10 Traffic Noise and Vibration

10.1 Introduction

10.1.1 Background

This section provides the traffic noise and vibration assessment for the proposed A68 Pathhead to Tynehead Improvement Scheme.

Section 3, Part 7, of Volume 11 of the Design Manual for Roads and Bridges (DMRB), (August 1994) provides guidance on the assessment of traffic noise and vibration. This guidance has been used as the basis for the traffic noise and vibration assessment for the proposed improvement scheme.

A DMRB Stage 1 report was prepared on behalf of the Scottish Executive in June 2004. This indicated that potential traffic noise and vibration effects resulting from the completed scheme were unlikely to be significant issues, due to the predicted low increase in future traffic flows and the small number of residential properties in the vicinity of the scheme.

A DMRB Stage 2 report was then completed in September 2006 for several road scheme options. This report concluded that the completed scheme was unlikely to have a significant impact on any potentially sensitive receptors and none of the road options considered would increase noise levels such that properties were entitled to insulation against road traffic noise. The final road alignment has now been chosen and this chapter details the findings of the Stage 3 Traffic Noise and Vibration assessment for the final scheme.

10.1.2 The Proposed Scheme and Existing Road Network

The section of the A68 proposed for the Pathhead to Tynehead Improvement Scheme covers a length of approximately 2.5 km (Figure 2.1) and does not include the village of Pathhead.

The proposed road improvement scheme will not cause changes in traffic flows on the A68 route of +25%/-20%, which are the DMRB Volume 11 criteria for Stage 3 assessment of the selected option. However, the scheme will result in changes in average traffic speeds on the A68 and the scheme will incorporate some alterations to the alignment and at several junctions where roads connect to the existing A68.

The stretch of the A68, which is relevant to the Pathhead scheme, has several small roads that connect to it. These are:

- The U60 Longfaugh Road
- The U77 Fala Dam Road
- The U78 Costerton Road; and

- The B6458 Tynehead & Saughland Road.

The final road alignment includes a new junction arrangement with the U60 Longfaugh Road, a new junction arrangement with the U77 Fala Dam Road and a new junction with the B6458 Tynehead and Saughland Road.

In addition to the new junction arrangement with the U77, there is a new proposed side road, which will connect the A68 with the U77 Fala Dam Road as an alternative route to the U78, which will be closed. The existing U77 junction with the A68 and the U78 will be closed and the new side road will therefore replace the existing U77 and U78 junctions with the A68.

10.2 Methods

10.2.1 Traffic Noise Assessment

This traffic noise assessment has been carried out with reference to the following documents:

- The Design Manual for Roads and Bridges (DMRB) Volume 11, Section 3, Part 7: Traffic Noise and Vibration (August 1994);
- The Noise Insulation (Scotland) Regulations 1975;
- Memorandum on the Noise Insulation (Scotland) Regulations 1975; and
- Calculation of Road Traffic Noise (CRTN) 1988.

The assessment follows the requirements of a Stage 3 assessment, as detailed in DMRB Volume 11, Section 3, Part 7; the objective of which is to undertake an assessment that is sufficient to identify the noise and vibration effects of the chosen scheme alignment.

When considering predicted noise levels it is useful to have some idea of the range of sound levels that are commonly found in the environment. An indication of the range can be seen in Table 10.1.

Table 10.1. Indication of the range of common sound levels.

Sound Level dB(A)	Location
20 to 30 dB(A)	Quiet bedroom at night
40 to 45 dB(A)	Living room during the day
50 to 60dB(A)	Typical Office
50 to 60 dB(A)	Inside a car
60 to 70 dB(A)	Typical high street
70 to 90 dB(A)	Inside factory
100 to 110 dB(A)	Burglar alarm at 1m away
110 to 130 dB(A)	Jet aircraft taking off.

Further examples can be seen in Figure 1 of DMRB Volume 11, Section 3, Part 7 Traffic Noise and Vibration.

10.2.2 Identification of Sensitive Receptor Locations

The Stage 3 assessment requires that a noise assessment is completed for all properties and other relevant locations where existing traffic is likely to be increased by at least 25% or reduced by 20%.

The traffic data provided by SIAS confirms that properties adjacent to the section of the U77 Fala Dam road between the A68 and the new side road (between the U77 and A68) will experience a decrease in traffic flows of greater than 20% due to closure of the U77. However the changes in noise levels due to vehicle movements on the new side road and the closure of the U78 Costerton Road will also need to be considered.

