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BASELINE NOISE MONITORING SURVEY

UNIVERSITY COLLEGE DUBLIN

Report Ref. 22989-3 Rev. 1.0
TMS Environment Ltd
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1.0 Scope

This report presents the results of a baseline environmental noise survey carried out at a number of different noise monitoring locations in the vicinity of the proposed Belfield Campus Development area to be located at the University College Dublin Campus, Belfield, Dublin 4.

2.0 Regional Environmental Setting

The baseline noise survey focussed on four locations, surrounding the area of the campus under development.

The proposed Development Area is situated on a recreational sports field area on the Southern boundary of the Belfield Campus, which adjoins the Roebuck Castle Residential Estate to the West of the Development site. The Roebuck Road runs in an east-west direction along the southern boundary of the proposed site along the Roebuck Precinct. The western boundary of the proposed site merges with Campus facilities including student residential accommodation and sports fields. To the north, the proposed site adjoins the college campus, including the UCD Southerland School of Law and the Belgrove Student Residences.

3.0 Noise Sensitive Receptors

The noise monitoring locations were chosen in order to best represent the current noise climate at the nearest noise sensitive receptor (NSR) locations and other key NSR locations in the vicinity of the proposed development site. Four NSR locations (N1 to N4) were selected at various locations surrounding the site and these are presented graphically in Appendix I and summarised in Table 1 below.

Table 1 Noise Monitoring Locations

Monitoring Location	Description
N1	On Path outside of Residential property 111 Roebuck Castle
N2	On Path outside of Residential property 213/214 Roebuck Castle
N3	On green area to North of Roebuck Hall Residence
N4	On green area to West of Merville Student Residence

Note: Refer to noise monitoring location map in Appendix I.

Noise measurements were carried out at or near the boundaries of the NSRs and this noise survey is an accurate representation of the current day, evening and night-time noise levels in the areas monitored.

4.0 Survey Protocol

4.1 Monitoring Locations

The monitoring locations were selected in accordance with the *ISO 1996 Acoustics - Description and Measurement of Environmental Noise* guidelines. Monitoring was carried out in accordance with the above-mentioned document and in all cases; the instrument was positioned in the location most sensitive to noise from the proposed site. Due care was taken to minimise potential interference from wind generated noises from trees etc during the course of the measurement programme.

4.2 Instrumentation and Methodology

Noise measurements were made according to the requirements of *ISO 1996: Acoustics - Description and Measurement of Environmental Noise* and in addition, with reference to the EPA publication; *Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4), 2016.* The measurements were made using a Bruel & Kjaer (B&K) 2250 Light meter fitted with a 1:1 and 1:3 octave band filter. The instrument was calibrated *in situ* at 94 dB prior to use and the calibration was cross-checked after the measurements using a B&K acoustic calibrator. The sound level meter was orientated towards the noise source and mounted on a tripod at 1.5m above ground level. This instrument is a Type 1 instrument in accordance with IEC 651 regulations. The Time Weighting used was Fast and the Frequency Weighting was A-weighted as per IEC 651.

4.3 Glossary of Terms Used

- L_{Aeq} : The equivalent steady sound level in dB containing the same acoustic energy as the actual fluctuating sound level over a given period.

- L_{A90}: the sound pressure level in dB(A) which is exceeded for 90% of the time.

- L_{A10}: the sound pressure level in dB(A) which is exceeded for 10% of the time.

- L_{ArT}: the sound pressure level in dB(A) with penalty adjustments added following the detection of tonal and/or impulsive noise.

- 1:3 Octave band Analysis: Frequency analysis of sound such that the frequency spectrum is sub-divided into bands of one-third of an octave each. An octave is taken to be a frequency interval, the upper limit of which is twice the lower limit. The unit of frequency is the Hertz, Hz.

- Tonal Noise: A tone is deemed to be present when the level difference between the Leq at the 1:3 octave band of the tone and each adjacent 1:3 octave band is greater than or equal to 15dB for low-frequencies (25Hz to 125Hz), 8dB for middle-frequencies (160Hz to 400Hz) or 5dB for high-frequencies (500Hz to 10,000Hz).

- L_{den}: the day, evening, and night time average noise level criteria. This criteria is used to assess noise on a 24-hour basis across the day, evening and night-time periods. Penalties are applied for the evening time slot and the night time slot and the noise level average is

then taken for the full 24 hour period. L_{den} in decibels (dB) is defined by the following formula:

$L_{den} = 10 \log 1/24 \{12*10^{Lday/10} + 4*10^{Levening +5/10} +8*10^{Lnight + 10/10}\}$ in which

L_{day} The long term A-weighted average sound level over the day period.

$L_{evening}$ The long term A-weighted average sound level over the evening period.

L_{night} The long term A-weighted average sound level over the night period

4.4 Survey Implementation

TMS Environment Ltd personnel (Enda Flood) conducted the noise monitoring survey on the 15th of February 2016. All monitoring was carried out in accordance with the methodology set out above.

The measurement parameters included meteorological observations of prevailing conditions at the time of the survey. The main measurement parameter was the equivalent continuous A-weighted sound pressure level, $L_{Aeq, T}$. Monitoring periods for the noise survey were 15 minute intervals during day and evening monitoring and a 5 minute interval during night time monitoring. A statistical analysis of the measurement results was also completed so that the percentile levels, $L_{AN, T}$, for N = 90% and 10% over 15-minute and 5-minute measurement intervals were also recorded. The percentile levels represent the noise level in dB(A) exceeded for N% of the measurement time. A 1:3 octave band frequency analysis was also carried out at each monitoring location.

5.0 Weather Conditions

The weather conditions on the day of monitoring were dry with a light or no breeze blowing. Local temperature were in the range of $0^{O}C$ to $5^{O}C$ over the entire monitoring period

6.0 Survey Results

The results of the baseline environmental noise survey are presented in Tables 2 to 5 below. The $^{1}/_{3}$-octave band frequency analysis results are presented in Appendix II and summarized in Tables 6 to 8.

Table 2 Results for Monitoring Location N1

Monitoring Location:	N1					
Period	**Date/Time**	**Measured Noise Levels dB(A)**				
		L_{Aeq}	L_{A90}	L_{A10}	L_{Amax}	L_{ArT}
Daytime 07:00-19:00	15 Feb 16, 10:42-10:57	48	41	47	79	48
	15 Feb 16, 13:43-13:58	49	49	49	72	49
	15 Feb 16, 15:12-15:27	46	48	48	61	46
	Average	**47**	**46**	**48**	**-**	**61**
	Daytime Criterion					**55**
Evening-time 19:00-23:00	15 Feb 16, 19:49-20:04	44	40	44	71.4	44
	Average	**44**	**40**	**44**	-	**44**
	Evening-time Criterion					**50**
Night-time 23:00-07:00	15 Feb 16, 23:10-23:15	39	34	40	60	39
	15 Feb 16, 23:15-23:20	38	33	39	59	38
	Average	**39**	**33**	**40**	**-**	**39**
	Night-time Criterion					**45**
	Calculated L_{den}					**58**

Daytime Comments:
The predominant noise source audible at this monitoring location is noise emanating from the construction works currently underway on the UCD Campus (Belgrove Student Residence). Noise from this construction site included the use of power equipment (drilling, saws).

