12 NOISE AND VIBRATION

12.1 Introduction

This chapter details the predicted noise and vibration impacts of the proposed upgrade of the A96. The Scheme would potentially affect traffic noise and vibration levels as experienced by sensitive receptors such as residential properties in the vicinity of the Scheme, as well as sensitive receptors along any other surrounding affected roads.

The current Noise and Vibration section of the Design Manual for Roads and Bridges (DMRB) HD 213/11-Revision 1 (issued November 2011) focuses on a risk based approach using three assessment levels:

- scoping;
- simple; and
- detailed.

A simple level assessment of various options was completed in 2011. From the results of this assessment a Proposed Scheme has been developed. This report contains a detailed level assessment of the Proposed Scheme.

The assessment considers both changes in absolute traffic noise levels and the effect on residents in terms of annoyance.

The assessment considers the following traffic scenarios:

- 2012 current baseline conditions;
- 2016 year of opening Do-Minimum (2016 DM), without the Scheme;
- 2016 year of opening Do-Something (2016 DS), with the Scheme;
- 2031 future assessment year 15 years after opening Do-Minimum (2031 DM), without the Scheme; and
- 2031 future assessment year 15 years after opening Do-Something (2031 DS), with the Scheme.

Temporary noise and vibration impacts arising from the construction works associated with the Scheme are also discussed. No specific information on the construction activities, plant or programme is currently available and therefore a qualitative assessment has been completed.

12.2 Approach & Methods

12.2.1 *Plans and Policies*

PAN 1/2011 'Planning and Noise' is the current advice note on considering noise in the planning system. With regard to road schemes the accompanying Technical Advice Note refers to the DMRB assessment methodology when assessing new road schemes.

The first round of strategic noise mapping in Scotland, required under the Environmental Noise Directive, was completed in 2007. Traffic noise levels along the A96 were mapped, in terms of the L_{den} and the L_{night}. As required by the Directive, the Scottish government has produced a Transportation Noise Action Plan which, following a prioritisation process, has identified a number of candidate noise management areas where intervention or management

measures may be appropriate to reduce exposure to road traffic noise. No candidate noise management areas are located on the A96 in the vicinity of the Scheme.

No regional or local planning policies relevant to road traffic noise have been identified.

Where noise from a new or altered road exceeds a certain trigger level, and meets other qualifying criteria, the Land Compensation (Scotland) Act 1973 provides, through the Noise Insulation (Scotland) Regulations 1975 (NISR), for insulation work to be carried out, or a grant to be made in respect of that insulation work. Under the NISR, the Land Compensation (Scotland) Act 1973 also confers a right to compensation for depreciation in the value of land caused by public works under certain circumstances.

At the local scale, discussions with Aberdeenshire Council Environmental Protection Department have established that they do not have any relevant specific local policies. However, with regard to construction impacts they have advised that standard working hours are 07:00 to 19:00 Monday to Friday and 07:00 to 12:00 Saturday morning. They would require the contractor to keep local residents informed of the works and provide a contact phone number for any complaints or queries.

Study Area

At the detailed assessment stage the Study Area for a traffic noise impact assessment is defined in the DMRB as follows:

a) The study area must include the proposed Scheme and all surrounding existing roads that are predicted to be subject to a change in traffic noise level of 1 dB(A) or more in the short term (2016 DM to 2016 DS) or 3 dB or more in the long term (2016 DM to 2031 DS) as a result of the proposed Scheme. These road links are defined as affected routes and are identified by analysis of the provided traffic data;

b) The study area of the detailed quantitative assessment of noise impacts is defined as a corridor 600 m either side of the proposed Scheme, and a set of corridors 600 m either side of all affected routes within 1 km of the proposed Scheme;

c) For dwellings and other sensitive receptors that are within 1 km of the Scheme, but more than 600 m from an affected route, a qualitative assessment of the noise and vibration impacts should be undertaken; and

d) For affected routes which are outside the 1 km boundary from the Scheme, an assessment should be undertaken by estimating the 'Calculation of Road Traffic Noise' (CRTN) Basic Noise Level on these roads (the traffic noise level at 10 m) with and without the proposed Scheme.

The extent of the Scheme, and identified potentially sensitive receptors within 600 m and 1 km of the Scheme are illustrated in Figure 12.1 – Noise Study Area.

Using the change criteria outlined in a) the minor side road through Chapel of Garioch was identified as an affected route. In the traffic model this road is split into five sections, see Figure 12.1 – Noise Study Area.

12.2.2 *Construction Noise and Vibration*

The noise levels generated by construction activities and experienced by nearby sensitive receptors, such as the occupants of residential properties, depends upon a number of variables, the most significant of which are:

a) the noise generated by plant or equipment used on site, generally expressed as a sound power level (L_w);

b) the periods of operation of the plant on the site, known as its 'on-time';

c) the distance between the noise source and the receptor; and

d) the attenuation due to ground absorption and barrier effects.

BS 5228: 2009 'Noise and vibration control on construction and open sites' provides a methodology for the estimation of likely construction noise levels as an equivalent continuous noise level averaged over a suitable assessment period, for example a one-hour period ($L_{Aeq,1h}$).

BS 5228 contains a database of the noise emission from individual items of equipment and routines which can be used to predict noise from construction activities at identified receptors. The prediction method gives guidance on the effects of different types of ground, barrier attenuation and how to assess the impact of fixed and mobile plant.

In order to quantify the likely noise from construction works in accordance with the methods and guidance in BS 5228, it is necessary to define the various activities to be undertaken and the equipment to be used, based upon the anticipated programme of work. At this stage no such details are available, therefore a qualitative discussion of the likely magnitude of construction noise impacts is provided. This is based on the identification of residential properties and other potentially sensitive receptors in the vicinity of the Scheme, the identification of activities which could have a significant effect, and best practice noise control measures.

With regard to construction vibration, piling works are the main activity with the potential to result in significant effects. At this stage no piling works are anticipated to be required, spread footing foundations are proposed in the current design for the new bridge over the railway and the adjacent underpass. Therefore, construction vibration effects have been scoped out of the assessment. There is a slight possibility that the appointed contractor may choose to use piled foundations, if so the contractor will be required to assess the potential for significant vibration effects at that stage.

With regard to construction traffic, an estimate of the likely construction traffic required for the works has been used to determine the impact on existing traffic noise levels along the A96.

12.2.3 *Operational Traffic Noise*

Noise from a flow of road traffic is generated by both vehicles' engines and the interaction of tyres with the road surface. The traffic noise level at a receptor, such as an observer at the roadside or residents within a property, is influenced by a number of factors including traffic flow, speed, composition (% HGV), gradient, type of road surface, distance from the road and the presence of any obstructions between the road and the receptor.

