubhag Road, Tomatin, IV13 7YP	-	-	-	-	-	64	63
1638	Woodland House, Allt Dubhag Road, Tomatin, IV13 7YP	-	-	-	-	-	64	63
1731	The Bellhouse, Allt Dubhag Road, Tomatin, IV13 7YP	-	-	-	-	-	73	72
1538	Gardener's Cottage, Tigh-An-Allt, Allt Dubhag Road, Tomatin, IV13 7YP	-	-	-	-	-	72	71
1159	The Sheiling, Dalmagarry, Shennachie Road, Tomatin, IV13 7YD	68	65	70	-	77	85	84
378	The Old Schoolhouse, Moy School Road, Tomatin, IV13 7YE	-	-	-	-	-	-	-
992	Allt-Na-Slanaichd, Lynebeg Road, Tomatin, IV13 7YE	73	70	48	76	-	-	-
965	Fearnach, Lynebeg Road, Tomatin, IV13 7YE	71	68	49	76	-	-	-
782	Moybeg Cottage, Lynebeg Road, Tomatin, IV13 7YE	62	59	53	67	-	66	65
723	Forester's House, Lynebeg Road, Tomatin, IV13 7YE	66	63	46	52	-	85	84

Receptor ID	Receptor Address	Noise level for other construction activities (dB L _{Aeq,1 hr})						
		Sub-structure	Super-structure	Underpass	Demolition	Watercourse	Access - Earthworks	Access - Road formation
1018	Keepers Cottage, Keeper's Cottage, Lynemore, Lynebeg Road, Tomatin, IV13	48	45	46	47	-	79	78
761	Suilven, Moy Station Road, Tomatin, IV13 7YF	-	-	46	49	-	-	-

17.4.59. The impact assessment compares the predicted construction noise levels with the threshold value for the noise category, as shown in Table 17.28.

Table 17.28: Predicted daytime construction noise impact significance at existing noise sensitive receptors

Receptor ID	Receptor Address	A9 Construction			Other Construction		
		Range of Predicted construction noise levels dB L _{Aeq,1 hr}	Exceedance over daytime category threshold value dB	Potential significant effect	Range of Predicted construction noise levels dB L _{Aeq,1 hr}	Exceedance over daytime category threshold value dB	Potential significant effect
1309	Porter's Lodge, Tomatin, IV13 7YP	53 - 61	0	No	56 - 85	20	Yes
1223	Pinewood, Tomatin, IV13 7YP	46 - 54	0	No	50 - 75	10	Yes
1551	Altdhubhag, Allt Dubhag Road, Tomatin, IV13 7YP	53 - 61	0	No	57 - 64	0	No
1638	Woodland House, Allt Dubhag Road, Tomatin, IV13 7YP	60 - 68	3	Yes	63 - 64	0	No
1731	The Bellhouse, Allt Dubhag Road, Tomatin, IV13 7YP	64 - 72	7	Yes	68 - 73	8	Yes
1538	Gardener's Cottage, Tigh-An-Allt, Allt Dubhag Road, Tomatin, IV13 7YP	55 - 63	0	No	59 - 72	7	Yes
1159	The Sheiling, Dalmagarry, Shennachie Road, Tomatin, IV13 7YD	62 - 70	0	No	65 - 85	15	Yes
378	The Old Schoolhouse, Moy School Road, Tomatin, IV13 7YE	50 - 58	0	No	54 - 54	0	No
992	Allt-Na-Slanaichd, Lynebeg Road, Tomatin, IV13 7YE	47 - 55	0	No	48 - 76	11	Yes