The sensitive receptors adjacent to the U77 and the new side road are therefore relevant to the assessment. In addition, properties adjacent to the alignment of the A68 road improvement scheme have also been considered. The receptors assessed are:

1. Marldene.
2. Old Crichton Dean.
3. Haugh Head House
4. Routhenhill.
5. Hope.

Appendix 10 identifies the distance of each of these receptors from each affected route.

DMRB requires that areas which are especially sensitive to noise or vibration should be identified. These include schools, hospitals and homes for the blind or for aged persons. A study of the area adjacent to the existing routes and proposed road improvement scheme has not identified any especially sensitive areas or locations.

Figure 10.1 (a and b) shows the existing A68, U77, U78 and receptor locations 1 to 5. Figure 10.2 (a and b) shows the proposed improvement scheme, the new side road and receptor locations 1 to 5.

10.2.3 Noise Predictions

The noise predictions have been carried out using the procedures set out in CRTN. The CRTN procedure entails predicting noise levels at a distance from the highway taking into account such factors as traffic flow, speed and composition, road configuration, intervening ground cover between source and receptor, screening, angle of view of traffic and reflections from facades.

Information relating to traffic flow, speed and composition has been provided by SIAS. The traffic data for those routes relevant to the five existing receptors is included in Appendix 10.

The receptors to consider which may be affected by changes in traffic flows / speeds are adjacent to the A68, U77, U78 and new side road:

- For the 2010 and 2025 Do Minimum scenario the properties adjacent to the U77 i.e. Marldene, Crichton Dean, Haugh Head House and Routhenhill are affected to varying degrees, by traffic noise from the A68 and U77. Routhenhill is also affected by traffic on the U78.

- For the 2010 and 2025 Do Something scenario the U78 and U77 (prior to the junction with the new side road), will be closed. For the 2010 and 2025 Do Something scenario the new side road will be opened. This will potentially affect Haugh Head House and Routhenhill as the flows on the new side road are >25% higher than those on the U77 (i.e. on the section of the U77 west of the U78).

- For both the 2010 and 2025 Do Minimum and Do Something scenarios the flows on the U77, U78 and new side road are very low i.e. <1000 vehicles/18 hour period. It is therefore not appropriate to predict changes in noise levels at the receptors adjacent to these routes using the CRTN prediction methodology.

- The Hope property is located adjacent to the A68. The traffic flows on the A68 are not low and the CRTN methodology can be used to predict noise levels from this road.

- Marldene, Crichton Dean, Haugh Head House, and Routhenhill will also be affected to some degree by road traffic noise from the A68. Noise levels from the A68 can be calculated using CRTN however due to the low flows on the U77, U78 and new side road, the overall noise levels, including noise from the A68, could not be determined using CRTN alone.

Noise predictions should be carried out for receptors adjacent to these routes using the procedures set out in CRTN (1988); however the low traffic flows have prevented this methodology from being used. Instead an energy based method has been used.

For the receptors 1, 2, 3 and 4 the flows on the adjacent minor roads are low for all 2010 and 2025 scenarios; ranging between 58 and 196 vehicles over an 18 hour period. For each of these receptors it has not therefore been possible to use CRTN to predict noise from the U77, U78 and new side road.

Instead an energy based method has been used. This has derived an $L_{Aeq\ 16\ hour}$ using the Sound Exposure Level of a typical vehicle (80 dB at 3 metres), the number of vehicles over a 16 hour period (taken as a proportional amount of 89% of the 18 hour

flows included in Appendix 10) and the distance of the property from the road (corrected as a line source). To determine the $L_{A10\ 18\ hour}$ from the $L_{Aeq\ 16\ hour}$ 2 dB(A) has been based on information contained in Planning Advice Note PAN 56 'Planning and Noise' 1999.

In addition to the noise from low traffic flows on the U77, U78 and new side road each of the properties are located less than 300 metres from the A68 and will be affected to some degree by noise from this route. The noise from the A68 at receptors 1, 2, 3 and 4 has been predicted using CRTN. The total ambient noise levels at receptors 1, 2, 3 and 4 are therefore the combined noise levels from the A68 (determined using CRTN) and the relevant minor road (determined using an energy based method).

It is recognised that this method has its limitations and that predicted noise levels will be approximate only; however the predicted noise levels will provide some indication of the scale of changes in noise levels likely at each receptor.

For the Hope property, where it is possible to undertake CRTN predictions for the A68 to determine the ambient noise level, the predictions have been carried out for the opening year (2010) and the design year (2025) for both Do Minimum and Do Something scenarios.

