BEAR Scotland

M80 DBFO – Year 5 Noise Assessment

6367102/rmg/R1/v4

20th February 2018

Move Forward with Confidence

Document Control Sheet

Identification	
Client	BEAR Scotland
Document Title	M80 DBFO – Year 5 Noise Assessment
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Contact Details		
Company Name	Bureau Veritas UK Limited	BEAR Scotland
Contact Name	Rocco Giudice	David Paton
Position	Senior Consultant	Network Engineer
Address	Suite 4/3 Cadell House 27 Waterloo Street Glasgow G2 6BZ	Chryston Works Auchengeich Road Chryston G69 0JL
Telephone	0141 229 5000	0141 413 2842
e-mail	rocco.giudice@uk.bureauveritas.com	DPaton@bearscotland.co.uk

Configuration				
Version	**Date**	**Author**	**Reason for Issue/Summary of Changes**	**Status**
v1	23/09/16	Rocco Giudice		Superseded
v2	05/07/17	Rocco Giudice	Report updated following comments from Kenneth Crichton & Bernadette McKell (Jacobs) and appendix updated to include additional monitoring at 63 Kilsyth Road.	Superseded
v3	03/10/17	Rocco Giudice	Amendment to Para 5.6 as per Kenneth Crichton comments received on the 2/10/17.	Superseded
v4	20/02/18	Rocco Giudice	Amendments of Section 4 wording as per Transport Scotland Request	Final

	Name	Job Title	Signature
Prepared By	Rocco Giudice, BSc(Hons), PgDip, MIOA	Senior Consultant	
Approved By	Craig Scott BEng (Hons), MIOA	Principal Consultant	

Contents

1. Introduction

1.1 Bureau Veritas was instructed by BEAR Scotland to undertake the year 5 noise assessment for the M80 motorway between Stepps and Haggs.

1.2 As part of the O&M works requirements under the DBFO contract, BEAR Scotland has a duty to undertake a noise assessment every 5 years for the M80 (until year 15).

1.3 The noise assessment is required to determine if any properties along the route of the M80 between Stepps and Haggs are subject to noise levels that would potentially qualify them for improved sound insulation under the Noise Insulation (Scotland) Regulations 1975 (NISR).

1.4 The following scope of works was agreed with all parties i.e. HMG (represented by WSP Parsons Brinckerhoff) and Scottish Ministers (represented by Jacobs) for the Year 5 noise assessment. This included the following work;

- Update the Year 1 noise model with traffic flows for Year 5;
- Identify properties that may qualify under NISR and compare with pre-construction noise model;
- Undertake noise monitoring at selected locations along the M80 in order to verify the Year 5 noise model;
- Where, if any, properties are identified as potentially meeting the qualification criteria under NISR, undertake further noise monitoring / perform hand calculations as per, the statutory method for determining entitlement to sound insulation which is contained in the Memorandum of Advice and Instruction (Noise Insulation (Scotland) Regulations, 1975.

1.5 The Year 1 (2012) noise model was prepared by WSP Parsons Brinckerhoff and this was provided to Bureau Veritas by BEAR Scotland. The Year 1 model contains the entire M80 scheme from Stepps to Haggs and has been developed using the CadnaA noise modelling software.

1.6 Traffic flow data for May 2016 was provided by Traffic Scotland. Subsequently, the Year 1 model was updated with the Year 5 traffic data and processed in order to obtain noise levels at properties within 300m of the carriageway.

1.7 A total of 3686 buildings have been included in the noise model and all residential dwellings have been assessed for their eligibility under the NI(S)R 1975. It should be noted that the majority of these buildings are single dwellings comprising of two floor levels. For multi storey buildings receptors locations include for higher floors.

2. Criteria for Noise Assessment

Noise Insulation (Scotland) Regulations 1975

2.1 The NI(S)R 1975 defines the legislative duty and additional discretionary powers to carry out sound insulation or to make grants when the use of a new or altered highway and any other highway in the vicinity causes or is expected to cause a noise level ('specified noise level') not less than $L_{A10,18h}$ 68 dB at the façade of an eligible residential building.

2.2 In addition, the noise level caused or expected to be caused by the altered or new highway together with other traffic in the vicinity ('relevant noise level') should be at least 1 dB higher than the 'prevailing noise level' defined as the noise level immediately before the construction of the works began.

2.3 Eligible properties must be within 300m from the nearest point of the carriageway and have clear line of sight to the new or altered road. The point of assessment corresponds to the most exposed windows or doors on a façade from which a straight line can be drawn to the new or altered road without passing through another building.

2.4 The requirement of the NI(S)R 1975 is to assess the noise level in relation to an eligible building within the first 12 months of opening the scheme and then to reassess at subsequent intervals at 5, 10 and 15 years. This reports addresses the year 5 requirements.

Memorandum of Advice & Instruction (Noise Insulation (Scotland) Regulations 1975) No. 1/74

2.5 This memorandum describes the methodology to quantify the road traffic noise at a given distance from a highway. It is a technical document that supports the Noise Insulation (Scotland) Regulations 1975.

2.6 It has been agreed with HMG that the CRTN method would be used for the purposes of the modelling, using a lower $L_{A10,18h}$ 65 dB as a proxy trigger, following which, eligible facades that are above the proxy trigger and are predicted to have a noise increase of 1 dB or more would be assessed using the NI(S)R 1975 Memorandum method.

Calculation of Road Traffic Noise (CRTN) 1988

2.7 This memorandum describes the methodology to calculate the road traffic noise at a given distance from the highway. This method is more robust than the above Memorandum method in predicting road traffic noise levels.

2.8 The methodology takes into account the intervening ground cover, road configuration and road layout. The calculation assumes a typical traffic and noise propagation conditions. Noise levels are presented in terms of the noise descriptor $L_{A10,18h}$ which is the arithmetic average of the noise level exceeded for 10% of the time each hour between 06:00 and 24:00 hours.