Receptor ID	Receptor Address	A9 Construction			Other Construction		
		Range of Predicted construction noise levels dB L _{Aeq,1hr}	Exceedance over daytime category threshold value dB	Potential significant effect	Range of Predicted construction noise levels dB L _{Aeq,1hr}	Exceedance over daytime category threshold value dB	Potential significant effect
965	Fearnach, Lynebeg Road, Tomatin, IV13 7YE	48 - 56	0	No	49 - 76	11	Yes
782	Moybeg Cottage, Lynebeg Road, Tomatin, IV13 7YE	54 - 62	0	No	53 - 67	2	Yes
723	Forester's House, Lynebeg Road, Tomatin, IV13 7YE	50 - 58	0	No	46 - 85	20	Yes
1018	Keepers Cottage, Keeper's Cottage, Lynemore, Lynebeg Road, Tomatin, IV13	46 - 54	0	No	45 - 79	14	Yes
761	Suilven, Moy Station Road, Tomatin, IV13 7YF	55 - 63	0	No	46 - 59	0	No

- 17.4.60. The assessment results presented in Table 17.28 indicate a potential significant effect during the daytime at two of the sample receptors, The Bellhouse and Woodland House, during the construction of the A9. The results at The Bellhouse show that all activities generate more than 65dB with potential for significant effect. Woodland House is further from the A9 and some of the activities are below 65dB and potentially not significant. There are two further properties in this area which are set further back from the A9, with potential for similar impacts as Woodland House.
- 17.4.61. Construction of the A9 during the daytime is unlikely to generate significant effects at other receptors.
- 17.4.62. The construction of Tomatin GSJ is unlikely to give rise to significant effects, except where road construction is close to properties. There is road construction on the C1121 in Tomatin with potentially significant effects on nearby properties.
- 17.4.63. The construction of Dalmagarry Burn and the access to Dalmagarry Farm is likely to give rise to significant effects. There is a number of properties at Dalmagarry Farm, with potential for similar effects.
- 17.4.64. The construction of Moy LILO junction is unlikely to give rise to significant effects.
- 17.4.65. The construction of Moy rail bridge is unlikely to give rise to significant effects.
- 17.4.66. The construction of Lynbeg LILO junction is unlikely to give rise to significant effects, except where road construction is close to properties, including the link between the junction and the B9154 and accesses to properties.

- 17.4.67. The construction of the Lynbeg rail underpass is likely to give rise to significant effects, particularly from the demolition of the existing structure.
- 17.4.68. It is noted that there may be a requirement for night works, particularly with the Lynbeg Rail Underpass. These works are likely to generate significant impacts, but such works will be of a limited duration.

Construction vibration

- 17.4.69. Vibration levels from typical mobile construction equipment, including demolition, are generally imperceptible at distances greater than around 20m from the source. There are no noise sensitive receptors within 20m of the works and this impact has not been considered any further.
- 17.4.70. Vibration levels from piling works on the structures are generally imperceptible at distances greater than around 150m from the source. It is unknown if piling will be required for the structures on the Proposed Scheme, however a preliminary assessment has been undertaken. Receptors are within 150m of certain structures, as shown in Table 17.29 below.

Table 17.29: Construction noise and vibration receptors and distances

Receptor ID	Receptor Address	Distance to Tomatin GSJ	Distance to Dalraddy Burn/ Underpass	Distance to Lynbeg LILO	Distance to Lynbeg Rail underpass
1309	Porter's Lodge, Tomatin, IV13 7YP	200	-	-	-
1223	Pinewood, Tomatin, IV13 7YP	300	-	-	-
1159	The Sheiling, Dalmagarry, Shennachie Road, Tomatin, IV13 7YD	-	25	-	-
992	Allt-Na-Slanaichd, Lynebeg Road, Tomatin, IV13 7YE	-	-	190	40
965	Fearnach, Lynebeg Road, Tomatin, IV13 7YE	-	-	180	40
782	Moybeg Cottage, Lynebeg Road, Tomatin, IV13 7YE	-	-	120	90

- 17.4.71. This table shows that there may be perceptible vibration at receptors near Dalraddy Burn/Underpass, Lynbeg LILO and Lynbeg Rail underpass.
- 17.4.72. Depending on the selection of piling technique used, there may be a low risk of cosmetic damage to properties within 25m of piling works. The Sheiling at Dalmagarry is the closest receptor to piling works, and this should be re-assessed once details of the construction techniques are confirmed.

Construction Traffic Noise Impact

- 17.4.73. There will be a number of HGV movements to/from site during construction of the project for the import and removal of materials and equipment. As described in Chapter

5 access for construction traffic will generally be limited to existing roads. Access will be permitted at side roads for construction works and for site workers.