Off-site noises audible at this location during day time monitoring included local traffic,

Evening time Comments:
During evening time monitoring the predominant noise source is from traffic on the Roebuck Road. Some cars passing into and out of the Roebuck Castle estate also contributed to noise levels. Max noise levels associated with vehicle movement through the estate.

Night time Comments:
Distant traffic on the Roebuck Road and Foster's Avenue are the main noise sources audible during night time monitoring.

Table 3 Results for Monitoring Location N2

Monitoring Location:	**N2**					
Period	**Date/Time**	**Measured Noise Levels dB(A)**				
		L_{Aeq}	**L_{A90}**	**L_{A10}**	**L_{Amax}**	**L_{ArT}**
Daytime 07:00-19:00	15 Feb 16, 10:17-10:42	49	42	50	68	49
	15 Feb 16, 14:03-14:18	45	36	47	63	45
	15 Feb 16, 15:30-15:45	50	39	47	72	50
	Average	**48**	**39**	**48**	**-**	**61**
	Daytime Criterion					**55**
Evening-time 19:00-23:00	15 Feb 16, 20:08-20:23	47	43	49	62.2	47
	Average	**47**	**43**	**49**	-	**47**
	Evening-time Criterion					**50**
Night-time 23:00-07:00	15 Feb 16, 23:23-23:28	40	34	41	65	40
	15 Feb 16, 23:28-23:33	40	34	43	57	40
	Average	**40**	**34**	**42**	**-**	**40**
	Night-time Criterion					**45**
	Calculated L_{den}					**58**

Daytime Comments:
The predominant noise audible at this location was from off-site noise sources including local traffic, traffic on the Roebuck Road 90m south of the monitoring location. Max noise levels at this location is associated with passing local traffic.

Evening time Comments:
Main noise source is the continuous passing traffic on the Roebuck Road. Occasional car also passing within estate.

Night time Comments:
Main noise source is the continuous passing traffic on Roebuck Road and Foster's Avenue. Max noise levels associated with passing vehicles on the M50.

Table 4 Results for Monitoring Location N3

Monitoring Location:	**N3**					
Period	**Date/Time**	**Measured Noise Levels dB(A)**				
		L_{Aeq}	**L_{A90}**	**L_{A10}**	**L_{Amax}**	**L_{ArT}**
Daytime 07:00-19:00	15 Feb 16, 12:10-12:25	47	44	49	62	47
	15 Feb 16, 13:19-13:34	46	44	48	65	46
	15 Feb 16, 14:47-15:02	47	43	49	72	47
	Average	**47**	**43**	**49**	**-**	**47**
	Daytime Criterion					**55**
Evening-time 19:00-23:00	15 Feb 16, 20:50-21:05	43	40	45	55	43
	Average	**43**	**40**	**45**	-	**43**
	Evening-time Criterion					**50**
Night-time 23:00-07:00	15 Feb 16, 23:53-23:58	39	34	39	61	39
	15 Feb 16, 23:58-00:03	39	34	40	62	39
	Average	**39**	**34**	**40**	**-**	**39**
	Night-time Criterion					**45**
	Calculated L_{den}					**48**

Daytime Comments:
Main noise source audible at this location is from the construction site 225m to the northwest of the monitoring location. Traffic entering and exiting the Owenstown Road entrance is a significant noise source. Max noise source is from passing traffic entering and exiting the Owenstown entrance. People playing sports in the sports fields to the north of the monitoring location, is also a significant noise source.

Evening time Comments:
Main noise source is from passing pedestrians and residential noise coming from the student apartments in the background. Traffic entering and exiting the Owenstown Road is also audible at this location during evening time monitoring.

Night time Comments:
The main noise source audible during night time monitoring, is due to campus traffic and pedestrian and pedestrian walking close to the meter.

Table 5 Results for Monitoring Location N4

Monitoring Location:	**N3**					
Period	**Date/Time**	**Measured Noise Levels dB(A)**				
		L_{Aeq}	**L_{A90}**	**L_{A10}**	**L_{Amax}**	**L_{ArT}**
Daytime 07:00-19:00	15 Feb 16, 11:550-12:05	61	45	61	83	61
	15 Feb 16, 12:29-12:44	62	44	61	83	62
	15 Feb 16, 14:27-14:42	58	42	55	82	58
	Average	**60**	**44**	**59**	**-**	60
	Daytime Criterion					**55**
Evening-time 19:00-23:00	15 Feb 16, 20:32-20:47	51	43	54	68	51
	Average	**51**	**43**	**54**	**-**	**51**
	Evening-time Criterion					**50**
Night-time 23:00-07:00	15 Feb 16, 23:39-23:44	55	41	46	75	55
	15 Feb 16, 23:44-23:49	48	38	51	71	48
	Average	**52**	**39**	**48**	**-**	**52**
	Night-time Criterion					**45**
	Calculated L_{den}					**60**

Daytime Comments:
Main noise source is traffic entering and exiting the Merville Student Residential Area. Traffic entering and exiting the Owenstown Road entrance as well as pedestrian by-passers are significant noise sources at this location. During daytime monitoring a ride-on lawn mower entered and exited the accommodation area a number of times, passing by the noise meter, this passing ride-on mower was the source of the Max noise level recorded.

Evening time Comments:
Main noise source is the continuous traffic entering and exiting the accommodation area entrance. Traffic entering/exiting the campus from the Owenspark Road entrance is a significant noise source. Max noise levels associated with vehicle entering the Merville accommodation area.

Night time Comments:
Main noise source is from apartments in the Merville student Residences. Traffic entering/exiting the campus form the Owenspark Road entrance is a significant noise source. Max noise levels associated with car horns blowing close to the noise meter.

Table 6 1/3 Octave Band Measurement Results (Daytime)

Monitoring Location	Tonal Frequencies	Applicable cause
N1	None	N/A
N2	None	N/A
N3	None	N/A
N4	None	N/A

Table 7 1/3 Octave Band Measurement Results (Evening time)

Monitoring Location	Tonal Frequencies	Applicable cause
N1	None	N/A
N2	None	N/A
N3	None	N/A
N4	None	N/A

Table 8 1/3 Octave Band Measurement Results (Night time)

Monitoring Location	Tonal Frequencies	Applicable cause
N1	None	N/A
N2	None	N/A
N3	None	N/A
N4	None	N/A

7.0 Evaluation of Results

7.1 Daytime Noise Survey

This survey was completed in order to assess the existing baseline noise environment in the vicinity of the proposed development of the college Campus at UCD. The baseline data collected can be used to identify the potential impact that activities associated with the proposed development could have on the local noise environment.

The daytime noise measurements were carried out between the hours of 07.00 and 19.00 and ranged in value from 45dB(A) L_{Aeq} at monitoring location N2 to 62dB(A) L_{Aeq} at monitoring location N4. The background noise characterised by the L_{A90} measurements ranged from 36dB(A) at monitoring location N2 to 45dB(A) at monitoring location N4.

It was generally observed that the main source of noise at each noise monitoring location was anthropogenic in nature and included traffic passing close by each monitoring location or along nearby roads. Construction noise was also a significant noise source audible at locations N1, N3 and N4. Non anthropogenic noise sources such as dogs barking and the breeze blowing through trees etc had only a minor impact on the noise environment at the noise monitoring locations.