2.9 The variables used in the calculation of the traffic noise level are:

- The annual average week day traffic flow (AAWT) for the 18-hour period from 06:00 to 24:00 hours;
- Mean traffic speed;
- Percentage of heavy vehicles;
- Road gradient;
- Type of road surface;
- Distance of the receptor from the road;
- Nature of the ground cover between the road and the receptor;
- Screening and reflections.

3. Road Traffic Noise Survey

3.1 The level of road traffic noise has been determined using the measurement and prediction methodology set out in, *"Calculation of Road Traffic Noise 1988,"* (CRTN 88). Noise measurements were made in accordance with the shortened measurement procedure during three consecutive hours between 10:00 and 17:00 hours.

3.2 Road traffic noise measurements were undertaken on the 20th and 24th May 2016 and the results of these surveys have been used to validate the CadnaA noise model.

3.3 The noise monitoring equipment was calibrated at the beginning and end of the assessment period using an acoustic calibrator, which had itself been calibrated against a reference set traceable to National and International Standards. No significant shift in calibration level was observed, i.e. <0.5dB. All measurements were undertaken with Class 1 sound level meters and the details of these can be found in Appendix B.

3.4 Measurements were made in a free-field location, at a height of approximately 1.5m above local ground level. The sound level meters were set to record hourly interval values for the measurement period, for the L_{A10}, L_{A90}, L_{Aeq} and L_{Amax} indices.

3.5 Meteorological conditions during the noise survey period were dry, still and partly sunny and hence considered to be generally conducive to carrying out road traffic sound level measurements.

3.6 The results from the noise measurements are given in Table 3.1 below. An arithmetic average of the three $L_{A10,1h}$ measurements at each location has been derived in accordance with CRTN to give a $L_{A10,3h}$ dB. The $L_{A10,\ 18h}$ dB (06:00 – 24:00) has subsequently been calculated in accordance with CRTN by subtracting 1 dB from the $L_{A10,3h}$.

Table 3.1: Road Traffic Noise Survey Data

Measurement Location	Description	Distance From Road (m)	$L_{A10,\ 3h}$ dB(A)	$L_{A10,\ 18h}$ dB(A)
1	Drumsack Farm	8	79.2	78.2
2	West of Auchengeich Road	6	80.5	79.5
3	East of Auchengeich Road	6	80.4	79.4
4	West of J4 Slip	6	80.4	79.4
5	Glenview Ave, Banknock	9	76.1	75.1
6	Castlecary Road	9	81.8	80.8
7	Carrick Road	6	81.9	80.9
8	M77 Off Slip	3	77.3	76.3

3.7 The dominant noise source at all the measurement positions was found to be from road traffic on the M80. Measurement locations can be seen in Appendix B and noise survey sheets with additional information can be found in Appendix C.

4. Noise Model

4.1 A road traffic noise model for the entire M80 scheme from Stepps to Haggs was prepared using CadnaA by WSP Parsons Brinkerhoff. Noise predictions were undertaken following the methodology described in CRTN. The WSP Parsons Brinkerhoff report dated December 2014 ref; 3513048C Issue 2 contains full details of the assumptions and methodologies used to build the model.

4.2 Bureau Veritas has obtained the Year 1 (2012) noise model prepared by WSP Parsons Brinckerhoff and road traffic data for May 2016 from Traffic Scotland.

4.3 Bureau Veritas has subsequently updated the Year 1 model with Year 5 traffic data in order to obtain noise levels at properties within 300m of the carriageway.

4.4 The results in the table below show the difference between the measured road traffic noise levels undertaken by Bureau Veritas in May 2016 with the predicted model data using the traffic flows provided by Transport Scotland.

Table 4.1: Comparison between Noise Modelling and Noise Survey Results

Measurement Location	Noise Modelling Results $L_{A10,18h}$ dB(A)	Noise Survey Results $L_{A10,18h}$ dB(A)	Difference dB
1 - Drumsack Farm	77.2	78.2	1
2 - West of Auchengeich Rd	78.2	79.5	1.3
3 - East of Auchengeich Rd	77.9	79.4	1.5
4 - West of J4 Slip	77.8	79.4	1.6
5 - Glenview Ave, Banknock	76.7	75.1	-1.6
6 - Castlecary Road	78.5	80.8	2.3
7 - Carrick Road	79.4	80.9	1.5
8 - M77 Off Slip	74.8	76.3	1.5

4.5 It can be seen from the table above that the difference between the noise model and survey results are generally within ~1.5 dB for all locations, with the exception of Location 6 – Castlecary Road, which was found to differ by 2.3 dB.

4.6 It is considered that variances can be accounted given the noise survey was only a 3-hour ‘snapshot’ of a typical weekday, whereas the noise modelling results were averaged over an entire month, included data from 06:00 to 24:00 and accounts for the variation in traffic flows. It must also be noted that the traffic count information from Traffic Scotland has inherent variability and errors due to the techniques employed. It was found that flows could range by around 12,000 on single stretches of road suggesting not all traffic counters were operating properly.

4.7 As previously highlighted, Location 6 showed the greatest difference between the measured and modelled results. This variance is likely to be attributed to the aforementioned factors and importantly, the traffic counters showed the great variations in flows across this section, suggesting errors in data capture. It may therefore not be suitable to use Location 6 as a verification point for the model due to possible errors encountered.

4.8 It is Bureau Veritas’ opinion that the differences calculated between the noise survey and noise model is an acceptable tolerance for the purpose of validating the noise model. As such, variances of ~1.5 dB between the measured and modelled noise levels are considered reasonable and therefore the noise model validated.