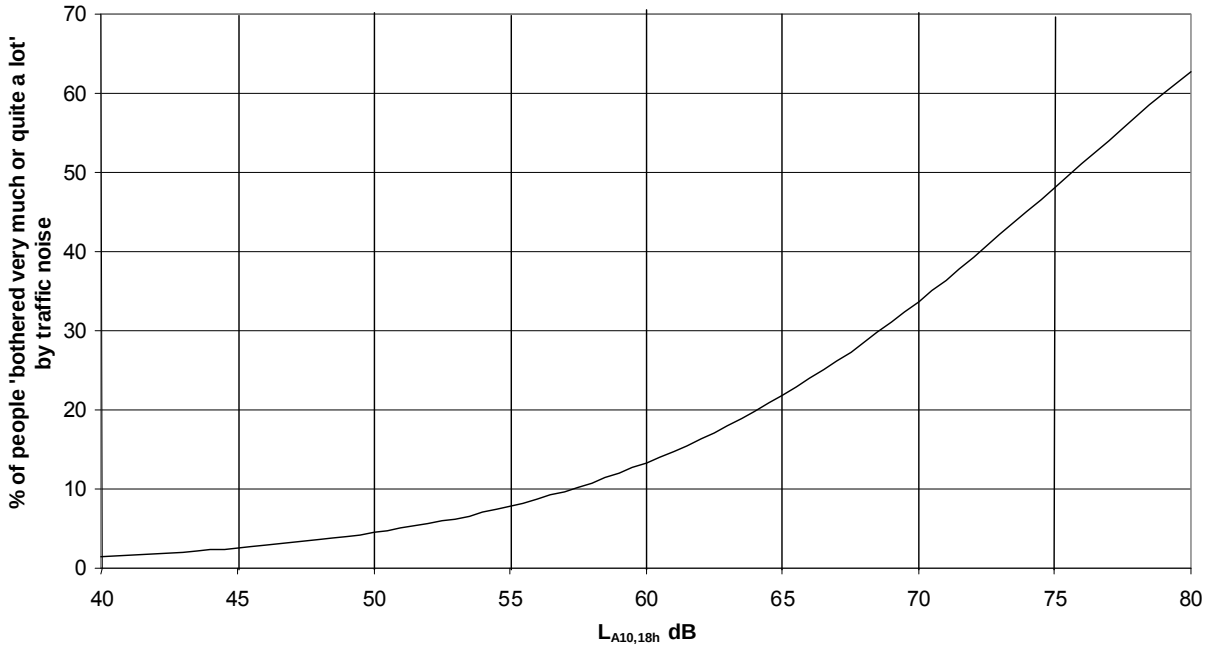
Noise from a stream of traffic is not constant; therefore, to assess the noise impact a single figure estimate of the overall noise level is necessary. The index adopted by the Government in 'The Calculation of Road Traffic Noise' (CRTN) to assess traffic noise is $L_{A10,18h}$. This value is determined by taking the highest 10 % of noise readings in each of the eighteen 1 hour periods between 06:00 and 24:00, and then calculating the arithmetic mean. A reasonably good correlation has been shown to exist between this index and residents' perception of traffic noise over a wide range of exposures.

CRTN provides the standard methodology for predicting the $L_{A10,18h}$ road traffic noise level. Noise levels are predicted at a point 1 m measured horizontally from the external façade of the building.

The DMRB also requires an assessment of night time traffic noise levels ($L_{night,outside}$), however, this parameter is not predicted by the standard CRTN methodology. Three methods of estimating $L_{night,outside}$ are outlined in the DMRB. Method 1 uses individual 1 hour traffic data over the night-time (23:00-07:00), method 2 uses 8 hour average night time traffic, and method 3 estimates the $L_{night,outside}$ from the $L_{A10,18h}$ traffic noise level. The façade level predicted by CRTN must be reduced by 2.5 dB to give the free-field $L_{night,outside}$ level. Method 3 has been used for the purposes of this assessment.

Once the traffic noise level has been predicted it can be used to provide an indication of the likely annoyance to residents caused by traffic noise. Individuals vary widely in their response to the same level of traffic noise. However, the average or community response from a large number of people to the same level of traffic noise is fairly stable; therefore, a community average degree of bother caused by traffic noise can be related to the long-term steady state noise level. The DMRB illustrates the relationship between the steady state traffic noise level and the estimated annoyance experienced, expressed as the percentage of people 'bothered very much or quite a lot' is illustrated in Plate 1 (taken from DMRB). This shows, for example, that approximately 13% of all residents would be 'bothered very much or quite a lot' at a façade road traffic noise level of 60 dB $L_{A10,18h}$.

Plate 1: Estimation of Traffic Noise Annoyance - Steady State



In addition, research has shown that people are more sensitive to abrupt changes in traffic noise, for example following the opening of a new road, than would be predicted from the steady state relationship between traffic noise and nuisance (described above). These effects last for a number of years, however, in the longer term the perceived noise annoyance tends towards the steady state level due to familiarisation. The percentage change in the traffic noise annoyance due to an abrupt change in the traffic noise is illustrated in Plate 2 (taken from DMRB).

Plate 2: Estimation of Traffic Noise Annoyance - Immediate Change in % people 'bothered very much or quite a lot' by traffic noise

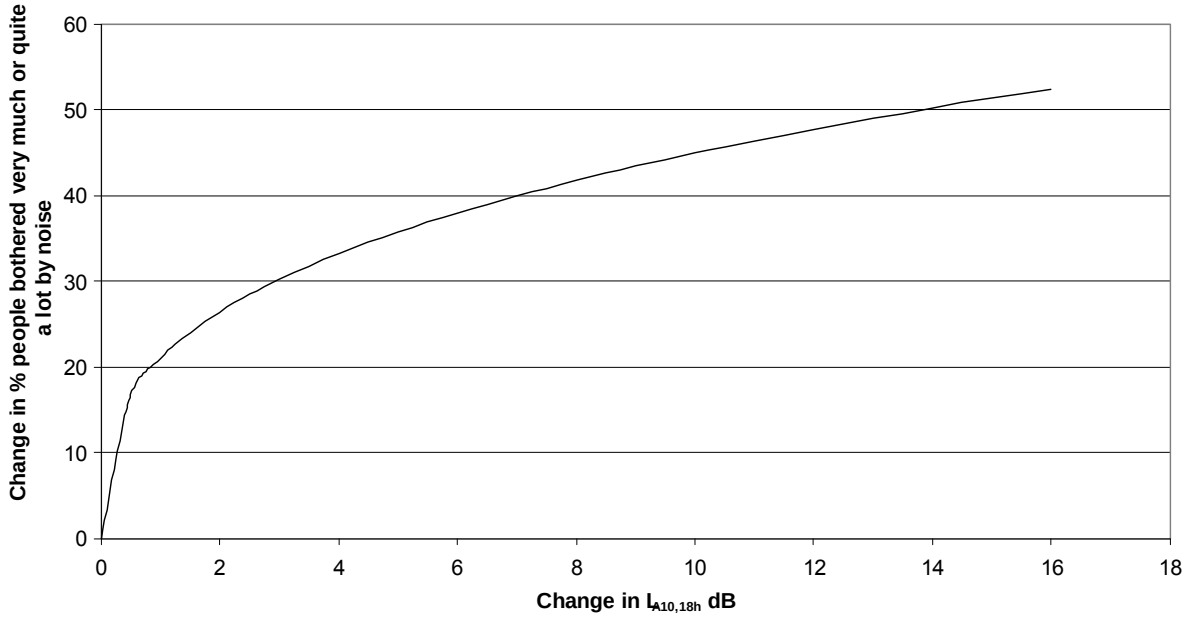


Plate 2 shows, for example, that with an abrupt (and permanent) increase of 10 dB(A) there would be a net change of 45% residents 'bothered very much or quite a lot' by road traffic noise. If the initial noise level was 60 dB $L_{A10,18h}$ (with 13% people already bothered) then there would be a total of 58% bothered immediately after an increase to 70 dB $L_{A10,18h}$. This would eventually diminish in the long term due to familiarisation to become approximately 34% bothered (Plate 1).