The changes in noise levels at each of the five locations have been assessed against a set of significance criteria. The criteria provided in Table 10.2 have been derived from information contained in DMRB (Volume 11 Section 3 Part 7). DMRB indicates that in the period following a change in traffic flows, people may find benefits or disbenefits when the noise changes are as small as 1 dB(A).

Table 10.2. Road Traffic Noise Assessment Magnitude Criteria.

Change in Noise Level	Potential Impact
<1 dB(A)	Imperceptible
1<3 dB(A)	Perceptible Impact
3<5 dB(A)	Minor Impact
5<10 dB(A)	Moderate Impact
>10 dB(A)	Major Impact

The significance of an environmental impact will be determined not only by the magnitude of the impact but also by the sensitivity of the receptor, as shown in Table 10.3.

Table 10.3. Methodology for Determining Sensitivity.

Sensitivity	Examples of Receptor
High	The receptor/resource has little ability to absorb change without fundamentally altering its present character, or is of international or national importance.

Moderate	The receptor/resource has moderate capacity to absorb change without significantly altering its present character, or is of high importance.
Low	The receptor/resource is tolerant of change without detriment to its character, is of low or local importance.

The sensitive locations considered in this noise assessment are residential. The existing receptors are considered to be moderately sensitive. Premises such as hospitals and nursing homes would be identified as highly sensitive; however there are no premises of this type in the area surrounding the site.

The significance of an environmental impact from road traffic noise is determined by the interaction of magnitude and sensitivity. The impact Significance Matrix used in this assessment is shown in Table 10.4.

Table 10.4. Impact Significance Matrix

Magnitude	Sensitivity		
	High	Moderate	Low
Major Impact	Major Adverse/Beneficial	Major-Moderate Adverse/Beneficial	Moderate-Minor Adverse/Beneficial
Moderate Impact	Major-Moderate Adverse/Beneficial	Moderate-Minor Adverse/Beneficial	Minor Adverse/Beneficial
Minor Impact	Moderate-Minor Adverse/Beneficial	Moderate-Minor Adverse/Beneficial	Minor-Insignificant
Perceptible Impact	Minor Adverse/Beneficial	Minor-Insignificant Adverse/Beneficial	Insignificant Adverse/Beneficial
Imperceptible	Insignificant Adverse/Beneficial	Insignificant Adverse/Beneficial	Insignificant Adverse/Beneficial

10.2.4 Noise and Vibration Nuisance Assessment

Using the predicted changes in noise levels for each of the five residential properties a noise and vibration nuisance assessment has been carried out. A noise nuisance assessment is only required where the change in noise is 1 dB(A) or more. The number of properties subject to the following changes in the percentage bothered by noise should then be identified: <10%, 10-<20%, 30-<40% and 40% or more.

Where necessary comments regarding traffic induced vibration have also been included.

10.2.5 Assessing the Need for Noise Mitigation

The results of the DMRB assessment should identify the ambient and predicted noise levels for all relevant properties and other locations taking into account any agreed

mitigation. With respect to the Pathhead Road Improvement Scheme no mitigation is proposed.

The Noise Insulation (Scotland) Regulations 1975 are used to indicate those properties, which may be eligible for statutory insulation.

Residential properties that are considered to be entitled to insulation against road traffic noise must satisfy the following criteria stipulated in The Noise Insulation (Scotland) Regulations, 1975 and the Memorandum on the Noise Insulation (Scotland) Regulations 1975. Regulations 3 and 6 require that:

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

The noise level is calculated for the most exposed window on the property façade in question, based on the layout and traffic flow immediately before the road works commence. This is defined as the ‘prevailing noise level’. A similar exercise is then carried out based on the revised road layout, using actual levels of traffic noise measured at intervals (1,5,10 and 15 years after opening as specified in the Memorandum on the Noise Insulation (Scotland) Regulations).

The Regulations prescribe a method for predicting noise levels. This method is set out in the Memorandum. It is recognised that CRTN is not the calculation method intended for use with the Noise Insulation (Scotland) Regulations and due to the difference in prediction methods a figure of 65 dB(A) has been used to suggest possible eligibility, where the CRTN procedure is used. This is to allow for any potential variation caused by using the different method.

For this traffic noise assessment noise levels at each of the five properties are predicted using CRTN and for Marldene, Crichton Dean, Haugh Head House and Routhenhill an energy based method has also been used. The entitlement for insulation at each of the properties is assessed against a noise level of 65 dB(A).