5. Discussion

5.1 The 2012 and 2016 models have been compared to establish consistency. This found that predicted noise levels for 2016 were generally very similar to the 2012 assessment i.e. most receptor noise levels were found to be within ±0.3 dB. It was found that a small number of noise levels did range from -4.0 to +1.9 dB at certain locations within the 2016 model, but this level of variation was unusual and is attributed to significant, but localised, variations in traffic flows. As previously stated, Stuart Hay of Transport Scotland confirmed with Bureau Veritas that there can be large inconsistencies in traffic flows due to the techniques employed to capture data. Furthermore, many counters were not recording accurate flows and some were considered to be malfunctioning.

5.2 Comparison of the results against the NI(S)R indicated that one dwelling has potentially met the criteria and this is discussed in further detail in paragraph 5.6. Although 580 dwellings were greater than 65 dB(A), either the noise levels have not increased by at least 1 dB or they have not met the other specifications i.e. the dwelling does not have a direct line of sight to the motorway or is within 300m of the motorway.

5.3 As an example, if the road traffic noise level at the façade of an eligible building was $L_{A10,18h}$ 63 dB before the construction began and $L_{A10,18h}$ 64 dB after, then the property does not qualify under the regulations. Conversely, if the prevailing noise level was $L_{A10,18h}$ 64 dB and the noise level at the facade of the same property is measured to be $L_{A10,18h}$ 65 dB with the new road in operation, then the property may qualify for sound insulation under NI(S)R. It is also possible to find properties which are above $L_{A10,18h}$ 65 dB both before and after the scheme opens, but do not experience a 1 dB increase. These would not be eligible.

5.4 The table below shows the number of receptor points that meet the requirements. It must be noted that several receptor points account for first and second floors for one building.

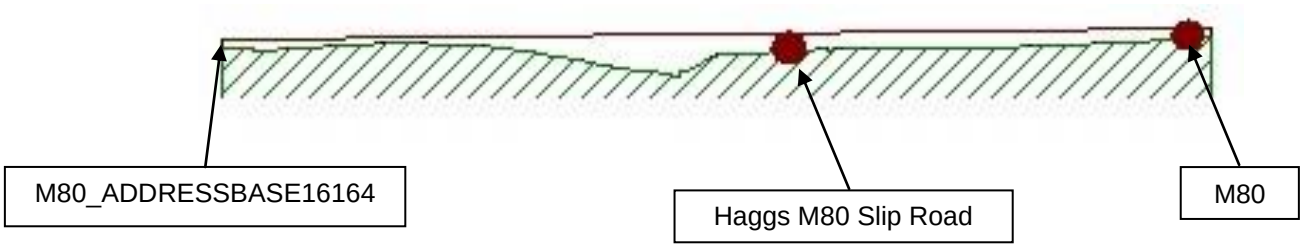
Table 5.1: Number of receptor points meeting the criteria

Criteria	No of receptor points
Are noise levels in 2016 greater than 2003?	475
Are noise levels greater than $L_{A10,18h}$ 65 dB?	80
Is the difference greater than or equal to 1 dB?	69
Dwellings within the 300m of motorway?	69
Direct Line of Sight?	1

5.5 All of the 69 receptors identified are exposed to noise levels greater than 65 dB $L_{A10,18h}$ and these have been shown to have increased by a minimum of 1 dB since 2003. Furthermore, all are located within 300m of the motorway. The receptors were found to be the same as those identified in the 2012 (Year 1) assessment as potentially meeting the NI(S)R criteria. Interrogating the noise model further and viewing a cross section of each of the receptors confirmed that 68 of the properties do not have a clear, direct line of sight to M80 and therefore do not satisfy the NI(S)R requirements wholly. However, 1 property was found to possibly have line of sight and required further review.

5.6 M80_ADDRESSBASE16164, is located at the corner of Kilsyth Road and the Haggs Slip Road to M80. Figure 5.1 shows a cross sectional view from the receptor point, created by the noise model. This shows that at 1.5m above local ground levels, the receptor point has a direct line of site to the M80. However, upon review of this location using Google Earth, it is unclear if the property had have line of sight to the M80, due to the presence of what appears to be an intervening ‘greenhouse’ type building. Further investigation was required to determine the visibility of the M80 from the rear of this property and a site visit was arranged with the owner for confirmation. (Please see Appendix D for the additional noise monitoring).

Figure 5.1: Line of sight for 63 Kilsyth Road, Bonnybridge, Haggs, FK4 1HA



6. Conclusion

6.1 Bureau Veritas have undertaken the year 5 noise impact assessment to review the noise levels generated from the M80 Motorway as part of the O&M works requirements under the DBFO contract. The requirements state that a noise assessment must be undertaken every 5 years for the M80 (until year 15).

6.2 A noise model developed using CadnaA noise modelling software was created in year 1 of the completion of the M80 by WSP Parsons Brinckerhoff which contains the entire M80 scheme from Stepps to Haggs. As part of the year 5 assessment the model was updated with the latest traffic flows to determine the impact on 3686 buildings or 7676 receptor points.

6.3 The traffic flow data for the entire month of May 2016 was provided by Traffic Scotland and used to calculate the $L_{A10,18h}$ which is the arithmetic average of the noise level exceeded for 10% of the time each hour between 06:00 and 24:00 hours.

6.4 The traffic data was input to the updated noise model and compared with the attended measurements at agreed locations to confirm its accuracy. The comparison showed a fairly consistent ~1.5 dB difference in noise levels which is considered reasonable when accounting for variables between noise monitoring and noise modelling. As discussed in Section 4 however, it was considered unsuitable to use Location 6 – Castlecary Road for the verification assessment. This is due to errors associated with the traffic counters which showed large variations in flows across this section of motorway, suggesting errors in the data capture.

6.5 Comparisons between the 2012 and 2016 model were also made to establish consistency. This found that predicted noise levels for 2016 were generally very similar to the 2012 assessment i.e. most receptor noise levels were found to be within ±0.3 dB. It was found that noise levels did range between -4.0 and +1.9 dB at certain locations within the 2016 model, but this level of variation was unusual and is attributed to significant, but localised, variations in traffic flows.