The objective of the assessment, as set out in the DMRB, is to gain an overall appreciation of the noise and vibration climate, both with (Do-Something) and without (Do-Minimum) the proposed Scheme. These conditions are assessed for the baseline year (the year of opening) and the future assessment year (15 years after opening). The DMRB outlines the steps to be carried out at the detailed assessment stage:

a) identify the study area, as discussed in section 12.2.2, and predict 18 hour (06:00-00:00) and 8 hour night-time (23:00-07:00) traffic noise levels at all residential properties within 600 m of the proposed Scheme and/or affected routes within 1 km of the Scheme. Predictions are required for the Do-Minimum and Do-Something scenarios in the year of opening and 15 years after opening. The computer noise modelling software SoundPLAN version 7.1, which implements the CRTN methodology and the estimation of $L_{night,outside}$ levels from $L_{A10,18h}$ levels, has been used to complete the traffic noise predictions. Further technical details of the noise modelling and data sources are provided in Appendix 12.1 – Noise Modelling.

b) carry out the following comparisons for each property in order to identify the number of properties which undergo an increase or decrease in traffic noise levels and annoyance:

- the Do-Minimum scenario in the baseline year against the Do-Minimum scenario in the future assessment year (long term) (2031 DM - 2016 DM);
- the Do-Minimum scenario in the baseline year against the Do-Something scenario in the baseline year (short term) (2016 DS - 2016 DM); and
- the Do-Minimum scenario in the baseline year against the Do-Something scenario in the future assessment year (long term) (2031DS - 2016DM).

For night time traffic noise levels, just the two long term comparisons are required and only properties where the $L_{night,outside}$ level is 55 dB(A) or more in one or more scenarios at one or more facades, need to be considered.

Clearly different façades of the same property can experience different changes in traffic noise level. DMRB requires that each of the above comparisons of traffic noise levels are based on the façade which experiences the worst case change i.e. the largest increase, or, if all facades undergo a decrease, the smallest decrease. Additionally, DMRB requires that the above comparisons of annoyance use the highest levels of annoyance in the first 15 years. For properties which experience an increase in noise due to the proposed development, the greatest annoyance is likely to be immediately after opening (Plate 2). For properties which experience a decrease (and also in the Do-Minimum comparison), the greatest annoyance is the steady state level of annoyance in the long term (Plate 1);

c) assess the impact on sensitive receptors, other than residential properties, within the 600 m study area. This is based on 18 hour (06:00-00:00) traffic noise levels and considers the same three comparisons as outlined above for residential properties. Other sensitive receptors considered include hospitals, schools, community facilities (such as places of worship) designated ecological areas (Areas of Outstanding Natural Beauty (AONB), National Parks, Special Areas of Conservation (SAC),

Special Protection Areas (SPA) and Site of Special Scientific Interest (SSSI)), heritage sites (Scheduled Ancient Monuments - SAM) and public rights of way (PRoW);

d) complete a qualitative assessment of sensitive receptors which are within 1 km of the Scheme but more than 600 m from the Scheme and affected routes; and

e) for affected routes which are outside the 1 km boundary from the Scheme, complete an assessment by estimating the Calculation of Road Traffic Noise (CRTN) Basic Noise Level on these roads (the traffic noise level at 10 m) with and without the proposed development. A count of the number of dwellings and other sensitive receptors within 50 m of these links should be undertaken.

The DMRB suggests two classifications for the magnitude of the noise impact of a Scheme, as outlined in Tables 12.1 and 12.2. These relate to short term changes in noise levels and long term changes in noise levels.

Table 12.1: Magnitude of Impact in the Short Term

Traffic Noise Change $L_{A10,18h}$ dB	Magnitude of Impact
0	No change
0.1-0.9	Negligible
1.0-2.9	Minor
3.0-4.9	Moderate
5+	Major

Table 12.2: Magnitude of Impact in the Long Term

Traffic Noise Change $L_{A10,18h}$ dB	Magnitude of Impact
0	No change
0.1-2.9	Negligible
3.0-4.9	Minor
5.0-9.9	Moderate
10+	Major

The above classifications are used to describe the magnitude of the operational noise impacts of the Scheme.

Finally, the predicted noise levels at each façade of each property have been used to carry out an initial assessment of the likelihood of any properties qualifying under the Noise Insulation (Scotland) Regulations 1975 (NISR). The NISR grant the power to a Highway Authority to provide noise attenuation measures including secondary glazing and mechanical ventilation to habitable rooms of residential properties affected by road traffic noise from a new or altered highway, such as the realigned A96, which meet the following criteria:

- the combined expected maximum traffic noise level, i.e. the relevant noise level, from the new or altered highway together with other traffic in the vicinity must not be less than the specified noise level, 68 dB $L_{A10,18h}$;

- the relevant noise level is at least 1.0 dB(A) more than the prevailing noise level, i.e. the total traffic noise level existing before the works to construct or improve the highway were begun; and

- the property is within 300m of the new or altered highway or at the end of the Scheme within a triangle extending 50m from the end of the Scheme and 300m from the side of the Scheme, and, a straight line can be drawn from the property to the new or altered highway without passing through another building.

The results of the traffic noise impact assessment have been used to determine if any properties within 300 m of the Scheme are likely to meet the criteria. It should be noted that if the Scheme goes ahead a dedicated NISR assessment is required, as a full assessment is beyond the scope of this report. In addition, the NISR specifies a methodology for predicting traffic noise levels which pre-dates CRTN and is therefore similar to, but not identical, to the prediction method used in this assessment.

12.2.4 *Operational Traffic Vibration*

Vibration from traffic can be transmitted through the air or through the ground. Airborne vibration is produced by the engines and exhausts of road vehicles, with dominant frequencies typically in the range 50 - 100 Hz. Ground borne vibration is produced by the interaction of the vehicle tyres and the road surface with dominant frequencies typically in the range 8 - 20 Hz. The passage of vehicles over irregularities in the road surface can be a source of ground borne vibration.

Traffic vibration can potentially have an effect on buildings and cause disturbance to occupiers. DMRB reports that extensive research on a wide range of buildings has found no evidence of traffic induced ground borne vibration being a source of significant damage to buildings. And also, that there is no evidence that exposure to airborne vibration has caused even minor damage.

Airborne vibration is noticed by occupiers more often than ground borne vibration as it may result in detectable vibrations in building elements such as windows and doors.