- 17.4.74. Therefore there may be localised noise impacts from construction traffic using side roads near the Proposed Scheme. Impacts may occur between the site access points and the A9. The majority of side roads in the study area have traffic flows which are below the threshold for noise calculations, and any impacts are likely to be from individual vehicles rather than a change in the overall traffic noise on the road. The site working hours (07:00 to 19:00) ensure that any disturbance is limited to daytime periods.
- 17.4.75. Once the construction traffic is on the A9 the noise from construction vehicles is not expected to give rise to a perceptible change in noise above the normal traffic using the A9, with a corresponding Negligible impact.

Cumulative Temporary Effects

- 17.4.76. The construction assessment shows that there may be both noise and vibration impacts from construction activities at properties near Dalmagarry Burn/Access, Lynbeg rail underpass and Lynbeg LILLO. Therefore, there may be some cumulative effects during the construction of these works.
- 17.4.77. Cumulative effects relating to other environmental parameters are considered in Chapter 20.

17.5 Potential Mitigation

Mitigation of Permanent Impacts

- 17.5.1. One property, Porters Lodge, has been identified as meeting the mitigation threshold in the long term with an increase in noise level of at least 3dB and with noise levels exceeding 59.5dB. There are two other properties in this area which also meet the mitigation criteria in the short term, one with a noise increase of 3dB and levels above 54.5 and one with an increase of nearly 2dB with noise levels above 59.5dB.
- 17.5.2. The design of the mitigation has focussed on reducing noise levels at Porters Lodge, being the only property to meet the mitigation threshold by the Design Year.
- 17.5.3. The magnitude of the noise impact at this property is greater in the Opening Year of the scheme than by the Design Year, and the inclusion of a noise barrier has been modelled and predicted to reduce both short term and long term impacts to negligible. A number of noise barrier options were considered for this property. Heights of 1.5m, 2m and 2.5m were modelled and tested with different lengths in order to provide mitigation.
- 17.5.4. These preliminary options have been reviewed and the 2m high option has been selected based on a height and length that does not compromise visibility, for all drivers, at the new Tomatin GSJ. This barrier is approximately 210m long, the location of which can be seen in Figure 13.8e. The barrier has been demonstrated, through noise modelling, to reduce the predicted noise impacts at Porters Lodge to negligible. The Proposed Scheme noise modelling results (residual impact, including the noise mitigation) are shown in Section 17.6.
- 17.5.5. The proposed noise mitigation is included in Chapter 21 as P12-NV3. The barrier will have acoustic performance properties in accordance with BS EN 1793-2:2012 (Category B2).

Mitigation of Temporary Impacts

17.5.6. Table 17.30 below details mitigation measures to minimise temporary impacts as far as possible. These measures are also set out in Chapter 21 Schedule of Environmental Commitments and comprise both A9 Dualling standard mitigation and also measures specifically applicable to the Proposed Scheme.

Table 17.30: Noise and Vibration Mitigation

Mitigation Item	Description
SMC-S3	<p>Throughout the construction period the Contractor will, as required, contribute towards the overall communications strategy for the A9 Dualling Programme. As part of this the Contractor will appoint a Community Liaison Officer supported by a liaison team as necessary who will:</p> <ul style="list-style-type: none"> · 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.
SMC-NV1	<p>A scheme of noise and vibration monitoring will be agreed with the Environmental Health Officer of Highland Council, and noise and vibration limits will be contained within the Construction Environmental Management Plan (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.</p>
SMC-NV2	<p>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. This includes the following:</p> <ul style="list-style-type: none"> · 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