7.2 Evening time Noise Survey

The evening time noise measurements were carried out between the hours of 19.00 and 23.00 and ranged in value from 43dB(A) L_{Aeq} at monitoring location N9 to 51dB(A) L_{Aeq} at monitoring location N4. The background noise characterised by the L_{A90} measurements ranged from 40dB(A) at monitoring location N3 & N1 to 43dB(A) at monitoring location N2.

Again the main source of noise at all noise monitoring locations during the evening time period was anthropogenic in nature and included passing traffic on the adjacent roads and noise from apartments in the student residence at N3 &N4. Non anthropogenic noise sources such as dogs barking and the breeze blowing through trees etc had only a minor impact on the noise environment at the noise monitoring locations.

7.3 Night time Noise Survey

The night time noise measurements were carried out between the hours of 23.00 and 07.00 and ranged in value from 38dB(A) L_{Aeq} at monitoring location N1 to 55dB(A) L_{Aeq} at monitoring location N4. The background noise characterised by the L_{A90} measurements ranged from 33dB(A) at monitoring location N1 to 41dB(A) at monitoring location N4

The main source of noise at all noise monitoring locations during the night time period was again anthropogenic in nature and included passing traffic on the adjacent roads and noise generated by pedestrian in the vicinity of each monitoring location. Non anthropogenic noise sources were not noted during night time monitoring.

7.4 $^1/_3$ Octave Band Frequency Analysis

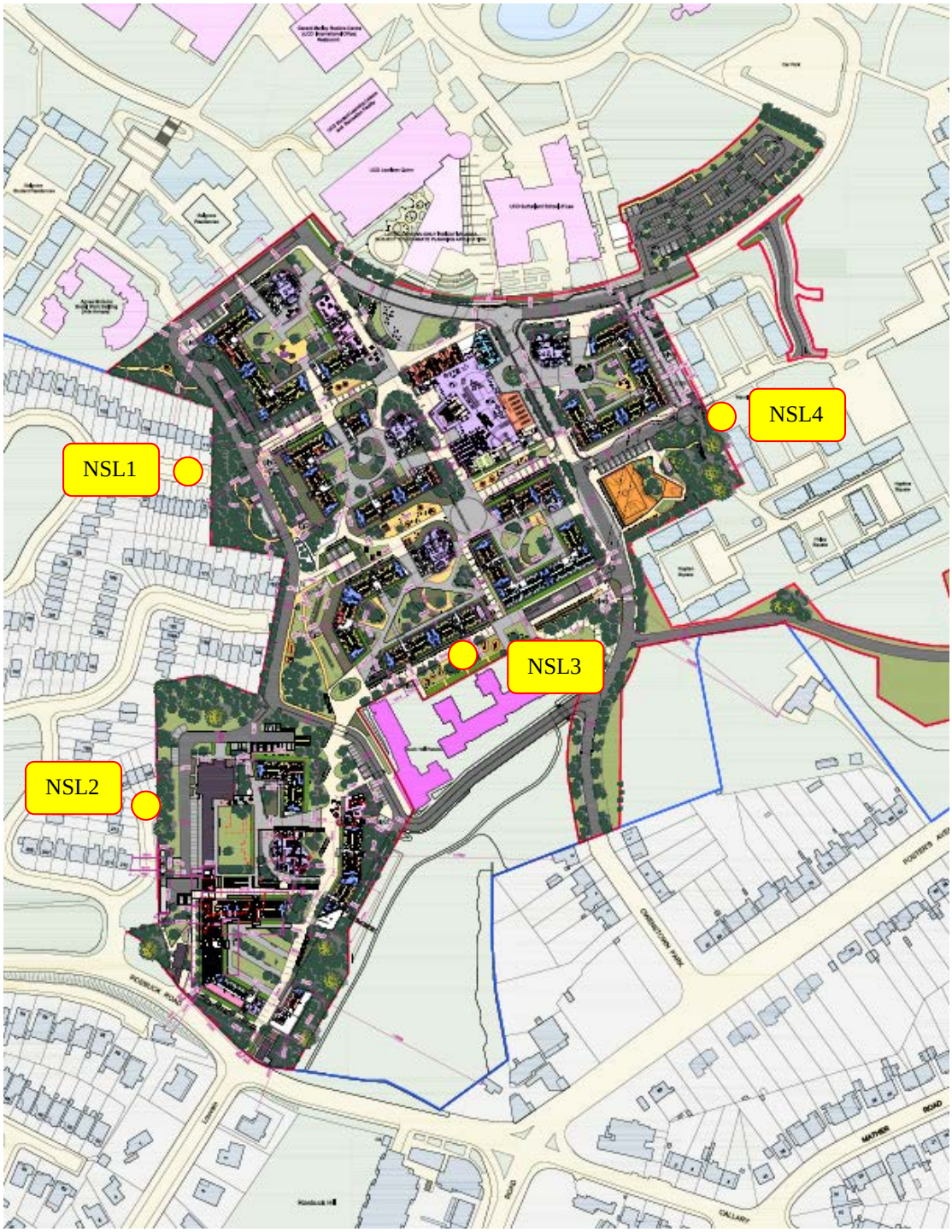
A $^1/_3$ octave band frequency analysis was conducted at each noise measurement location in order to assess any tonal or impulsive component associated with the noise emissions observed.

A summary of the analysis results of the $^1/_3$ octave band frequency spectra measured at each of the noise monitoring locations for daytime, evening time and night time measurement surveys are presented in Tables 16, 17 and 18. A tone is deemed to be present in the noise spectra when the level difference between the L_{eq} at the 1:3 octave band of the tone and each adjacent 1:3 octave band is greater than or equal to 15dB for low-frequencies (25Hz to 125Hz), 8dB for middle-frequencies (160Hz to 400Hz) or 5dB for high-frequencies (500Hz to 10,000Hz).

Tonal frequencies were not observed at any of the locations during monitoring over the three separate monitoring periods. Tonal frequencies are graphically presented in Appendix II.

APPENDIX I

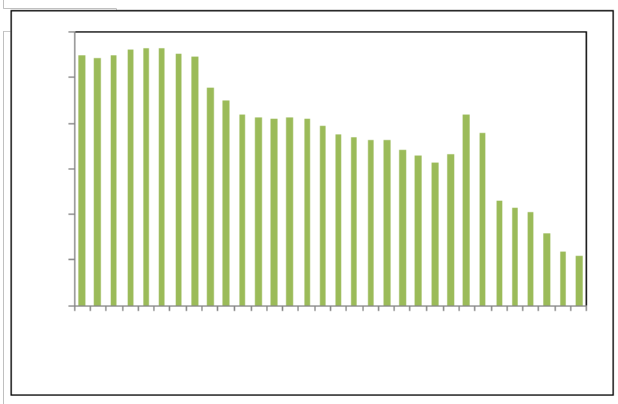
Map Illustrating Noise Monitoring Locations