Vibration has not been identified as an issue on the existing A96 through discussions with the Local Authority and observations while on site. The DMRB states that perceptible vibration only occurs in rare cases and identifies that the normal use of a building, such as closing doors and operating domestic appliances can generate similar levels of vibration to that from traffic. No areas of particular sensitivity to vibration, such as ecological or historic sites, have been identified in the immediate vicinity of the Scheme. Therefore, a quantitative assessment of operational vibration effects, in terms of annoyance to occupiers or effects at any other receptors, is not required and has been scoped out

12.2.5 *Baseline Noise Survey*

The purpose of the baseline noise survey is to provide data on existing ambient noise levels at a selection of receptors close to the Scheme. The data are used in both the construction noise assessment in rating the significance of the construction noise effect, and the operational noise assessment, to check that the noise modelling is performing adequately.

Long term measurements were undertaken at four locations in proximity to the existing and proposed route of the relevant section of the A96:

- M1 – The Stables. The noise monitoring equipment was located to the immediate south of The Stables (‘residential block’) within a wooded area. The topography was noted to slope gently upwards towards the A96.

- M2 – The Lodge. The noise monitoring equipment was located to the immediate west of The Lodge, beyond a wooden hut used by the occupier as a dog grooming business. It was noted that (with the exception of the driveway area) a solid stone wall of approximate 1.5m height lines the northern side of the A96 in this location) thus breaking line of sight from the lower floor of The Lodge and the noise monitoring location. The topography was also noted to slope gently down from the A96 towards the residential property.

- M3 – Mill of Pitcaple. The noise monitoring equipment was located just outside the south east corner of the garden area, with direct line of sight to the A96 and the railway bridge crossing the A96, where vehicles were noted to queue at the lights on a regular basis.

- M4 – Dunmuir. The noise monitoring equipment was located to the immediate south of Dunmuir at an equal distance to the road as the front façade of the property. Dunmuir is the southern most property of six lining the A96 in this location.

Long-term unattended ambient noise measurements were undertaken at Locations M1 to M4 between Monday 22nd August and Saturday 27th August 2011.

Additional short-term (3 hour) measurements were also taken on the 22nd August and 23rd August 2011 at four locations:

- M5 – Dier Cottage. The noise monitoring equipment was located to the immediate north of Dier Cottage at an equal distance to the road as the front façade of the property. Dier Cottage is the northern most property of two lining the A96 in this location.

- M6 – Pitcaple. The noise monitoring equipment was located at 5m from the roadside at an equal distance to the road as the front façade of the nearest properties (which were unoccupied). This location is outside the 600m traffic noise prediction study area for the proposed Scheme.

- M7 – Pitcaple Castle. The noise monitoring equipment was located on the edge of the grassed area, approximately 15m from the front door to the castle.

- M8 – Govals. The noise monitoring equipment was located within the garden area to the immediate east of the residential building. This location was noted to be elevated and looked down towards the A96 to the east.

All noise monitoring locations are illustrated in Figure 12.1 – Noise Study Area. Details of the instrumentation used during the ambient noise survey are provided in Appendix 12.2 – Baseline Noise Survey.

All measurements were taken at approximately 1.5m above ground level, complying with the requirements of British Standard BS 7445. All monitoring locations were located at least 3.5m from any reflecting surface, other than the ground (i.e. free-field).

The noise instrumentation was programmed to log various parameters including the L_{Aeq} and L_{A10} values in one hour contiguous intervals at all monitoring locations.

The calibration of the equipment was checked prior to, and after, the monitoring periods - no significant changes (± 0.1 dB) were noted.

Details of weather conditions during the survey are given in Appendix 12.2 - Baseline Noise Survey. A number of rain showers occurred during the long term survey, and wind speeds occasionally exceeded 5 ms^{-1} though consideration of the noise monitoring results suggests this did not unduly influence the measured levels.

12.2.6 *Significance of Effects*

The significance of the effect (construction and operational noise) is determined based on the magnitude of the impact and the sensitivity of the receptor. In addition, for construction, the duration of the impact and the existing ambient noise climate are also taken into consideration.

Residential properties are classed as of high sensitivity, other receptors identified within 1 km of the Scheme include two SSSIs, a PRoW and a SAM. These non-residential receptors are classed as medium sensitivity.

The combination of sensitivity of the receptor and magnitude of the impact to determine the significance of effect is outlined in Table 12.3

Table 12.3: Matrix for Determination of Significance of Effect

Magnitude of Impact	**Sensitivity of Receptor**				
	Very High	**High**	**Medium**	**Low**	**Negligible**
Major	Very Large	Large or Very Large	Moderate or Large	Slight or Moderate	Slight
Moderate	Large or Very Large	Moderate or Large	Moderate	Slight	Neutral or Slight
Minor	Moderate or Large	Slight or Moderate	Slight	Neutral or Slight	Neutral or Slight
Negligible	Slight	Slight	Neutral or Slight	Neutral or Slight	Neutral
No Change	Neutral	Neutral	Neutral	Neutral	Neutral

For operational traffic noise impacts the magnitude of the impact is classified in the short and long term in accordance with the criteria in DMRB, as outlined in Tables 12.1 and 12.2. For construction noise, no detailed information is available to quantify the likely level of construction noise during the various aspects of the works. Therefore, the magnitude of impact is based on professional judgment using the distance from the works and the nature of the likely works.

12.2.7 *Assumptions and Limitations*

Only limited information is currently available on the nature and duration of the construction works. No details of specific activities or plant are currently available, which are required to complete a quantitative noise assessment.

The traffic noise predictions are based on the supplied traffic data in terms of the 18 hour annual average weekday traffic (AAWT), the % HGV and average speed. The traffic data have been provided by the Glasgow URS traffic team. The traffic data contain all future committed developments in the surrounding area due to be implemented before the baseline year or the future assessment year.

Speeds below 20 km hr^{-1} have been adjusted to 20 $kmhr^{-1}$, as this is the minimum speed in the CRTN calculation method.

Some links in the study area have very low traffic flows, below the minimum flow at which the CRTN prediction method is applicable (18 hour flows of less than 1000 vehicles). On the majority of minor side roads the Scheme has no impact on traffic conditions; therefore this is not a significant issue. However, on the minor road connecting the A96 with Chapel of Garioch flows are above the 1000 vehicle cut off in the Do-Minimum scenarios but fall significantly with the Scheme in operation to well below 1000 vehicles. This minor road, split into five sections in the traffic model, is included in the assessment as an affected route, however, as it is more than 1 km from the Scheme the assessment is limited to a calculation of the Basic Noise Level (BNL) and a count of receptors. The BNL for each section of this minor road is reported, as required by the DMRB methodology, however, caution should be used in

interpreting the predicted reduction in traffic noise levels as the Do-Something flows are well outside the range of the CRTN prediction methodology.

With regard to road surfacing, in the baseline and Do-Minimum scenarios standard hot rolled asphalt (HRA) has been assumed on all roads, including the A96. In both Do-Something scenarios a low noise surface has been assumed on the section of the A96 replaced by the Scheme. This mitigation measure has been agreed with Transport Scotland as an intrinsic aspect of the Scheme. All other roads in the study area are assumed to remain as standard HRA.