6.6 The results of the noise model were considered against The Noise Insulation (Scotland) Regulations 1975 and 1 property was found to be potentially entitled to sound insulation or a grant. It was established that 69 receptor points increased by a minimum of 1 dB, are exposed to noise levels of more than $L_{A10,18h}$ 65 dB at the façade and are within 300m from the nearest point of the carriageway. Further interrogation of the noise model and viewing a cross section of each of the receptors confirmed that 68 of the properties do not have a clear, direct line of sight to M80 and therefore do not satisfy the NI(S)R requirements wholly.

6.7 The one potential property that meets the NI(S)R qualifying criteria is located at the corner of Kilsyth Road and the Haggs Slip Road to M80. Interrogation of the noise model shows that at 1.5m above local ground levels, the receptor point has a direct line of site to the M80. However, upon review of this location using Google Earth, it was unclear if this property does have line of sight to the M80, due to the presence of what appears to be an intervening ‘greenhouse’ type building. Further investigation was required to determine the visibility of the M80 from the rear of this property and a site visit was arranged with the owner for confirmation. (Please refer to Appendix D for the additional noise monitoring at this property).

Appendix A

Glossary of Acoustic Terminology

"A" Weighting (dB(A))
The human ear does not respond uniformly to different frequencies. "A" weighting is commonly used to simulate the frequency response of the ear. It is used in the assessment of the risk of damage to hearing due to noise.

Decibel (dB)
The range of audible sound pressures is approximately 2 x 10^{-5} Pa to 200 Pa. Using decibel notation presents this range in a more manageable form, 0 dB to 140 dB.
Mathematically:
Sound Pressure Level (dB) = 20 log {p(t) / P_o}
where P_o = 2 x 10^{-5} Pa

Frequency (Hz)
The number of cycles per second, for sound this is subjectively perceived as pitch.

Frequency Spectrum
Analysis of the relative contributions of different frequencies that make up a noise.

L_{eq}(T)
The equivalent continuous sound level. It is that steady sound level which would produce the same energy over a given time period T as a specified time varying sound.

L_{Amax}(T)
The maximum RMS A-weighted sound pressure level occurring within a specified time period.

L_{AE} or SEL
A measure of A-weighted sound energy used to describe noise events such as the passing of a train or aircraft; it is the A-weighted sound pressure level which, if occurring over a period of one second, would contain the same amount of A-weighted sound energy as the event. The relationship between $L_{Aeq,(T)}$ and SEL is as follows:

$$L_{Aeq,(T)} = 10 \log [\underline{\text{antilog } SEL_1/10 + \text{antilog } SEL_2/10 + ...}$$

Total time period in seconds
where SEL_n is the measured single event level for a given event

$L_{A10,T}$
Road traffic noise level. The A-weighted sound pressure level of the residual noise in decibels exceeded for 10% of a given time interval.

$L_{A90,T}$
Background noise level. The A-weighted sound pressure level of the residual noise in decibels exceeded for 90% of a given time interval.

Noise
Unwanted sound.

Octave Band
A range of frequencies defined by an upper limit which is twice the lower limit. Octave bands are identified by their centre frequency.

R_{TRA} (dB)
The Traffic Noise Reduction Sound Insulation is derived by taking into account a typical spectrum of road traffic in town and city centres

R_W (dB)	The weighted sound reduction incorporates a correction for the ear's response and has been derived in accordance with BS 5821:1984.
Specific Noise	The equivalent continuous A-weighted sound pressure level at the assessment position produced by the specific noise source over a given reference time interval.
Rating Level, $L_{Ar,T}$	The specific noise level plus any adjustment for the character of the noise.
Ambient Noise	Totally encompassing sound in a given situation at any given time composed of noise from many sources, near and far.
Residual Noise	The ambient noise remaining at a given position in a given situation when the specific noise source is suppressed to a degree such that it does not contribute to the ambient noise.

Appendix B

Schedule of Monitoring Equipment

Noise Equipment

Brüel and Kjær Sound Analyser Type 2260	Serial Number 2520045
Brüel and Kjær Microphone Type 4189	Serial Number 2719881
Brüel and Kjær Sound Level Calibrator Type 4231	Serial Number 2229809
Brüel and Kjær Sound Analyser Type 2260	Serial Number 2124597
Brüel and Kjær Microphone Type 4189	Serial Number 2625098
Brüel and Kjær Sound Level Calibrator Type 4231	Serial Number 2229809
Brüel and Kjær Sound Analyser Type 2260	Serial Number 2443404
Brüel and Kjær Microphone Type 4189	Serial Number 2795597
Brüel and Kjær Sound Level Calibrator Type 4231	Serial Number 2229809
Rion Sound Level Meter Model NL-52	Serial Number 01054193
Rion Microphone Type UC-59	Serial Number 08576
Brüel and Kjær Sound Level Calibrator Type 4231	Serial Number 2229809

Brüel and Kjær Sound Analysis Software BZ 7202 (version 2)

Appendix C

Noise Survey Sheets

NOISE SURVEY SHEET

MEASUREMENT LOCATION:	1	DATE:	20/05/2016

Client:	BEAR Scotland
Project:	M80 Year 5 Assessment
Job Number:	6367102

Equipment:	RION NL-52
Serial No:	1054193
Responsible:	Rocco Giudice

WEATHER CONDITIONS

Temperature (°C)	Wind Speed (mm/s)	Wind Direction	Humidity (%)	General Comments
14	6	SW	67	Partly cloudy with sunny spells

NOISE MEASUREMENTS (dB)