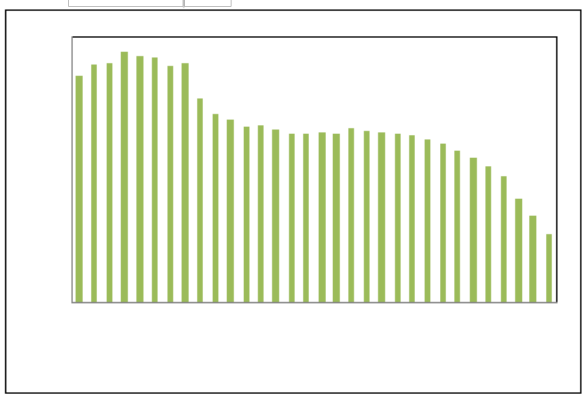

NSL1
NSL2
NSL3
NSL4

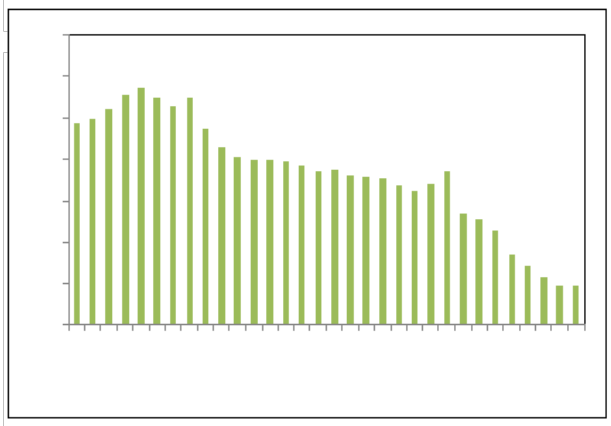
APPENDIX II

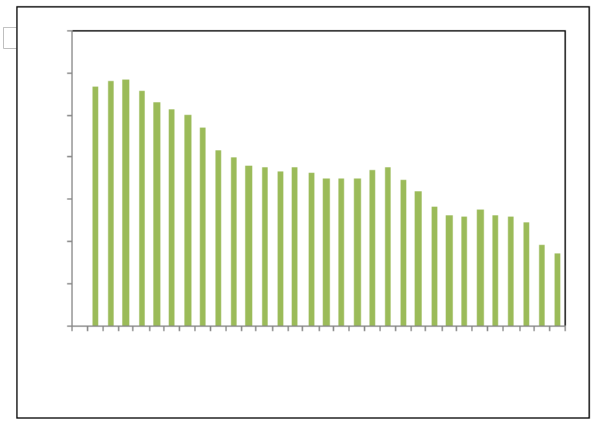
1/3 Octave Band Spectra

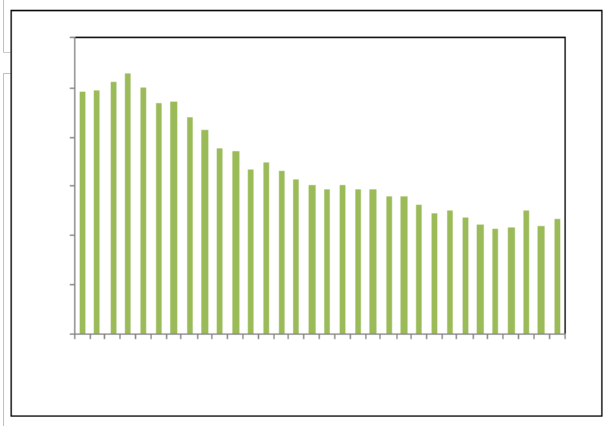
1:3 Octave Band Spectra for Monitoring Location N1

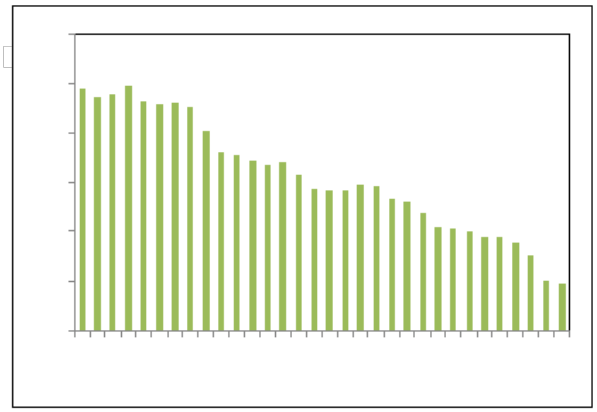




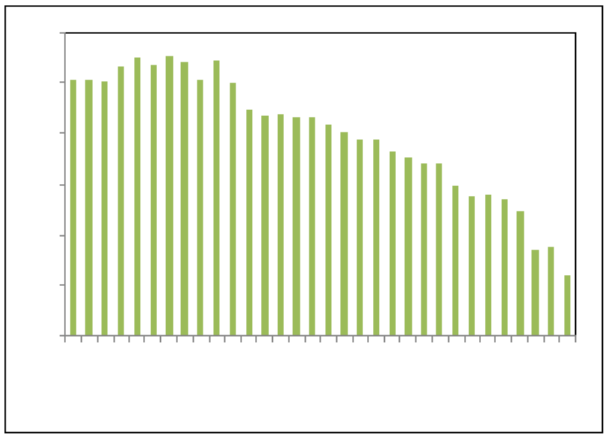




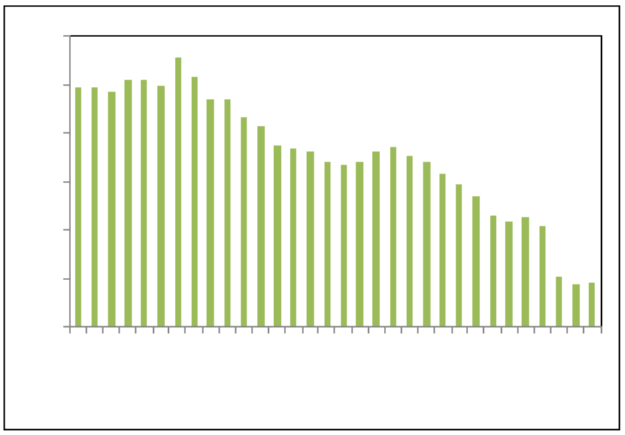




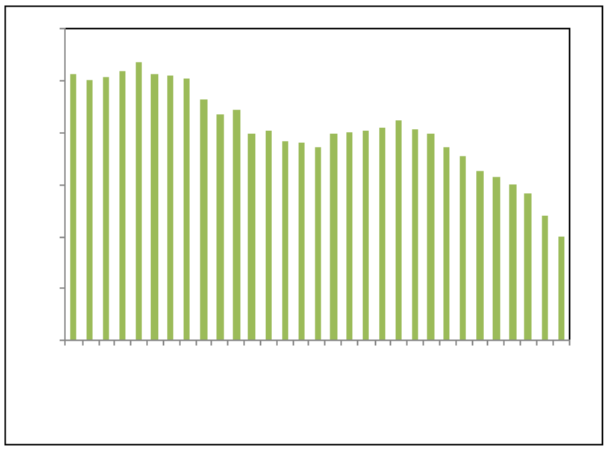
1:3 Octave Band Spectra for Monitoring Location N2