The 'low noise surface' correction of -3.5 dB is applied to applicable links in the Do-Something scenarios for speeds of 75 $kmhr^{-1}$ or more, as recommended in Annex 4 of the DMRB. DMRB acknowledges that in reality there will be not be a sharp cut-off at 75 $kmhr^{-1}$ in terms of the additional benefit achieved, and that there will be some benefit at lower speeds. This is of particular relevance to this Scheme as predicted speeds on the realigned A96 are just above 75 $kmhr^{-1}$ at the north (from north end to Govals access) and south (from Uryview to south end) of the Scheme, but just below in the central section. The low noise surface correction has been applied (or not) as required by DMRB, however this is a worst case approach for the central section of the Scheme where some benefit is likely but is not represented in the predictions.

12.3 Baseline Conditions

12.3.1 *Baseline Noise Monitoring Survey*

A summary of the long term measured ambient noise levels is provided in Table 12.4. In addition, the predicted 2012 $L_{A10,18h}$ and $L_{Aeq,8h}$ night-time traffic noise levels at each monitoring location are also provided. The monitoring locations are shown in Figure 12.1 – Noise Study Area. The measured levels are provided for the 12 hour day (07:00 to 23:00), which corresponds with the Councils preferred construction working hours, the 4 hour evening (19:00 to 23:00) and the 8 hour night (23:00 to 07:00). In addition, the measured 18 hour L_{A10} level, which is the main parameter for road traffic noise assessments, is also provided

Time histories of the monitoring data at each location are provided in Appendix 12.2 Baseline Noise Survey. At all the locations the expected diurnal cycle of noise levels, i.e. peaking during the day and falling to a minimum in the early hours of the morning, is observed.

Table 12.4 Summary of Measured Long Term Ambient Noise and Predicted Traffic Noise

Location	Long Term Measured Ambient Noise* (free-field)				Predicted Traffic Noise (free-field)	
	$L_{Aeq,12h}$ dB Day	$L_{Aeq,4h}$ dB Evening	$L_{Aeq,8h}$ dB Night	$L_{A10,18h}$ dB	$L_{Aeq,8h}$ dB Night	$L_{A10,18h}$ dB
M1	51.1	47.7	43.4	52.7	44.4	55.1
M2	60.8	57.8	53.7	63.4	54.1	64.8
M3	49.1	46.3	41.8	49.8	40.5	51.2
M4	62.1	60.2	56.7	65.6	56.7	67.5

*Only days on which the complete time period was monitored are included in the averages

As would be expected the highest ambient noise levels were measured at M2 and M4 which are very close to the existing A96. The lowest levels were monitored at M3 which is set back approximately 300m from the A96.

The measured and predicted $L_{A10,18h}$ noise levels match very well at locations M1-M4; the maximum difference is 2.4 dB. The night time levels also match very well at M1-M4; the maximum difference is 1.3 dB. The predicted night time levels are based on a relationship between $L_{A10,18h}$ traffic noise levels and $L_{Aeq,8h}$ night time traffic noise levels derived for the

whole of the UK, therefore achieving a match between measured and predicted levels of within 1.3 dB is considered to be very good.

The close agreement between the long term measured ambient levels and the predicted traffic noise levels indicates that the noise model is performing well and that road traffic noise from the A96 is the dominant noise source at the measurement locations.

This correlates with the observations while on site that road traffic on the A96 was the dominant noise source at all long term locations. Occasional aircraft movements and train movements on the Inverness to Aberdeen line were also noted, although these were infrequent. The train timetable indicates 22 passenger trains per day (11 each way Monday to Saturday) pass through the study area.

A perfect correlation between the long term measured and predicted levels would not be expected as the noise model is based on average traffic data and estimated vehicle speeds. The model cannot incorporate variations in traffic conditions, weather conditions and other local noise sources experienced during the monitoring.

The noise monitoring time history plots (see Appendix 12.2 - Baseline Noise Survey) illustrate a short duration unusually loud event occurred on the morning of Friday 26th August 2011 at M1, The Stables. A similar event occurred on the afternoon of Monday 22nd August at M3, Mill of Pitcaple. These unusually loud events have been excluded from the calculated average levels reported in Table 12.4. As the monitoring was largely unattended it is not possible to conclusively determine the source, but as they were not evident in the data from the other monitoring locations they are assumed to be events in close proximity to that noise meter. These events are likely to be activities at the property at which the equipment was installed. The Environmental Protection Department of Aberdeenshire Council identified the Pitcaple Quarry as a potential source of occasional noise in the area, in particular due to blasting, though no such noise was observed whilst on site.

A summary of the short term (3 hour) measured ambient noise levels are provided in Table 12.5. As the measurements conformed to the 'shortened measurement procedure' in CRTN the $L_{A10,18h}$ noise level has been estimated from the 3 hour monitoring data. However, it should be noted that in comparison to the long term measurements (completed over a full 18 hour period over several days), the 3 hour measurements on a single day are a less reliable indicator of the $L_{A10,18h}$.

Table 12.5 Summary of Short Term Measured Noise Levels & Comparison with Predicted Traffic Noise Levels (free-field)

Location	Measured Average (over 3hrs) (free-field)		Calculated from Measured (free-field)	Predicted (free-field)
	$L_{Aeq,3h}$ dB Day	$L_{A10,1h}$ dB	$L_{A10,18h}$ dB	$L_{A10,18h}$ dB
M5	62.6	66.8	65.8	68.4
M6	71.5	76.5	75.5	70.7
M7	48.4	50.0	49.0	52.1
M8	49.0	51.5	50.5	45.2

At M5 and M7 there is good agreement between the $L_{A10,18h}$ calculated from the 3 hour measurements and the predicted $L_{A10,18h}$. The model over predicts by around 3 dB.

At M6 and M8 the predicted $L_{A10,18h}$ level is around 5 dB below the level calculated from the measurements. M6 is immediately adjacent to the A96 and the noise model predictions match the measured levels at all the other roadside positions (M2, M4 and M5). Therefore, it is believed to be a factor local to M6 which is resulting in the mismatch, such as the influence of the nearby junction on traffic conditions, combined with the potentially less reliable nature of

the short term measurements. It is also worth noting that M6, and the other nearby properties, are outside the 600 m detailed traffic noise prediction study area.

At M8 both measured ambient noise levels and predicted traffic noise levels are very low. It was noted during the monitoring that wind rustling vegetation close to the monitoring position was a constant noise source at this location. This source is obviously not included in the traffic noise predictions and may be preventing the measured levels falling to the lower levels predicted by the traffic noise modelling. Furthermore, as for M6, the potentially less reliable nature of the short term measurements in determining the $L_{A10,18h}$ must be considered.

12.3.2 *Future Do-Minimum*

A summary of overall Do-Minimum traffic noise levels and the change from the baseline year to the future assessment year is provided in Table 12.6. A total of 31 properties are located within 600m of the Scheme and the identified affected route. However, only 10 properties meet the DMRB criterion of 55 dB $L_{night,outside}$ at one or more façade in one or more scenarios for inclusion in the night time traffic noise assessment.

Sensitive receptors other than residential properties within 600 m of the Scheme consist of one SSSI and one PRoW, see Figure 12.1 – Noise Study Area . The assessment is based on free-field traffic noise level at the closest approach of the SSSI and PRoW to the Scheme. No schools, hospitals or places of worship have been identified in the 600 m study area.