Mitigation Item	Description
	<p>appointed specifically for the purpose. A method of noise measurement would be agreed with the local authority prior to the commencement of site works;</p> <ul style="list-style-type: none"> • 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. <p>In addition, THC would be consulted regarding any proposed working out-with normal working hours.</p>
P12-NV4	<p>Use of a temporary noise barrier if required to reduce construction noise impacts at and near The Bellhouse to below the significance threshold. BS 5228 advises that the approximate acoustic attenuation provided by a barrier will be 5 dB when the top of the plant is just visible to the receiver over the noise barrier and 10 dB when the barrier completely obscures the noise sources from the receiver.</p>
P12-NV5	<p>Specific mitigation may be required for locations where potentially significant effects are shown. This mitigation would be confirmed when the final selection of plant and equipment is known and the impacts reassessed. Mitigation may take the form of solid site hoardings. Depending on the scheduling of works there may be a need to consider specific arrangements to manage night-time construction impacts for residents at Moy who are close to Lynebeg Rail Underpass. Such arrangements will be agreed between the Contractor and residents.</p>

17.6 Residual Effects

- 17.6.1. The operation of the Proposed Scheme will not give rise to any permanent significant noise or vibration effects.
- 17.6.2. There is potential for some significant temporary impacts during the construction, however with the use of appropriate mitigation these adverse impacts will be minimised.
- 17.6.3. The inclusion of the noise barrier reduces the scheme impacts, as shown in the following tables.

Calculation Area Impacts, First full year of operation with mitigation

- 17.6.4. The detailed assessment at the 246 receptors in the calculation area shows the following changes in noise, as shown in Table 17.31 and Figure 17.6a-f.

Table 17.31: Short-term (2026 First full year of operation) Changes in Traffic Noise

Change in noise level		Number of dwellings	Number of other sensitive receptors
Increase in noise levels, L _{A10, 18h}	0.1 – 0.9	19	0
	1 – 2.9	148	10
	3 – 4.9	0	0
	>=5	0	0
No change	=0	3	0
Decrease in noise level, L _{A10, 18h}	0.1 – 0.9	14	1
	1 – 2.9	46	3
	3 – 4.9	1	0
	>=5	1	0

17.6.5. By comparison with Table 17.12 there are no longer any increases in noise of 3dB or more, demonstrating that the mitigation prevents these larger increases in noise from occurring. The barrier has a small effect on noise levels at nearby properties such that the overall number of perceptible increases in noise reduces from 161 dwellings to 148, and the overall number of perceptible decreases in noise increases from 37 dwellings to 48.

17.6.6. Table 17.2 below shows the predicted noise impacts for Porters Lodge with mitigation. In Table 17.32 DM is Do Minimum, the situation without the Proposed Scheme and DS is Do Something, the situation with the Proposed Scheme.

Table 17.32: Short-term (2026 First full year of operation) Changes in Traffic Noise (Porters Lodge, With Mitigation)

Sample Receptor ID	Sample Receptor Address	DM First full year of operation dB L _{A10, 18h}	DS First full year of operation dB L _{A10, 18h}	Noise Change dB L _{A10, 18h}	Impact Magnitude
1309	Porter's Lodge, Tomatin, IV13 7YP	58.8	59.6	0.8	Negligible

Calculation Area Impacts, by the Design Year with mitigation

17.6.7. Table 17.33 presents the noise results in terms of the DMRB long term noise change magnitude levels for daytime with the Proposed Scheme in place. The change in noise is shown in Figure 17.7a-f.

Table 17.33: Changes in Traffic Noise by the Design Year with the Proposed Scheme (Daytime)

Change in noise level		Number of dwellings	Number of other sensitive receptors
Increase in noise levels, L _{A10, 18h}	0.1 – 2.9	176	10
	3 – 4.9	0	0
	5 – 9.9	0	0
	>=10	0	0

Change in noise level		Number of dwellings	Number of other sensitive receptors
No change	=0	1	0
Decrease in noise level, L _{A10, 18h}	0.1 – 2.9	54	4
	3 – 4.9	1	0
	5 – 9.9	0	0
	>=10	0	0

17.6.8. By comparison with Table 17.14 there are no longer any perceptible increases in noise. The mitigation prevents the seven perceptible increases occurring. The perceptible decrease in noise shown in Table 17.14 remains.

17.6.9. Table 17.34 presents the noise results in terms of the DMRB long term noise change magnitude levels for night-time with the Proposed Scheme in place. Night-time impacts are only reported where the predicted noise level is greater than 55 dB L_{night, outside} in any scenario.