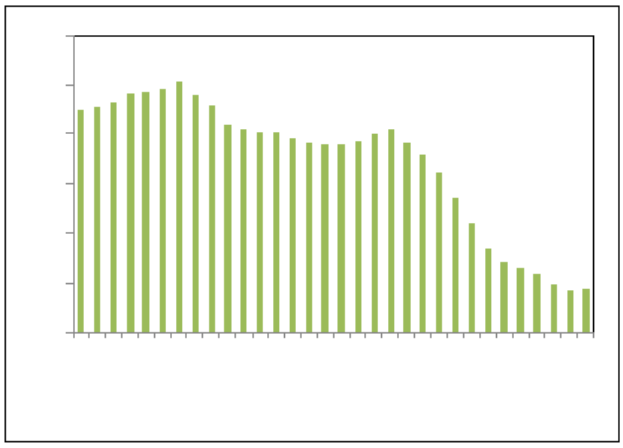
Daytime – Run 1



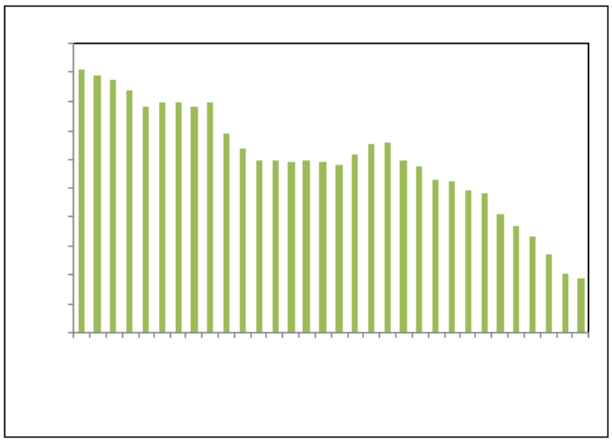
Daytime Run 2



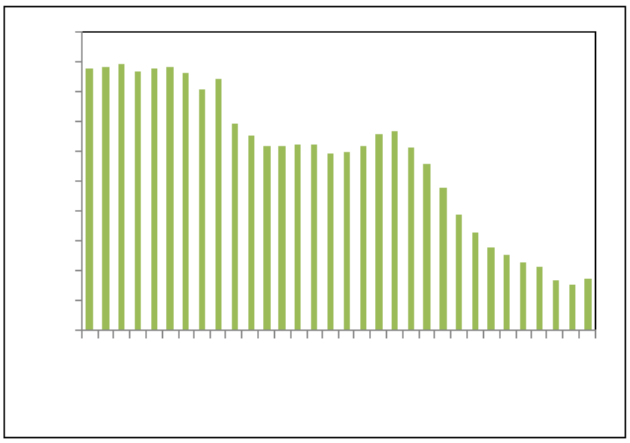
Daytime Run 3



Evening Time

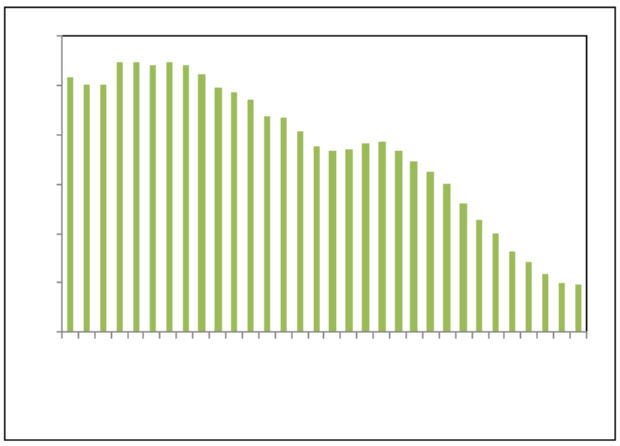


Night Time Run 1



Night Time Run 2

1:3 Octave Band Spectra for Monitoring Location N3



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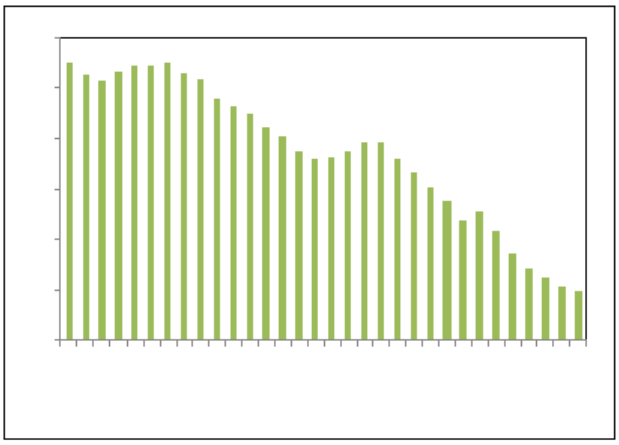

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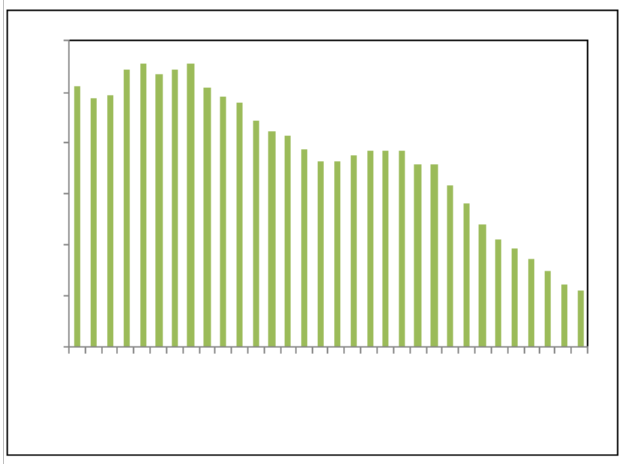

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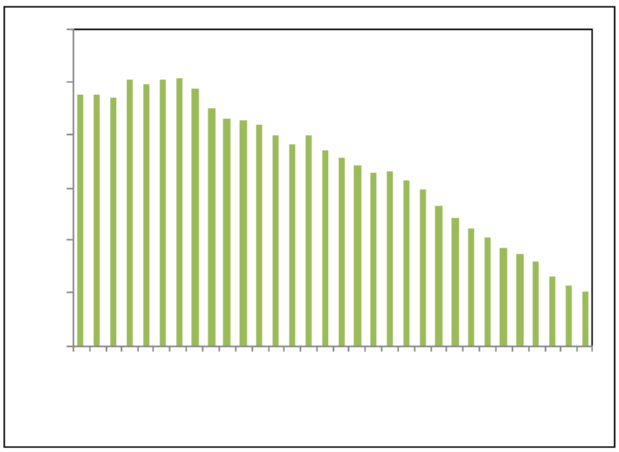
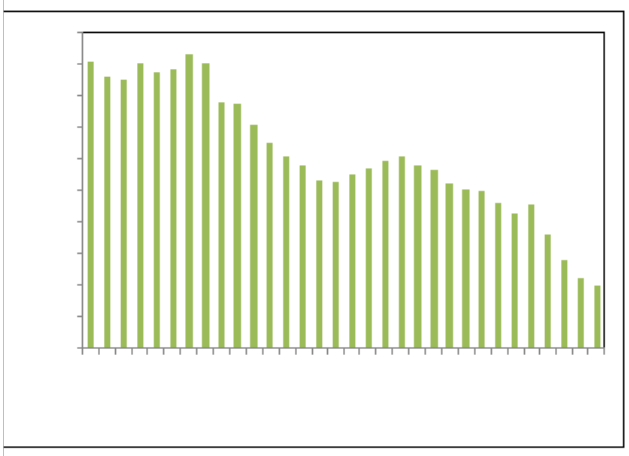
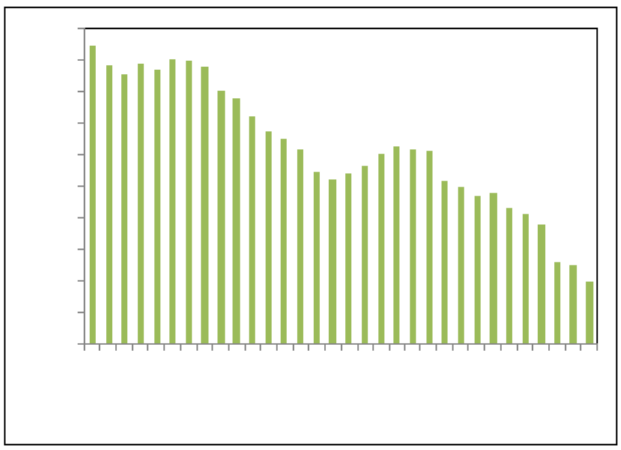