Start Time	Elapsed	31.5	63	125	250	500	1k	2k	4k	8k	A	L_{AMaxF}	$L_{AF10.0}$	$L_{A90.0}$
10:00	1h	72.3	74.8	72.0	69.5	68.1	74.5	69.5	60.7	50.8	76.6	85.8	79.3	71.0
11:00	1h	74.3	75.8	73.1	70.4	68.4	74.3	69.3	60.3	50.6	76.5	88.3	79.1	71.0
12:00	1h	72	74.9	72.0	71.6	68.6	75.3	70.4	62.3	53.5	77.4	104.7	79.1	71.9
Notes:	Road traffic noise dominant													

PHOTOS

NOISE SURVEY SHEET

MEASUREMENT LOCATION:	2	DATE:	20/05/2016

Client:	BEAR Scotland
Project:	M80 Year 5 Assessment
Job Number:	6367102

Equipment:	B&K 2260
Serial No:	2520445
Responsible:	Rocco Giudice

WEATHER CONDITIONS

Temperature (°C)	Wind Speed (mm/s)	Wind Direction	Humidity (%)	General Comments
14	6	SW	67	Partly cloudy with sunny spells

NOISE MEASUREMENTS (dB)

Start Time	Elapsed	31.5	63	125	250	500	1k	2k	4k	8k	A	L_{AMaxF}	$L_{AF10.0}$	$L_{A90.0}$
11:09	1h	72	74.6	72.1	67.9	69.9	75.1	70.8	61.3	51.6	77.5	90.1	80.2	70.8
12:09	1h	71.6	74.1	71.7	67.8	70.3	75.6	71.9	63.9	56.2	78.3	93.6	80.8	71.8
13:09	1h	71.6	74.2	71.8	67.4	69.5	75.6	71.8	62.5	52.9	78.1	92.1	80.6	72.2
Notes:	Road traffic noise dominant													

PHOTOS

NOISE SURVEY SHEET

MEASUREMENT LOCATION:	3	DATE:	20/05/2016

Client:	BEAR Scotland
Project:	M80 Year 5 Assessment
Job Number:	6367102

Equipment:	B&K 2260
Serial No:	2124597
Responsible:	Rocco Giudice

WEATHER CONDITIONS

Temperature (°C)	Wind Speed (mm/s)	Wind Direction	Humidity (%)	General Comments
14	6	SW	67	Partly cloudy with sunny spells

NOISE MEASUREMENTS (dB)

Start Time	Elapsed	31.5	63	125	250	500	1k	2k	4k	8k	A	L_{AMaxF}	$L_{AF10.0}$	$L_{A90.0}$
10:56	1h	70.8	74.3	71.7	68.9	70.4	74.8	70.9	60.2	48.7	77.4	90.2	80.2	70.2
11:56	1h	71	73.7	71.4	68.7	70.6	74.8	71.2	61.9	52.7	77.6	93.0	80.2	71.0
12:56	1h	69.2	73.7	71.2	68.2	70	75.5	72.7	63.6	54.1	78.4	87.0	80.8	72.8
Notes:	Road traffic noise dominant													

PHOTOS

NOISE SURVEY SHEET

MEASUREMENT LOCATION:	4	DATE:	20/05/2016

Client:	BEAR Scotland
Project:	M80 Year 5 Assessment
Job Number:	6367102

Equipment:	B&K 2260
Serial No:	2443404
Responsible:	Rocco Giudice

WEATHER CONDITIONS

Temperature (°C)	Wind Speed (mm/s)	Wind Direction	Humidity (%)	General Comments
14	6	SW	67	Partly cloudy with sunny spells

NOISE MEASUREMENTS (dB)

Start Time	Elapsed	31.5	63	125	250	500	1k	2k	4k	8k	A	L_{AMaxF}	$L_{AF10.0}$	$L_{A90.0}$
10:38	1h	71.0	74.5	71.9	68.7	68.8	75.0	70.8	61.2	50.9	77.4	90.4	80.2	70.4
11:38	1h	72.5	74.5	72.1	69.0	69.0	75.2	70.9	61.2	50.9	77.5	95.1	80.2	70.4
12:38	1h	70.3	74.1	71.5	67.6	68.4	75.5	72	63.5	55	78.1	86.2	80.8	71.8
Notes:	Road traffic noise dominant													

PHOTOS

NOISE SURVEY SHEET

MEASUREMENT LOCATION:	5	DATE:	24/05/2016

Client:	BEAR Scotland	Equipment:	B&K 2260
Project:	M80 Year 5 Assessment	Serial No:	2520445
Job Number:	6367102	Responsible:	Rocco Giudice

WEATHER CONDITIONS

Temperature (°C)	Wind Speed (mm/s)	Wind Direction	Humidity (%)	General Comments
15	4	E	63	Partly cloudy with sunny spells

NOISE MEASUREMENTS (dB)

Start Time	Elapsed	31.5	63	125	250	500	1k	2k	4k	8k	A	L_{AMaxF}	$L_{AF10.0}$	$L_{A90.0}$
10:01	1h	71.4	76	71.8	66.9	68.0	71.7	66.6	56.9	45.5	74.1	94.3	76.4	69.2
11:01	1h	71.1	75.3	71.5	66.7	67.7	71.3	66.0	56.3	44.9	73.6	85.4	76.2	68.6
12:01	1h	69.9	75.2	71.3	66.7	67.2	70.8	65.6	55.9	44.6	73.2	83.2	75.8	68.4
Notes:	Road traffic noise dominant													

PHOTOS

NOISE SURVEY SHEET

MEASUREMENT LOCATION:	6	DATE:	24/05/2016

Client:	BEAR Scotland	Equipment:	B&K 2260
Project:	M80 Year 5 Assessment	Serial No:	2443404
Job Number:	6367102	Responsible:	Rocco Giudice

WEATHER CONDITIONS

Temperature (°C)	Wind Speed (mm/s)	Wind Direction	Humidity (%)	General Comments
15	4	E	63	Partly cloudy with sunny spells