10.2.6 Vibration Assessment

The DMRB methodology requires that an assessment be made of the annoyance due to traffic induced airborne vibration caused by vehicle engines and exhausts. The survey of vibration nuisance, used as the basis for determining the percentage of people bothered very much or quite a lot by vibration in DMRB was restricted to properties within 40m of the carriageway where there were no barriers to traffic noise.

The $L_{A10\ 18h}$ index is among the physical variables most closely associated with average disturbance ratings. DMRB recognises that the relationship between the percentage of people bothered by largely airborne vibration and this noise exposure index is similar to that for noise nuisance except that the percentage of people bothered by vibration is lower at all exposure levels. For the purpose of predicting vibration nuisance DMRB requires that Figure 2 in Volume 11, Section 3, Part 7 'Traffic Noise and Vibration' is used, with a suitable adjustment, to predict vibration nuisance.

DMRB confirms that for a given level of noise exposure the percentage of people bothered very much or quite a lot by vibration is 10% lower than the corresponding figure for noise nuisance. On average, traffic induced vibration is expected to affect a very small percentage of people at exposure levels below 58 dB(A) and therefore zero percent should be assumed in these cases.

A nuisance assessment has been undertaken and the predicted noise levels (for Do Minimum and Do Something scenarios) have been used to determine the levels of vibration nuisance. Given the low traffic flows and the closure of the U77 and U78, it is likely that noise levels would be below 58 dB(A) at Marldene, Crichton Dean, Haugh Head House and Routhenhill and in turn zero percent of people would be affected by traffic induced vibration. The only property likely to experience noise levels greater than 58 dB(A) would be Hope, due to the proximity of the A68.

Ground-borne vibration is generated by irregularities in the road surface and is much less likely to be a cause of disturbance than airborne vibration when considering disturbance from new roads. Mouchel has indicated that the road improvement scheme will be designed and constructed to ensure that there are no significant irregularities in the road which will ensure that ground-borne vibration levels are minimised. It is not therefore necessary to assess ground-borne vibration.

10.3 Assessment of Impacts

10.3.1 Change in Noise Levels

DMRB states that in the period following a change in traffic flow, people may find benefits or disbenefits when the noise changes are as small as 1 dB(A) – equivalent to an increase in traffic flow of 25% or decrease in traffic flow of 20%. DMRB therefore considers that changes in noise levels of 1 dB(A) or greater may be perceptible as indicated in the significance criteria detailed in Table 10.2 of this assessment.

The noise predictions carried out for receptors 1 to 5 are included in Appendix 11. For each of the four scenarios, 2010 Do Minimum and Do Something and 2025 Do Minimum and Do Something, each of the 5 locations has been classified according to their predicted ambient levels. The results for 2010 and 2025 are illustrated in Appendix 12 and summarised below in Tables 10.5 to 10.8.

Table 10.5 Predicted Ambient Noise Levels for the 2010. Do Minimum Scenario.

Ambient Noise Level	Number of Properties experiencing noise level
≥70 dB(A)	
60-<70 dB(A)	1 (Hope)
50-<60 dB(A)	3 (Marldene, Crichton Dean, Haugh Head House)
<50 dB(A)	1 (Routhenhill)

Table 10.6 Predicted Ambient Noise Levels for the 2025. Do Minimum Scenario.

Ambient Noise Level	Number of Properties experiencing noise level
≥70 dB(A)	
60-<70 dB(A)	1 (Hope)
50-<60 dB(A)	4 (Marldene, Crichton Dean, Haugh Head House and Routhenhill)
<50 dB(A)	

Table 10.7 Predicted Ambient Noise Levels for the 2010. Do Something Scenario.

Ambient Noise Level	Number of Properties experiencing noise level
≥70 dB(A)	
60-<70 dB(A)	1 (Hope)
50-<60 dB(A)	4 (Marldene, Crichton Dean, Haugh Head House and Routhenhill)
<50 dB(A)	

Table 10.8 Predicted Ambient Noise Levels for the 2025. Do Something Scenario.

Ambient Noise Level	Number of Properties experiencing noise level
≥70 dB(A)	
60-<70 dB(A)	1 (Hope)
50-<60 dB(A)	4 (Marldene, Crichton Dean, Haugh Head House and Routhenhill)
<50 dB(A)	

By comparing the Do Minimum and Do Something scenarios the number of properties subject to the following increases and decreases have been determined: 1-<3 dB(A), 3-5<dB(A), 5-<10 dB(A), 10-15 dB(A) and over 15 dB(A). The results for the 2025 design year are shown in Table 10.9.