Evening Time

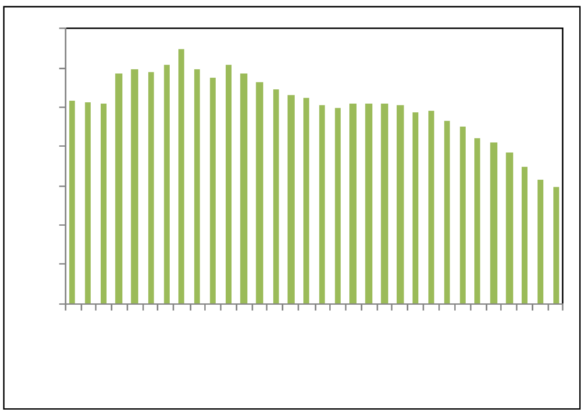


Night Time Run 1

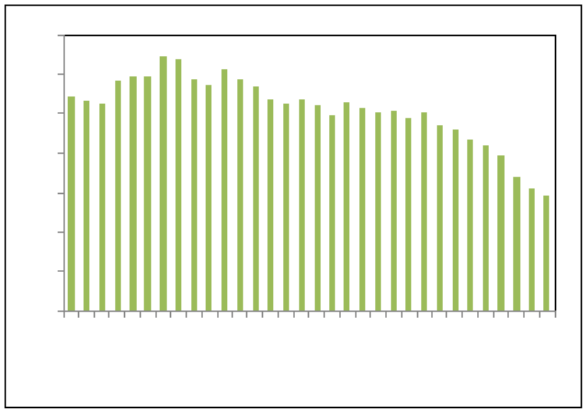


Night Time Run 2

1:3 Octave Band Spectra for Monitoring Location N4



Daytime – Run 1



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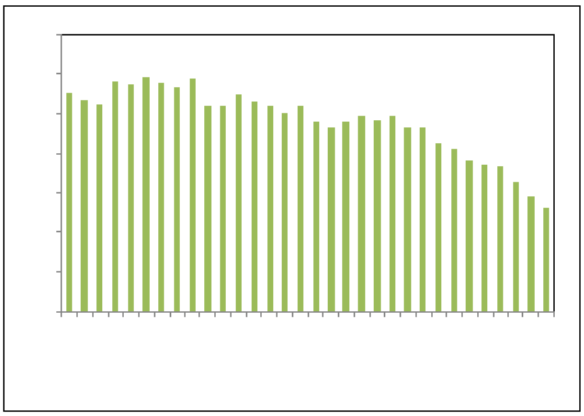

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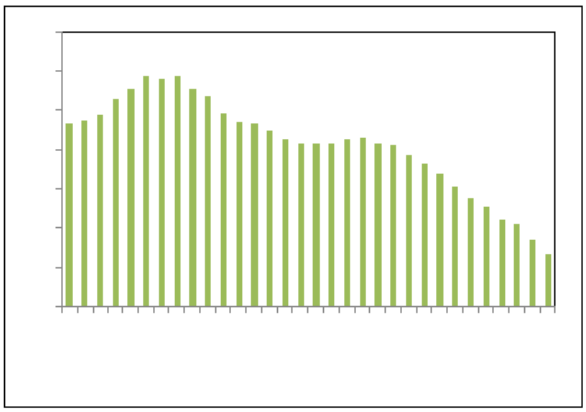
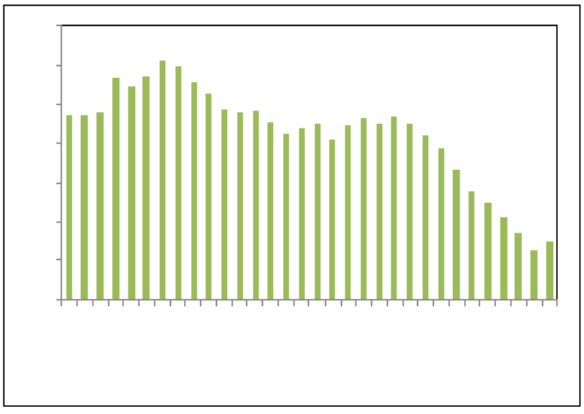
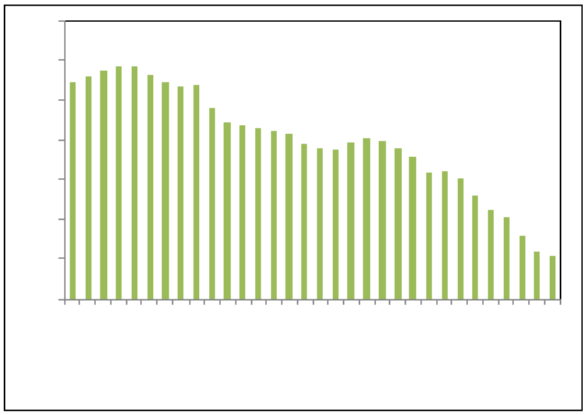


Evening Time



Night Time Run 1



Night Time Run 2

APPENDIX III

Monitoring Equipment
Calibration Certificates

NSAI
National Metrology Laboratory

Certificate of Calibration

Issued to	TMS Environment Ltd. 53 Broomhill Drive Tallaght Dublin 24
Attention of	Martin Kearns

Certificate Number	151658
Item Calibrated	Bruel and Kjaer 2250 Light Sound Level Meter, complete with Type 4950 Microphone and Type ZC0032 Preamp
Serial Numbers	2625696 (Sound Level Meter), 2621489 (Microphone) and 8606 (Preamp)
Client ID Number	--------
Order Number	D158325
Date Received	23 Sep 2015
NML Procedure Number	AP-NM-09
Method	The above sound level meter was allowed to stabilise for a suitable period in laboratory conditions. It was then calibrated by carrying out the verification tests detailed in IEC 61672-3 (2006) *Periodic tests, specification for the verification of sound level meters.* This standard specifies a procedure for the periodic verification of conformance of a sound level meter or integrating-averaging meter to IEC 61672-1 (2003).
Calibration Standards	Norsonic 1504A Calibration System incorporating: SR DS360 Signal Generator, No. 0735 [Cal. Due Date: 30 Sep 2015] Agilent 34401A Digital Multimeter, No. 0736 [Cal Due Date: 20 Jul 2016] B&K 4134 Measuring Microphone, No. 0742 [Cal Due Date: 13 Jan 2016] B&K 4228 Pistonphone, No. 0741 [Cal Due Date: 13 Jan 2016] B&K 4226 Acoustical Calibrator, No. 0150 [Cal Due Date: 06 May 2016]

Calibrated by	David Fleming	Approved by	Paul Hetherington
Date of Calibration	28 Sep 2015	Date of Issue	28 Sep 2015

CIPM MRA

This certificate is consistent with Calibration and Measurement Capabilities (CMC's) that are included in Appendix C of the Mutual Recognition Arrangement (MRA) drawn up by the International Committee for Weights and Measures. Under the MRA all participating institutes recognize the validity of each other's calibration certificates and measurement reports for quantities, ranges and measurement uncertainties specified in Appendix C (for details see www.bipm.org)

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5. This contract is governed by the laws of Ireland whose courts shall have exclusive jurisdiction.