NOISE MEASUREMENTS (dB)

Start Time	Elapsed	31.5	63	125	250	500	1k	2k	4k	8k	A	L_{AMaxF}	$L_{AF10.0}$	$L_{A90.0}$
10:25	1h	72.0	75.7	72.6	68.1	71.0	77.6	72.2	60.6	49.7	79.5	86.7	82.0	73.6
11:25	1h	71.8	75.5	71.9	68.0	70.4	77.3	72.1	60.5	49.4	79.2	86.7	81.8	73.2
12:25	1h	71.2	75.1	72.3	67.8	70.3	77.2	72.1	60.5	49.7	79.1	87.1	81.6	73.0
Notes:	Road traffic noise dominant													

PHOTOS

NOISE SURVEY SHEET

MEASUREMENT LOCATION:	7	DATE:	24/05/2016

Client:	BEAR Scotland
Project:	M80 Year 5 Assessment
Job Number:	6367102

Equipment:	B&K 2260
Serial No:	2124597
Responsible:	Rocco Giudice

WEATHER CONDITIONS

Temperature (°C)	Wind Speed (mm/s)	Wind Direction	Humidity (%)	General Comments
15	4	E	63	Partly cloudy with sunny spells

NOISE MEASUREMENTS (dB)

Start Time	Elapsed	31.5	63	125	250	500	1k	2k	4k	8k	A	L_{AMaxF}	$L_{AF10.0}$	$L_{A90.0}$
10:37	1h	72.6	77.6	73.6	68.8	72.1	76.7	71.9	62.4	52.6	79.0	90.0	82.0	71.2
11:37	1h	71.8	77	72.5	68.2	71.4	76.4	71.9	62.3	52.8	78.7	88.9	81.6	71.2
12:37	1h	71.8	77.1	73.0	69.4	71.9	76.6	72.0	62.5	52.7	79.0	89.3	82.0	71.4
Notes:	Road traffic noise dominant													

PHOTOS

NOISE SURVEY SHEET

MEASUREMENT LOCATION:	8	DATE:	24/05/2016

Client:	BEAR Scotland
Project:	M80 Year 5 Assessment
Job Number:	6367102

Equipment:	RION NL-52
Serial No:	1054193
Responsible:	Rocco Giudice

WEATHER CONDITIONS

Temperature (°C)	Wind Speed (mm/s)	Wind Direction	Humidity (%)	General Comments
15	4	E	63	Partly cloudy with sunny spells

NOISE MEASUREMENTS (dB)

Start Time	Elapsed	31.5	63	125	250	500	1k	2k	4k	8k	A	L_{AMaxF}	$L_{AF10.0}$	$L_{A90.0}$
11:05	1h	67.9	73	69.8	65.4	69.7	70.9	65.9	57	46.2	73.6	89.4	77.7	61.1
12:05	1h	67.2	72.7	67.1	64.4	68.1	69.5	64.6	56	46.5	72.2	91.9	76.3	60.2
13:05	1h	68.1	73.4	68.9	65.6	69.7	70.9	65.9	57.1	46.6	73.6	86.6	77.8	60.5
Notes:	Road traffic noise dominant													

PHOTOS

Appendix D

Noise survey at 63 Kilsyth Road, Bonnybridge

Acoustics and Vibration Group

Our ref: 6367102/rmg/LR1/v2
16th January 2017

Mr David Paton
BEAR Scotland
Chryston Works
Auchengeich Road
Chryston
G69 0JL

Dear David,

Noise Monitoring - 63 Kilsyth Road, Haggs

1. Introduction

1.1 Bureau Veritas was instructed by BEAR Scotland to undertake the year 5 noise assessment for the upgraded M80 motorway between Stepps and Haggs.

1.2 The noise assessment was required to determine if any properties along the route of the M80 between Stepps and Haggs were subject to noise levels that would potentially qualify them for compensation under the Noise Insulation (Scotland) Regulations 1975 (NISR).

1.3 A total of 3686 buildings were included in the noise model and all residential dwellings have been assessed for their eligibility under the NI(S)R 1975. It should be noted that the majority of these buildings are single dwellings comprising of two floor levels. For multi storey buildings receptors locations include for higher floors.

1.4 It was agreed with HMG and Jacobs that the CRTN method would be used for the purposes of the modelling, using a lower $L_{A10,18h}$ 65 dB as a proxy trigger, following which, eligible facades that are above the proxy trigger and are predicted to have a noise increase of 1 dB or more would be assessed using the NI(S)R 1975 Memorandum method.

1.5 Comparison of the results against the criteria indicated that one dwelling at 63 Kilsyth Road had potentially qualified, in that free-field noise levels were calculated to be greater than $L_{A10,18h}$ 65 dB(A), the noise levels had increased by at least 1 dB, the property had a direction line of sight to the motorway and was within 300m of the motorway.

1.6 As per the agreed scope of work, the following was recommended on identification of any properties which may meet the qualifying criteria;

- Noise monitoring to be undertaken to conform with NISR requirements to determine the $L_{A10,\ 18hr}$. If it is found that measured noise levels are below the qualifying level, Bureau Veritas will report this and cease the study at that point;
- Where the measured $L_{A10,18hr}$ verifies that qualifying criteria can be met, detailed calculations as required by NISR will be carried out.

1.7 Two site visits were subsequently made to 63 Kilsyth Road in November in order to determine whether the house had line of site to the M80 (which we considered it had) and to undertake the noise monitoring.

Bureau Veritas UK Limited
Suite 4/3 Cadell House
27 Waterloo Street
Glasgow G2 6BZ

Telephone: +44 (0) 141 229 5000
Registered in England 1758622
www.bureauveritas.co.uk

Registered Office
Suite 308 Fort Dunlop
Fort Parkway
Birmingham B24 9FD

1.8 It should be noted that as per the NSIR requirements, road traffic noise monitoring should ideally be undertaken during the busiest months of the year, i.e. May or August. Due to substantial delays out with the control of Bureau Veritas, the year 5 noise model was not completed until September 2016 and hence the ideal window for noise monitoring had already passed. Nevertheless, the Regulations state that alternative dates can be accepted.