Table 10.9 Predicted Change in Ambient Noise Levels for the 2025 Design Year.

Change in noise level	Number of Properties experiencing change in noise level
Increase	
1-<3 dB(A)	
3-<5 dB(A)	
5-<10 dB(A)	
10-15 dB(A)	
>15 dB(A)	
Total experiencing an increase	
Decrease	
1-<3 dB(A)	2
3-<5 dB(A)	
5-<10 dB(A)	
10-15 dB(A)	
>15 dB(A)	
Total experiencing a decrease	2
Total experiencing a change less than 1 dB(A)	3

The results for the design year indicate that three properties will experience a change in noise levels <1 dB(A) (Marldene, Routhenhill and Hope). Two properties (Crichton Dean and Haugh Head House) will experience a beneficial reduction in noise levels of 1-<3 dB(A).

The changes in noise levels at Marldene, Routhenhill and Hope are not therefore likely to be perceptible and the impact will be insignificant. Taking into account the sensitivity of these receptors the impact will remain insignificant.

At Crichton Dean and Haugh Head House a beneficial impact is likely. The reduction in noise levels is likely to be perceptible and of minor/insignificant beneficial impact.

10.3.2 Nuisance Assessment

A nuisance assessment is only required for receptors when the change in noise levels is 1 dB(A) or more. This assessment is therefore only required for Crichton Dean and Haugh Head House.

For the 2025 Do Minimum and Do Something scenarios, Figure 2 of DMRB (Volume 11, Section 3, Part 7) has been used to provide an estimation of percentage of people bothered very much or quite a lot by traffic noise, for both the Do Minimum and Do Something scenarios. The results are shown in Table 10.10.

Table 10.10 Estimation of percentage of people bothered very much or quite a lot by traffic noise for the 2025 Do Minimum and 2025 Do Something Scenarios.

Percent bothered	Number of Properties experiencing percentage
2025 Do Minimum	
<10 %	2
10-<20 %	
20-<30 %	
30-<40% dB(A)	
≥40 dB(A)	
2025 Do Something	
<10 %	2
10-<20 %	
20-<30 %	
30-<40% dB(A)	
≥40 dB(A)	

The results confirm that for both the 2025 Do Minimum and So Something scenarios the two properties will lie in the <10% band of 'estimated percentage of people bothered very much of quite a lot by traffic noise'.

The change in the percentage of people bothered very much or quite a lot by traffic noise has then been determined. The results in Table 10.11 indicate that there is a potential reduction in the percentage of people bothered at Crichton Dean and Haugh Head House. This corresponds to the reduction in noise levels at each of the two properties due to the proposed road scheme.

Table 10.11 Change in the percentage of people bothered very much or quite a lot by traffic noise for the 2025 Do Minimum and 2025 Do Something Scenarios.

	Percentage of people bothered very much or quite a lot by traffic noise.
2025 Do Minimum	
Crichton Dean	8%
Haugh Head House	7%
2025 Do Something	
Crichton Dean	6%
Haugh Head House	5%

10.3.3 Traffic Induced Vibration

The noise levels at Marldene, Crichton Dean, Haugh Head House and Routhenhill are predicted to be below 58 dB(A). On average traffic induced vibration is expected to affect a very small percentage of people at exposure levels below 58 dB(A) and therefore zero percent of people bothered very much or quite a lot by vibration should be assumed.

Noise levels predicted at the Hope property indicate ambient noise levels above 58 dB(A); however no change in noise levels of 1 dB(A) or more is predicted and in turn it has not been considered necessary to assess vibration or vibration nuisance as any changes are not likely to be significant.

10.4 Mitigation

The traffic noise assessment indicates that a perceptible increase in traffic noise is unlikely to occur in 2010 and 2025 at three of the five noise receptors assessed. Two receptors, Crichton Dean and Haugh Head House are likely to experience a perceptible beneficial change in noise levels.

Predictions have been carried out which indicate that traffic noise levels may exceed 65 dB(A) $L_{10\ 18\ hour}$ at the Hope property. However the proposed scheme will not cause a perceptible change in noise levels at this receptor and it is not therefore likely to be eligible for compensation in accordance with the Noise Insulation (Scotland) Regulations.

Therefore, at this stage it is not considered necessary to recommend any measures to mitigate noise at any of the receptor locations assessed.