Table 12.7 contains a summary of the change in traffic noise annoyance at residential properties from the baseline year to the future assessment year, as required by the DMRB.

Tables 12.6 and 12.7 are based on the façade at each building which undergoes the worst change in traffic noise level from the 2016 Do-Minimum scenario to the 2031 Do-Minimum scenario.

Table 12.6 Long-term Change in Do-Minimum Traffic Noise Levels (2016 DM to 2031 DM)

Change in Traffic Noise Level		Daytime		Night-time
		Number of dwellings	Number of other sensitive receptors	Number of dwellings
Increase in noise level Daytime $L_{A10,18h}$ dB Night-time $L_{night,outside}$ dB	0.1-2.9	31	2	10
	3.0-4.9	0	0	0
	5.0-9.9	0	0	0
	≥10	0	0	0
No Change	0	0	0	0
Decrease in noise level Daytime $L_{A10,18h}$ dB Night-time $L_{night,outside}$ dB	0.1-2.9	0	0	0
	3.0-4.9	0	0	0
	5.0-9.9	0	0	0
	≥10	0	0	0

Table 12.7 Long-term Change in Do-Minimum Traffic Noise Annoyance (2016 DM to 2031 DM)

Change in % Annoyed		Daytime
		Number of dwellings
Increase in Annoyance level	<10%	31
	10<20%	0
	20<30%	0
	30<40%	0
	≥40%	0
No Change	0	0
Decrease in Annoyance level	<10%	0
	10<20%	0

Change in % Annoyed		Daytime
		Number of dwellings
	20<30%	0
	30<40%	0
	≥40%	0

All residential properties and both non-residential receptors undergo a negligible increase (< 3 dB) in daytime traffic noise in the long term from 2016 to 2031 in the absence of the Scheme. This is to be expected as in the absence of the Scheme traffic flows are generally predicted to increase slightly over time. The negligible increase in road traffic noise levels from 2016 to 2031 in the absence of the Scheme, results in a corresponding increase in annoyance due to road traffic noise. All properties fall within the <10% increase in annoyance band.

The change from 2016 to 2031 is presented as a noise contour plot in Figure 12.2 – Change: 2013 Do Minimum minus 2016 Do Minimum. The map is based on free-field traffic noise levels at first floor level (4 m above ground) calculated on a 5m x 5m grid.

Table 12.8 outlines the Do-Minimum Basic Noise Level (BNL) in 2016 and 2031 for each of the five sections of the minor road between the A96 and Chapel of Garioch, which is the only identified affected route outside the 1 km study area, see Figure 12.1 – Noise Study Area. A count of the number of sensitive receptors within 50 m of each link is also provided. The single non-residential receptor is the Chapel of Garioch Parish Church.

Table 12.8 Long-term Change in Do-Minimum Traffic Noise - Affected Routes (2016 DM to 2031 DM)

Link Ref	Basic Noise Level L_{A1018h} dB			Number of dwellings	Number of other sensitive receptors
	2016 DM	2031 DM	Change		
1	61.9	62.5	+0.6	7	0
2	62.2	62.8	+0.6	4	0
3	60.6	61.3	+0.6	4	0
4	61.0	61.6	+0.6	8	1
5	61.1	61.8	+0.6	1	0

A negligible increase in traffic noise is predicted along all sections of the minor side road between 2016 and 2031 in the absence of the Scheme.

12.4 Predicted Impacts

Table 12.9 summarises the change in traffic noise levels in 2016 between the Do-Minimum and Do-Something scenarios at both residential properties and other sensitive receptors within the 600 m study area, see Figure 12.1 – Noise Study Area. Table 12.10 summarises the change between the 2016 Do-Minimum and 2031 Do-Something scenarios. Table 12.11 outlines the worst case change in annoyance. All the comparisons are based on the façade experiencing the worst case change in traffic noise levels for that comparison.

Table 12.9 Short-term Change in Do-Something Traffic Noise Levels (2016 DM to 2016 DS)

Change in Traffic Noise Level		Daytime	
		Number of dwellings	Number of other sensitive receptors
Increase in noise level Daytime $L_{A10,18h}$ dB	0.1-0.9	18	2
	1.0-2.9	5	0
	3.0-4.9	0	0

Change in Traffic Noise Level		Daytime	
		Number of dwellings	Number of other sensitive receptors
	≥5	0	0
No Change	0	0	0
Decrease in noise level Daytime $L_{A10,18h}$ dB	0.1-0.9	2	0
	1.0-2.9	0	0
	3.0-4.9	6	0
	≥5	0	0

Table 12.10 Long-term Change in Do-Something Traffic Noise Levels (2016 DM to 2031 DS)

Change in Traffic Noise Level		Daytime		Night-time
		Number of dwellings	Number of other sensitive receptors	Number of dwellings
Increase in noise level Daytime $L_{A10,18h}$ dB Night-time $L_{night,outside}$ dB	0.1-2.9	22	2	2
	3.0-4.9	1	0	0
	5.0-9.9	0	0	0
	≥10	0	0	0
No Change	0	0	0	0
Decrease in noise level Daytime $L_{A10,18h}$ dB Night-time $L_{night,outside}$ dB	0.1-2.9	2	0	2
	3.0-4.9	1	0	1
	5.0-9.9	5	0	5
	≥10	0	0	0

Table 12.11 Worst Case Change in Traffic Noise Annoyance

Change in % Annoyed		Daytime
		Number of dwellings
Increase in Annoyance level	<10%	0
	10<20%	18
	20<30%	5
	30<40%	0
	≥40%	0
No Change	0	0
Decrease in Annoyance level	<10%	8
	10<20%	0
	20<30%	0
	30<40%	0
	≥40%	0

The change in $L_{A10,18h}$ traffic noise levels in 2016 between the Do-Minimum and Do-Something scenarios is illustrated in Figure 12.3 - Change: 2016 Do Something minus 2016 Do Minimum. Figure 12.4 - Change: 2031 Do Something minus 2016 DO Minimum illustrates the change between the 2016 Do-Minimum and 2031 Do-Something scenarios. As would be expected, the relocation of the A96 to the east generally results in an increase in a traffic noise levels to the east and a reduction to the west.

A negligible increase in traffic noise levels is predicted at both the non-residential sensitive receptors (SSSI and PRoW) in both the long term and short term. Based on the sensitivity of the non-residential receptors the significance of the effect at the SSSI and PRoW is classed as neutral.

At sensitive receptors located beyond the 600 m quantitative study area but within the overall 1 km area, the significance of the effect of the Scheme is considered to be slight at most in the short term and long term.

In the short term, 18 of the 31 identified residential properties are predicted to experience a negligible (0.1 - 0.9 dB) increase in traffic noise and five a minor (1.0-2.9 dB) increase. Two experience a negligible decrease in the short term, and six a moderate decrease. The beneficial effects are predicted at the eight properties located immediately to the west of the A96 (1-4 Station Cottages, Rowan Cottage, Dunmuir, Dier Cottage and Dockendale)

In the long term, 22 of the 31 identified residential properties are predicted to experience a negligible (0.1 - 2.9 dB) increase in traffic noise in the daytime and eight a negligible to moderate (5.0 – 9.9 dB) decrease. These are the same eight properties identified as experiencing a benefit in the short term. A single property, Uryview at the southern end of the Scheme, is predicted to experience a minor increase of 3.4 dB in the long term. This increase in traffic noise is predicted on a single façade at the rear of the property. A negligible reduction is predicted at the façade facing the A96.