1.9 Traffic Scotland provided the annual average week day traffic flow (AAWT) for the 18-hour period from 06:00 to 24:00 hours for the month on November 2016. This data was analysed so that average daily road traffic flows (Q) could be compared with those of a 'busy' month, such as May or August. This would verify whether the results of our November monitoring were representative of a busy month.

1.10 The data was provided for the north bound and south bound M80 sections adjacent to 63 Kilsyth Road in Haggs. A comparison of this data was made with the month of May 2016 which was used in our year 5 noise model. It can be seen from Table 1.1 below that the traffic counts varied very little and the Novembers flows only showed a total difference in flow of approximately -2.4 – 1.5%. The small difference in flow means that if monitoring had taken place in May there would have been a negligible difference in noise levels (i.e. at the very most 0.07 dB higher).

Table 1.1: Average Weekly Road Traffic Counts

Road Section	Direction	May'16 Traffic Count (Q)	Nov'16 Traffic Count (Q)	Difference (Q)	Difference (%)	Difference (dB)
NTC00482	NB	31292	31772	+480	+1.5 %	+ 0.07
NTC00485	SB	37677	36767	-910	-2.4 %	- 0.1

2. Road Traffic Noise Survey

2.1 The level of road traffic noise was measured using the principles set out in the Noise Insulation (Scotland) Regulations 1975.

2.2 Road traffic noise measurements were undertaken for a period of 24 hours between the 22nd and 23rd November 2016 within the back garden of 63 Kilsyth Road. Details of the noise equipment can be found in Appendix A while the site plan can be seen in Appendix B.

2.3 The noise monitoring equipment was calibrated at the beginning and end of the assessment period using an acoustic calibrator, which had itself been calibrated against a reference set traceable to National and International Standards. No significant shift in calibration level was observed, i.e. <0.5dB.

2.4 Façade measurements were made approximately 1m from the most exposed window, at a height of approximately 2.5m above local ground level in order to represent the highest part of the property's windows. The sound level meter was set to record hourly interval values for the measurement period, for the L_{A10}, L_{A90} and L_{Aeq} indices. A photo of the monitoring position can be seen in Figure 1.

Figure 1: Monitoring Location at 63 Kilsyth Road

2.5 Meteorological conditions during the noise survey period were dry, still and generally clear and hence considered to be conducive to carrying out road traffic sound level measurements. The weather conditions experienced during the survey are shown below.

Table 2.1: Weather Conditions

Date	Wind Speed (m/s)	Wind Direction	Max. Temp. (°C)	Min. Temp. (°C)	Humidity (%)	Precipitation (mm)
22/11/16	3	NW	7	-1	80	0
23/11/16	0.8	W	6	-5	90	0

2.6 The results from the noise measurements are given in Table 2.2 below. It should be noted that the 18-hour noise levels were calculated by arithmetically averaging the 1-hour noise levels. The full, hourly results can be found in Appendix C.

Table 2.2: Measured Façade Road Traffic Noise Levels

Measurement Time	$L_{Aeq, 18h}$ dB(A)	$L_{A10, 18h}$ dB(A)	$L_{A90, 18h}$ dB(A)	Notes
06:00 – 24:00	58.9	59.1	51.7	Noise from M80 and Kilsyth Road dominant.

2.7 It should be noted that the dominant noise source at the measurement position was found to be from road traffic on the M80 as well as local road traffic from Kilsyth Road.

3. Conclusions

3.1 Noise measurements at 63 Kilsyth Road were undertaken due to the dwelling potentially meeting the Noise Insulation (Scotland) Regulations (NISR) 1975 criteria for a grant or improved sound insulation with respect to road traffic noise.

3.2 The year 5 noise model predicted that the dwelling would exceed the $L_{A10,18hr}$ 65 dB proxy trigger, that noise levels had increased by more than 1 dB, that the house was within 300m of the M80 and that there was a clear line of site to the motorway.

3.3 In order to verify that noise levels at the property had exceeded the trigger criterion, noise monitoring was undertaken for a period of 24 hours between the 22nd and 23rd November 2016.

3.4 The results of the noise monitoring found that the façade noise level was $\boldsymbol{L_{A10,18hr}}$ **59.1 dB**. It was therefore established that the façade level was below the $L_{A10,18hr}$ 68 dB trigger criterion stipulated in the NISR.

3.5 Although it would have been preferable to measure 'worst case' road traffic noise levels in May or August it was not possible due to delays in the project delivery which were out with the control of Bureau Veritas. The Regulations state that if it is not possible to measure during these months then alternatives times can be accepted.

3.6 In order to ensure that the monitored levels in November were representative of worst case noise levels (i.e. similar to those of May or August), traffic flows for November 2016 were obtain from Traffic Scotland. It was found that there was a negligible difference in flows between November and May and hence it is considered that the noise levels measured in November are acceptable for use in this exercise.

3.7 In light of this new evidence, the noise monitoring undertaken suggests that 63 Kilsyth Road would not be eligible for a grant or improved sound insulation with respect to road traffic noise as it does not meet all the applicable criteria of the NISR.

We trust the above is clear and satisfactory, if you have any questions, please do not hesitate to contact us.