Ambient laboratory conditions :

Barometric Pressure :	102.9 kPa ± 0.5 kPa
Temperature :	22.0 °C ± 1 °C
Relative Humidity:	47 % ± 5 %

Summary of Results:

The following table summarises the results of the verification tests. The detailed results are given in the subsequent tables.

IEC 61672 Test	Test Title	Status
10	Self-generated Noise (Electrical)	See Notes
11	Acoustical Signal	PASS
12	Frequency Weighting	PASS
13	Frequency and Time Weighting @ 1 kHz	PASS
14	Level Linearity Test on Reference Level Range	PASS
15	Level Linearity including Range Control	Not Applicable
16	Toneburst Response	PASS
17	Peak C	PASS
18	Overload Indication	PASS

Detailed Results.

Prior to carrying out the verification tests the sound level meter was checked ensure it was reading correctly using its associated calibrator (Brüel & Kjær 4231, Serial Number: 2623773).

Self-generated Noise Test (Electrical Input) (Test #10)[6]

Range: 140 dB
Mode: Leq

SLM Configuration	Freq. Weighting Network	SLM Reading[2][3]
Microphone installed	A	21.5 dB
Microphone replaced by electrical signal device and Fitted with a short-circuit	A	13.9
	C	15.3
	Z (Linear)	20.9

Acoustical signal test of a frequency weighting (Test #11)[1]

Range: 140 dB
Frequency Weighting setting: A
Time Weighting response: Slow

Input Level[4]	Input Freq.	SLM Error of Indication[5]	Tolerance[5] (±)	Uncertainty of Measurement (±)
94.0 dB	1000 Hz	0.0 dB	1.0 dB	0.3 dB
	125	0.0	1.0	0.3
	4000[7]	+0.3	1.0	0.5
	8000[7]	+0.8 £	1.5, -3.0 dB	0.9

Electrical signal tests of frequency weightings (Test #12)[1]

Range: 140 dB

Freq. (nominal)	Input Level[4]	SLM Reading	SLM Error of Indication[5]	Tolerance[6] (±)	Uncertainty of Measurement (±)
A-Weighting					
63 Hz	95 dB	95.0 dB	0.0 dB	1.5 dB	0.20 dB
125	95	95.0	0.0	1.5	0.20
250	95	95.0	0.0	1.4	0.20
500	95	95.0	0.0	1.4	0.20
1000	95	95.0	0.0	1.1	0.20
2000	95	95.0	0.0	1.6	0.20
4000	95	94.9	-0.1	1.6	0.20
8000	95	94.7	-0.3	2.1, -3.1	0.20
16000	95	95.6	0.6	3.5, -17	0.20
C-Weighting					
63 Hz	95 dB	95.0 dB	0.0 dB	1.5 dB	0.20 dB
125	95	95.0	0.0	1.5	0.20
250	95	95.0	0.0	1.4	0.20
500	95	95.0	0.0	1.4	0.20
1000	95	95.0	0.0	1.1	0.20
2000	95	95.0	0.0	1.6	0.20
4000	95	94.9	-0.1	1.6	0.20
8000	95	94.7	-0.3	2.1, -3.1	0.20
16000	95	95.5	0.5	3.5, -17	0.20
LIN Weighting					
63 Hz	95 dB	94.9 dB	-0.1 dB	1.5 dB	0.20 dB
125	95	95.0	0.0	1.5	0.20
250	95	95.0	0.0	1.4	0.20
500	95	95.0	0.0	1.4	0.20
1000	95	95.0	0.0	1.1	0.20
2000	95	95.0	0.0	1.6	0.20
4000	95	94.9	-0.1	1.6	0.20
8000	95	94.7	-0.3	2.1, -3.1	0.20
16000	95	95.6	0.6	3.5, -17	0.20

Frequency and time weightings at 1 kHz (Test #13)[1]

Range: 140 dB

Time Weighting Setting	Frequency Weighting Setting	Input Level[4]	Deviation from Reference	Tolerance[6] (±)	Uncertainty of Measurement (±)
Fast	A	94.0 dB	Ref.	-	0.20 dB
	C		0.0 dB	0.4 dB	0.20
	Z		0.0	0.4	0.20
Slow	A	94.0 dB	0.0	0.3	0.20
Leq.	A	94.0 dB	0.0 dB	0.3 dB	0.20 dB
SEL	A	114.0 dB	0.0 dB	0.3 dB	0.20 dB

Linearity level on the reference range (Test #14)[2]

Input Frequency: 8 kHz
SLM Measuring Mode: SPL

Range	Input Level[4]	SLM Reading	SLM Error of Indication[5]	Tolerance[6] (±)	Uncertainty of Measurement (±)
140 dB	94 dB	94.0 dB	0.0 dB	1.1 dB	0.20 dB
	99	99.0	0.0	1.1	0.20
	104	104.0	0.0	1.1	0.20
	109	109.1	0.1	1.1	0.20
	114	114.1	0.1	1.1	0.20
	119	119.1	0.1	1.1	0.20
	124	124.1	0.1	1.1	0.20
	129	129.1	0.1	1.1	0.20
	134	134.1	0.1	1.1	0.20
	137	137.1	0.1	1.1	0.20
	138	138.1	0.1	1.1	0.20
	139	139.1	0.1	1.1	0.20
	140	140.1	0.1	1.1	0.20
	141	141.1	0.1	1.1	0.20
	94	94.0	0.0	1.1	0.20
	89	89.1	0.1	1.1	0.20
	84	84.0	0.0	1.1	0.20
	79	79.1	0.1	1.1	0.20
	74	74.0	0.0	1.1	0.20
	69	69.0	0.0	1.1	0.20
	64	64.0	0.0	1.1	0.20
	59	59.0	0.0	1.1	0.21
	54	54.0	0.0	1.1	0.21
	49	49.0	0.0	1.1	0.21
	44	44.1	0.1	1.1	0.21
	39	39.1	0.1	1.1	0.21
	34	34.2	0.2	1.1	0.23
	28	28.2	0.2	1.1	0.25
	27	27.3	0.3	1.1	0.25
	26	26.4	0.4	1.1	0.25
	25	25.4	0.4	1.1	0.25
	24	24.5	0.5	1.1	0.25

Toneburst response (Test #16)[1]