A similar pattern is observed in the night time traffic noise results. Of the 10 properties which meet the DMRB criterion of 55 dB $L_{night,outside}$ at one or more façade in one or more scenarios for inclusion in the night time traffic noise assessment, two are predicted to experience a negligible (0.1 - 2.9 dB) increase in traffic noise in the long term and eight a negligible, minor or moderate decrease.

A full list of the $L_{A10,18h}$ traffic noise results for all scenarios at all facades of the 31 identified residential properties in the 600 m study area is provided in Appendix 12.3 – Traffic Noise Predictions.

The magnitude of the negligible or minor increases in road traffic noise levels from 2016 to 2031 at 23 properties results in a corresponding increase in annoyance due to road traffic noise. These properties fall within the 10 to<20% or 20 to <30% increase in annoyance band, based on the worst case change in annoyance. Eight properties fall within the <10% decrease in annoyance band.

The results of the preliminary Noise Insulation (Scotland) Regulations assessment indicate no properties are likely to meet the criteria. However, as outlined in section 12.2.4, a dedicated NISR assessment will be required once the design is finalised, if the Scheme goes ahead.

Table 12.12 outlines the Do-Something basic noise level in 2016 and 2031 for each of the five sections of the minor road between the A96 and Chapel of Garioch. This is the only identified affected route outside the 1 km study area, see Figure 12.1 – Noise Study Area. . A count of the number of sensitive receptors within 50 m of each link is also provided. The single non-residential receptor is the Chapel of Garioch Parish Church.

Table 12.12 Short-term and Long-term Change in Traffic Noise - Affected Routes

Link Ref	Basic Noise Level L_{A1018h} dB				Number of dwellings	Number of other sensitive receptors
	2016 DS	2031 DS	Change 2016DS-2016DM	Change 2031DS-2016DM		
1	55.5	56.1	-6.4	-5.8	7	0
2	56.8	57.4	-5.5	-4.8	4	0
3	55.8	56.5	-4.8	-4.2	4	0
4	48.0	48.6	-12.9	-12.3	8	1
5	50.6	51.3	-10.5	-9.9	1	0

A major (≥5 dB) reduction in traffic noise levels is predicted in the short term at four of the five sections of the minor side road. In the long term, a minor reduction (3.0 - 4.9 dB) is predicted along Sections 2 and 3, a moderate reduction (5.0 - 9.9 dB) along Sections 1 and 5, and a major reduction (≥10 dB) along Section 4, west of the centre of the village of Chapel of Garioch.

As noted in section 12.2.8 the Do-Something Basic Noise Levels in Table 12.11 should not be relied upon, as the flows are very low on this minor road once the Scheme is operational. Flows are well below the lower cut off of 1000 vehicles on which the CRTN prediction method is based. In the 2031 Do-Something scenario 18 hour flows range from 72 on Section 4 to 653 on Section 3. This is a drop of almost 1100 vehicles from the 2016 Do-Minimum scenario. At such low flows it is likely that other noise sources in the ambient noise climate, such as more distant traffic, agricultural activities etc. will become the dominant noise sources and prevent actual noise levels from reducing as much as suggested in Table 12.12. However, it is likely that the operation of the Scheme will have a slight to moderate beneficial effect on noise levels at receptors located along the minor road between the A96 and Chapel of Garioch, due to the transfer of traffic onto the upgraded A96.

The proposed scheme complies with the principles of PAN 1/2011.

12.5 Mitigation

12.5.1 *Construction Noise*

The suggested location for the construction compound at the northern end of the Scheme between the realigned A96 and the railway is reasonably remote from residential properties (over 100m), and partially shielded by the railway embankment. The final location of the compound will be confirmed once the contractor is appointed.

A range of good site practices would be adopted in order to mitigate construction phase noise. It is assumed that the contractor will follow best practicable means to reduce the noise impact on the local community, including:

- fixed and semi-fixed ancillary plant such as generators, compressors etc. which can be located away from receptors to be positioned so as to cause minimum noise disturbance. If necessary, acoustic barriers or enclosures to be provided for specific items of fixed plant;
- all plant used on site will comply with the EC Directive on Noise Emissions for Outdoor Equipment, where applicable;
- selection of inherently quiet plant where appropriate. All major compressors to be 'sound reduced' models fitted with properly lined and sealed acoustic covers which are kept closed whenever the machines are in use, and all ancillary pneumatic percussive tools to be fitted with mufflers or silencers of the type recommended by the manufacturers;
- all plant used on site will be regularly maintained, paying particular attention to the integrity of silencers and acoustic enclosures;
- machines in intermittent use to be shut down in the intervening periods between work or throttled down to a minimum;
- drop heights of materials from lorries and other plant will be kept to a minimum; and
- adherence to the codes of practice for construction working and piling given in British Standard BS 5228 and the guidance given therein for minimising noise emissions from the site.

Aberdeenshire Council recommend construction working hours are limited to 07:00-19:00 on weekdays and 07:00-12:00 on Saturdays, with no working on Sundays and Bank Holidays.

Some works outside these hours will be required to construct the bridge over the railway. Ensuring the duration of night-time and weekend works is kept to a minimum will minimise the adverse effect. The contractor will be required to apply in writing to the Council for works outside of normal hours.

Local residents will be kept informed and provided with a contact name and number for any queries or complaints. In particular residents will be notified in advance of the night time works.

12.5.2 *Operational Traffic Noise*

The use of a 'low noise surface' on the proposed Scheme is included as a mitigation measure which is intrinsic to the Scheme design. Based on the results of the assessment, which include the low noise surface, no further noise mitigation measures are proposed.

12.6 Disruption due to Construction

The construction works are estimated at this stage to take approximately one year. Traffic management measures, including one way traffic, are estimated to be required for around 10 weeks during the tie-in of the Scheme to the existing road.

The likely construction works include vegetation clearance along the route, construction of the temporary access road at the southern end, earthworks to form the 3d alignment, construction of the road (sub base and surfacing) and construction of the new bridge over the railway and new access underpass. The large scale earthworks and the construction of the new bridge are likely to involve the most plant on site and take the longest time. The new bridge is at least 65 m from the closest properties Dier Cottage and Dockendale.

Construction of the new road bridge over the railway will require some weekend night works during railway 'possessions', though the duration is not currently known. Night time works inevitably have a greater potential to result in significant adverse effects than daytime works. The results of the baseline survey indicated that night time ambient noise levels are 5.5-7.5 dB lower than daytime levels.

A total of 31 residential properties have been identified in the 600 m noise prediction study area. However, the potential for significant adverse construction noise effects is likely to be limited to the 12 properties closest to the Scheme. These are: 1-4 Station Cottages, Rowan Cottage, Dunmuir, Dier Cottage, Dockendale, Uryview, Milton Cottage, Milton of Inveramsey and Mill House. All are approximately 100 m or less from the Scheme. However, the baseline survey (M4 and M5) indicates that existing ambient noise levels at the majority of these properties are likely to be reasonably high due to their proximity to the existing A96. Daytime levels at M4 and M5 are in the low to mid 60 dB L_{Aeq} range.