Yours sincerely,

Rocco Giudice
Senior Consultant (Acoustics and Vibration)
Bureau Veritas UK Ltd.
T (0) 141 229 5014
E rocco.giudice@uk.bureauveritas.com

Appendix A

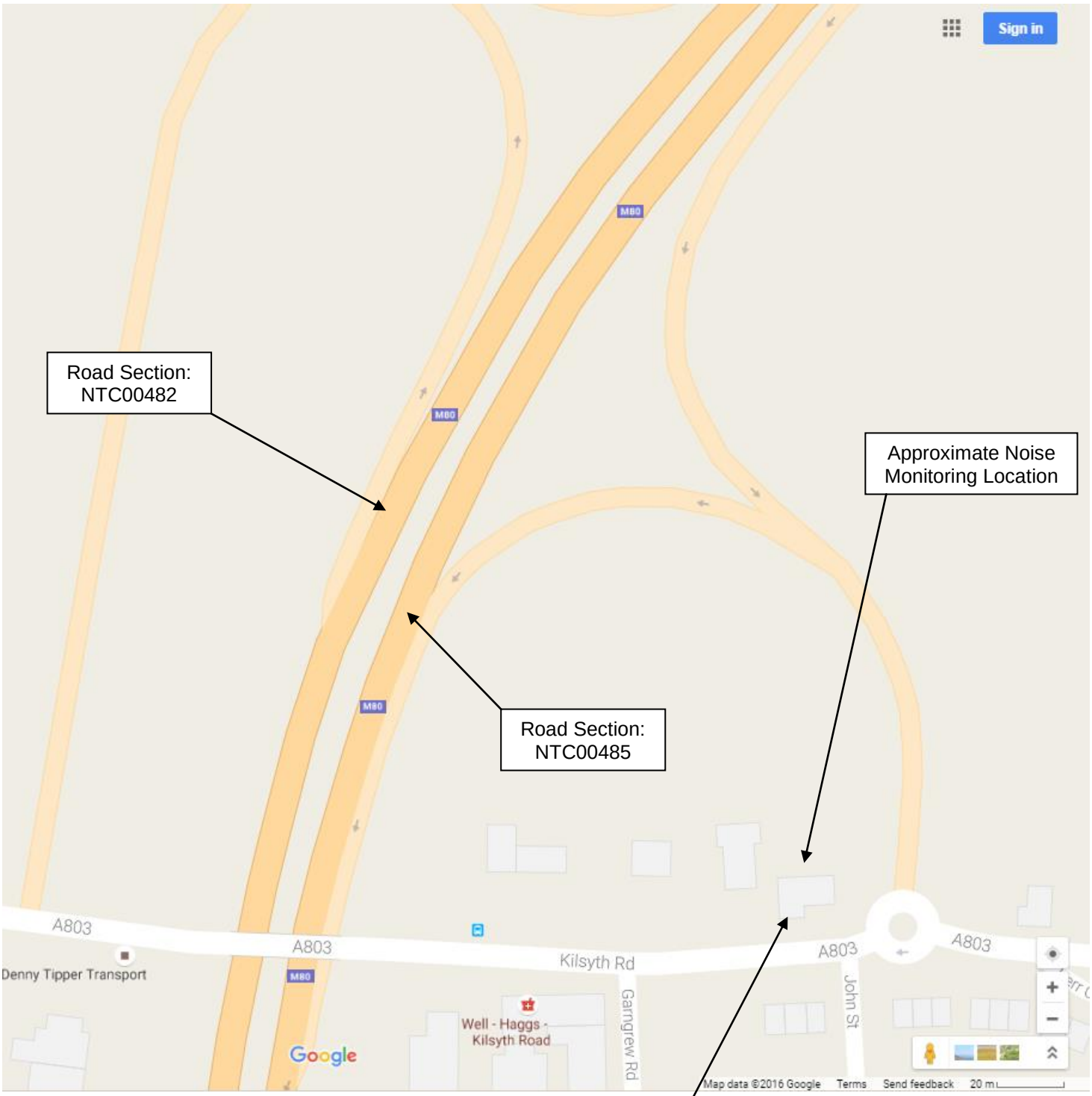
Schedule of Monitoring Equipment

Noise Equipment

Rion NL-52 Sound Level Meter	Serial Number 01054193
Rion NH-25 Microphone	Serial Number 54266
Brüel and Kjær Sound Level Calibrator Type 4231	Serial Number 2122928

Appendix B

Site Map (not to scale)



Appendix C

Measured Noise Data

Date	Start Time	End Time	$L_{Aeq,\ 1h}$ dB(A)	$L_{A10,\ 1h}$ dB(A)	$L_{A90,\ 1h}$ dB(A)
22/11/16	15:00	16:00	62.7	64.8	59.6
22/11/16	16:00	17:00	61.6	63.5	59.0
22/11/16	17:00	18:00	60.4	62.1	58.4
22/11/16	18:00	19:00	61.4	62.8	58.9
22/11/16	19:00	20:00	62.0	64.5	58.1
22/11/16	20:00	21:00	59.5	62.6	54.0
22/11/16	21:00	22:00	55.8	58.2	51.5
22/11/16	22:00	23:00	55.2	58.0	49.7
22/11/16	23:00	00:00	52.5	55.7	45.6
23/11/16	00:00	01:00	50.2	54.0	41.0
23/11/16	01:00	02:00	50.6	54.7	41.8
23/11/16	02:00	03:00	50.4	54.1	43.0
23/11/16	03:00	04:00	51.7	55.4	41.9
23/11/16	04:00	05:00	52.6	56.0	44.4
23/11/16	05:00	06:00	53.9	56.9	47.8
23/11/16	06:00	07:00	59.0	61.6	54.6
23/11/16	07:00	08:00	58.7	60.7	55.6
23/11/16	08:00	09:00	58.4	60.2	55.9
23/11/16	09:00	10:00	56.8	58.9	53.6
23/11/16	10:00	11:00	56.8	59.3	52.9
23/11/16	11:00	12:00	56.3	58.5	52.9
23/11/16	12:00	13:00	55.7	58.0	51.9
23/11/16	13:00	14:00	56.0	58.4	51.8
23/11/16	14:00	15:00	57.8	59.6	53.5