Range: 140 dB

Burst Type	SLM Mode	Input Level[4]	SLM Error of Indication[5]	Tolerance[6] (±)	Uncertainty of Measurement (±)
200 ms	LAF	119.0 dB	0.0 dB	0.8 dB	0.3 dB
2.0 ms	LAF	102.0	-0.1	1.3	0.3
0.25 msec	LAF	93.0	-0.1	1.3, -3.3	0.3
200 ms	LAS	112.6 dB	0.0 dB	0.8 dB	0.3 dB
2.0 ms	LAS	93.0	-0.1	1.3, -1.8	0.3
200 ms	SEL	113.0 dB	0.0 dB	0.8 dB	0.3 dB
2.0 ms	SEL	93.0	-0.1	1.3	0.3
0.25 ms	SEL	84.0	-0.1	1.3, -3.3	0.3

Peak C sound level (Test #17)[1]

Range: 140 dB

Pulse Type	Pulse Frequency	Input Level[4] (peak value)	SLM Error of Indication[5]	Tolerance[6] (±)	Uncertainty of Measurement (±)
1 cycle	8 kHz	138.4 dB	0.3 dB	2.4 dB	0.35 dB
Pos. ½ cycle	500 Hz	137.4 dB	-0.2 dB	1.4 dB	0.35 dB
Neg. ½ cycle	500 Hz	137.4 dB	-0.2 dB	1.4 dB	0.35 dB

Overload Indication (Test #18)[1]

Range: 140 dB
SLM Measuring Mode: LAEq

Test description	Overload occurred at (±)	Meas. Diff. (Pos – Neg)	Tolerance[6] (±)	Uncertainty of Measurement (±)
Positive ½ cycle at 4 kHz	143.2 dB	-	-	-
Negative ½ cycle at 4 kHz	143.1 dB	-	-	-
Level difference of positive & negative pulses	-	0.1 dB	1.8 dB	0.30 dB

Notes :

(1) The test number given in parentheses after the section heading, refers to the relevant clause in IEC 61672-3 (2006).

(2) SLM denotes Sound Level Meter

(3) The measured self generated noise was found to be marginal to specification. This is likely due to the influence of ambient noise levels.

(4) All input levels are given in dB relative to a 20 µPa reference level.

(5) The SLM Error of Indication is defined as follows :
SLM Error of Indication = (SLM Reading - Input Level)
Any error of indication that exceeds the relevant tolerance limits [see note (6)] is indicated using a $ symbol.
£ indicates a marginal-to-specification condition. That is, the measured value, extended by its associated uncertainty, overlaps the specified accuracy limit.

(6) The figures in the column labelled 'Tolerance' are the acceptance limits given in IEC 61672-1(2003). These tolerance limits include an allowance for the maximum expanded uncertainty of the test laboratory. The criteria for compliance with the tolerance is that the measurement result, extended by its associated uncertainty, lies within the specified limits.

(7) Microphone response at 4 and 8 kHz was measured using an electrostatic actuator. Free field corrections of +1.2 and +4.0 dB respectively were applied to the measured actuator response.
This measurement is not included in NML's tables of Calibration and Measurement Capabilities, approved under the CIPM MRA.
For information, the measured sensitivity and frequency response of the microphone is given in an addendum to this certificate.

Comments:

The above sound level meter was found to meet the requirements of IEC 61672-3 (2006), with the exception of the 8 kHz electrostatic actuator test, where it was found to be marginal-to-specification.

Uncertainty of Measurement:

The measurement uncertainty is reported as a standard uncertainty multiplied by a coverage factor k=2 which, for a normal probability distribution, corresponds to a coverage probability of approximately 95%. The given uncertainty refers to the measured values only and carries no implication regarding the long term stability of the item calibrated.

Traceability:

The reported measurement results are traceable, via national standards maintained by NSAI National Metrology Laboratory (NML), to internationally accepted realisations of the SI units.

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Certificate of Calibration

Issued to	TMS Environment Ltd. 53 Broomhill Drive Tallaght Dublin 24
Attention of	Martin Kearns

Certificate Number	**151655**
Item Calibrated	Bruel & Kjaer Type 4231 Sound Level Calibrator
Serial Number	1883708
Client ID Number	----------
Order Number	D158325
Date Received	23 Sep 2015
NML Procedure Number	AP-NM-13
Method	The above calibrator was allowed to stabilize for a suitable period in laboratory conditions. It was then calibrated by measuring the sound pressure level generated in its measuring cavity (half-inch configuration). The calibrator's operating frequency was also measured.
Calibration Standards	Norsonic 1504A Calibration System incorporating: Agilent 34401A Multimeter, No. 0736 [Cal due: 20 Jul 2016] B & K 4134 Measuring Microphone, No. 0742 [Cal due: 13 Jan 2016] B & K 4228 Pistonphone, No. 0741 [Cal due: 13 Jan 2016]

Calibrated by	David Fleming	Approved by	Paul Hetherington
Date of Calibration	25 Sep 2015	Date of Issue	25 Sep 2015

CIPM MRA

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Certificate No.: 151655

Measuring Conditions:

Ambient Pressure:	(101.8 ± 0.5) kPa
Ambient Temperature:	(21.3 ± 1.0) °C
Ambient Rel. Humidity:	(42 ± 5) %RH

Results:

The measured sound pressure level(s) reported below refer to the reference conditions specified by the manufacturer. Corrections were applied using sensitivity coefficients provided by the manufacturer, where available. These reference conditions and sensitivity coefficients are listed below.

Parameter	Reference Value	Sensitivity Coefficient
Ambient Pressure	101.325 kPa	0.000 8 dB/kPa
Ambient Temperature	20 °C	0.000 dB/°C (1)
Ambient Relative Humidity	65 %RH	0.000 dB/%RH (1)

Calibrator Setting	Measured Parameter	Measured Value (2)		Tolerance (3)	Meas. Uncertainty (4)
		Before Adj.	After Adj.	(±)	(±)
94 dB	Sound Pressure Level	94.01 dB	*	0.40 dB	0.15 dB
	Frequency	999.83 Hz	*	10 Hz	0.25 Hz
114 dB	Sound Pressure Level	114.01 dB	*	0.40 dB	0.15 dB
	Frequency	999.81 Hz	*	10 Hz	0.25 Hz

Notes: (1) No sensitivity coefficient information was available for this parameter.

(2) * indicates that no calibration adjustment was made.
$ indicates an out-of-tolerance condition. Note that for acoustic calibrators which meet IEC 60942 (2003), the instrument is considered out of tolerance if the measured deviation from the set level, extended by it associated uncertainty, exceeds the specified tolerance limits.

(3) IEC 60942 (2003), Sound Calibrators, Class 1.

(4) The measurement uncertainty is reported as a standard uncertainty multiplied by a coverage factor k=2 which, for a normal probability distribution corresponds to a coverage probability of approximately 95%. The given uncertainty refers to the measured values only and carries no implication regarding the long-term stability of the item calibrated.

Comments:

The sound level calibrator was found to comply with the requirements of IEC 60942 (2003), Class 1 for sound pressure level and frequency measurements.
When using the calibrator with a sound level meter any manufacturer's guidelines regarding free-field corrections should be observed.

Traceability:

The reported measurement results are traceable, via national standards maintained by NSAI National Metrology Laboratory (NML), to internationally accepted realisations of the SI units.