Based on the nature of the proposed works and the proximity of residential properties the magnitude of the temporary adverse impact of construction noise is classed as moderate. Based on the high sensitivity of residential properties, the likely duration of the works and the existing ambient noise levels the significance of the effect is classed as moderate adverse.

An estimate of the likely volume of construction traffic required for the works of 109 HGVs per day (two way) has been provided. Current two way 18hr flows on the A96 in 2012 are around 9800, of which 6.7% are HGVs. The addition of the construction traffic would result in a negligible increase in traffic noise levels at receptors along the A96. The significance of the effect of construction traffic on residential properties along the A96 is classed as negligible adverse.

As discussed in Section 12.2.2 the current design of the new bridge is for spread footing foundations, therefore construction vibration effects have been scoped out of the assessment.

However, there is a slight possibility that the appointed contractor may choose to use piled foundations, if so the contractor will be required to assess the potential for significant vibration effects at that stage. Based on the distance from the proposed bridge to the nearest properties, approximately 65m, significant vibration effects are considered to be very unlikely.

12.7 Residual Impacts

12.7.1 *Construction Noise*

At this stage no specific construction noise mitigation measures, such as construction noise barriers, are proposed. The use of best practice noise control measures, minimising the need for night works, complying with the Council's standard working hours and keeping residents informed, are assumed within the assessment. The requirement for mitigation measures for specific activities or items of plant will be considered once a contractor is appointed and specific details of the works are available. The magnitude of the impacts and significance of the effects therefore remain unchanged from that detailed in section 12.6.

12.7.2 *Operational Traffic Noise*

No additional mitigation measures are proposed in addition to the inclusion of a low noise surface as part of the Scheme design. The magnitude of the impacts and significance of the effects therefore remain unchanged from that detailed in section 12.4.

10.8 Compliance with Plans & Policies

Following completion of the noise assessment there is no evidence to suggest that the Scheme will contravene national noise guidelines, planning policy at national level or in the development plan and guidance outlined within PAN 1/2011 'Planning and Noise' has been followed.

12.8 Summary

The proposed Scheme will result in both temporary noise impacts during the construction works and permanent noise impacts due to the operation of the Scheme.

The potential for significant adverse construction noise effects is likely to be limited to the 12 properties in closest proximity to the Scheme. However, existing ambient noise levels at these properties are reasonably high as they are close to the existing A96. The works with the greatest potential to result in significant adverse effects are the large scale earthworks and the construction of the new bridge as they are likely to involve the most plant on site and take the longest time. The total duration of the works is 12 months. Construction of the new road bridge over the railway will require some weekend night works.

At this stage no specific construction noise mitigation measures, such as construction noise barriers, are proposed. The use of best practice noise control measures, minimising the need for night works, complying with the Council's standard working hours and keeping residents informed, are assumed within the assessment. The need for mitigation measures for specific activities or items of plant will be considered once a contractor is appointed and specific details of the works are available.

The significance of the temporary construction noise effects is classed as moderate adverse.

In the absence of the Scheme road traffic noise levels in the 600 m study area increase slightly from the baseline year 2016 to the future assessment year of 2031 due to the general increase in traffic flows over time.

With the Scheme in place, in the long term, 22 of the 31 identified residential properties within 600 m undergo an increase in daytime traffic noise levels of negligible magnitude. A single

property is predicted to undergo a minor increase on a single façade. Eight properties to the west of the Scheme undergo a negligible to moderate decrease in daytime traffic noise levels in the long term. The Scheme also results in the transfer of traffic from the minor side road through Chapel of Garioch onto the A96, resulting in a beneficial effect at receptors along the minor side road .

References

- British Standard Institute BS 5228: (2009) 'Noise and Vibration control on construction and open sites'
- British Standard Institute BS 7445: (2003) 'Description and measurement of environmental noise'
- Department of Transport and the Welsh Office (1998) Calculation of Road Traffic Noise
- Highways Agency (2011) Design Manual for Roads and Bridges (DMRB) Volume 11 Part 7 HD213/11 Revision 1
- Land Compensation (Scotland) Act (1973) Chapter 56.
- The Noise Insulation (Scotland) Regulations (1975), Statutory Instrument No. 460 (S.60)
- The Scottish Government (2008) Transportation Noise Action Plan
- The Scottish Government (2011) Planning and Noise (PAN) 1/2011
- The Scottish Government (2011) Technical Advice Note Assessment of Noise

Legend

- Scheme
- 1km Noise Study Area
- 600m Traffic Noise Prediction Area
- Noise Monitoring Locations
- Significant Links Outside 1km Study Area
- Residential within 1km
- Designated Ecological Sites - SSSI
- Right of Way
- Scheduled Ancient Monument

M1
M2
M3
M4
M5
M6
M7
M8

1
2
3
4
5

0 150 300 600 900 1,200
Meters

N

Job Title

A96 INVERAMSAY
BRIDGE IMPROVEMENT

Drawing Title

NOISE STUDY AREA

TRANSPORT SCOTLAND
An agency of The Scottish Government

URS

Drawing Number

FIGURE 12.1

Legend

$L_{A10,18h}$ dB (free-field) at 4m

- < -10
- -10 - -5
- -5 - -3
- -3 - 0
- 0 - 3
- 3 - 5
- 5 - 10
- > 10
- 600m Traffic Noise Prediction Area
- Scheme
- 1 House Reference Number (Appendix 15C)

0 100 200 400 600 800 Meters

N

Job Title

A96 INVERAMSAY
BRIDGE IMPROVEMENT

Drawing Title

CHANGE:
2031 DO MINIMUM
MINUS
2016 DO MINIMUM

TRANSPORT SCOTLAND

URS

Drawing Number

FIGURE 12.2

Legend

$L_{A10,18h}$ dB (free-field) at 4m

- < -5
- -5 - -3
- -3 - -1
- -1 - 0
- 0 - 1
- 1 - 3
- 3 - 5
- > 5
- 600m Traffic Noise Prediction Area
- Scheme
- 1 House Reference Number (Appendix 15C)

0 100 200 400 600 800 Meters

N

Job Title

A96 INVERAMSAY
BRIDGE IMPROVEMENT

Drawing Title

CHANGE:
2016 DO SOMETHING
MINUS
2016 DO MINIMUM

TRANSPORT SCOTLAND

URS

Drawing Number

FIGURE 12.3

Legend

$L_{A10,18h}$ dB (free-field) at 4m

- < -10
- -10 - -5
- -5 - -3
- -3 - 0
- 0 - 3
- 3 - 5
- 5 - 10
- > 10
- 600m Traffic Noise Prediction Area
- Scheme
- 1 House Reference Number (Appendix 15C)

0 100 200 400 600 800 Meters

N

Job Title

A96 INVERAMSAY
BRIDGE IMPROVEMENT

Drawing Title

CHANGE:
2031 DO SOMETHING
MINUS
2016 DO MINIMUM

TRANSPORT SCOTLAND

URS

Drawing Number

FIGURE 12.4