Table 17.34: Changes in Traffic Noise by the Design Year with the Proposed Scheme (Night-time, receptors >=55dB)

Change in noise level		Number of dwellings	Number of other sensitive receptors
Increase in noise levels, L _{night}	0.1 – 2.9	39	3
	3 – 4.9	0	0
	5 – 9.9	0	0
	>=10	0	0
No change	=0	0	0
Decrease in noise level, L _{night}	0.1 – 2.9	3	0
	3 – 4.9	0	0
	5 – 9.9	0	0
	>=10	0	0

17.6.10. By comparison with Table 17.15, it can be seen the mitigation results in a small reduction in the number of properties with noise levels above 55dB. Table 17.15 includes 44 dwellings whereas Table 17.33 includes 42 dwellings. All changes in night time noise remain negligible.

17.6.11. Table 17.35 below shows the predicted daytime noise impacts for Porters Lodge with mitigation. In Table 17.35 DM is Do Minimum, the situation without the Proposed Scheme and DS is Do Something, the situation with the Proposed Scheme.

Table 17.35: Changes in Traffic Noise by the Design Year with the Proposed Scheme (daytime, Porters Lodge, With Mitigation)

Sample Receptor ID	Sample Receptor Address	DM First full year of operation dB $L_{A10, 18h}$	DS Design year dB $L_{A10, 18h}$	Noise Change dB $L_{A10, 18h}$	Impact Magnitude
1309	Porter's Lodge, Tomatin, IV13 7YP	58.8	60.0	1.2	Negligible

Noise Nuisance Calculations with Mitigation

- 17.6.12. As described in Section 17.2 an assessment of the change in nuisance is required for residential receptors. The assessment considers the worst case change in nuisance by the design year for the situations with the scheme including mitigation and without the Proposed Scheme. The results are presented in Table 17.36.

Table 17.36: Traffic Noise Nuisance Assessment

Change in nuisance level		Number of dwellings – without scheme	Number of dwellings – with scheme
Increase in nuisance level	>0 - <10 %	232	12
	10 - <20 %	0	14
	20 - <30 %	0	150
	30 - <40 %	0	0
	>=40 %	0	0
No change	=0 %	0	1
Decrease in nuisance level	>0 - <10 %	0	55
	10 - <20 %	0	0
	20 - <30 %	0	0
	30 - <40 %	0	0
	>=40 %	0	0

- 17.6.13. By comparison with Table 17.20 the largest increase in nuisance level is now in the 20-30% band when previously there were 3 properties in the 30-40% band. Overall there are fewer properties with an increase in nuisance, decreased to 176 dwellings from 188, and there are more properties with a decrease in nuisance, increased to 55 dwellings (with mitigation) from 44 (without mitigation).

17.7 References

- ⁱ Design Manual for Roads and Bridges Volume 11, Section 3, Part 7 (HD213/11), November 2011
ⁱⁱ Department of Transport and Welsh Office (1988). Calculation of Road Traffic Noise. HMSO
ⁱⁱⁱ Statutory Instrument, 1975, No. 460 (S.60). The Noise Insulation (Scotland) Regulations 1975.
^{iv} Scottish Development Department, Memorandum on the Noise Insulation (Scotland) Regulations 1975 Regulations 3 and 6, 1975
^v World Health Organisation (2000). Guidelines for Community Noise.
^{vi} World Health Organisation (2009). Night Noise Guidelines for Europe.
^{vii} World Health Organisation (2000). Guidelines for Community Noise.
^{viii} Department for Transport, Transport Analysis Guidance Unit A3, December 2015

^{ix} Watts, G.R. (1990). Traffic induced vibration in buildings. TRRL RR246. Transport and Road Research Laboratory.

^x British Standards Institute, BS 5228-1:2009+A1:2014, Code of practice for noise and vibration control on construction and open sites. Noise

^{xi} British Standards Institute, BS 5228-2:2009+A1:2014, Code of practice for noise and vibration control on construction and open sites. Vibration