MOTT MACDONALD

Cardiff Arena

Acoustic Baseline Survey Report

July 2021

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Contents

1 Introduction

Mott MacDonald Limited has been commissioned by Cardiff Council (CC) to gather noise data to inform the proposed development of a new 15,000 capacity arena ('Cardiff Arena'). The purpose of the survey was to establish existing external noise levels across the site, in order to inform future assessment of impacts for the proposed arena. In the absence of a detailed scheme, the contents of this report assume a potential development of the whole site.

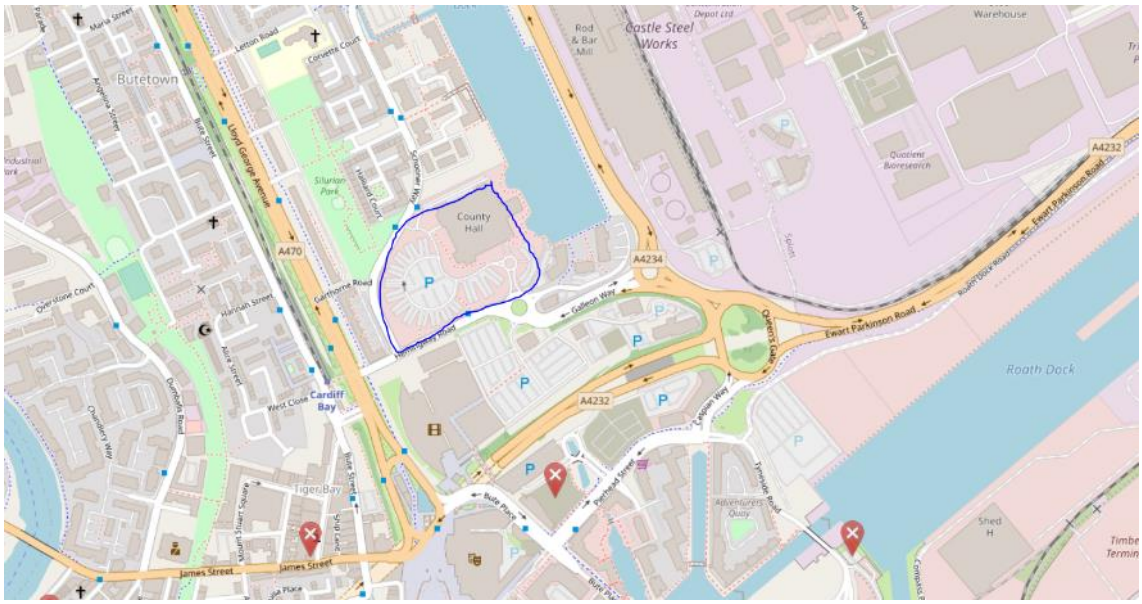
The Cardiff Arena would be located within the existing grounds of Cardiff City Council's County Hall building and car park. The site lies 1km south of Cardiff City at National Grid Reference ST 19259 75090 (Figure 1.1). Residential areas surround the site on the north, east and west boundary. A Travelodge hotel is located to the south. The A4234 lies to the northeast, and the Cardiff Queen Street to Cardiff Bay train line is located to the west. Cardiff Bay town centre is located south west of the site.

The main contributing noise source at this site is road traffic on the A4234 and the surrounding residential roads. Noise from the rail line and station is not audible during the daytime but may be audible at night-time when flows on the local road network are reduced.

This report summarises the results of the baseline noise survey undertaken between 24 June to 2 July 2020. The scope of this report does not include the assessment of the results of the survey or suitability of the site.

A glossary of acoustic terms can be found in Appendix A.

Figure 1.1: Indicative Location of the proposed Cardiff Arena



Source: Adapted from © OpenStreetMap contributors 2020

2 Noise Survey

2.1 Summary of Survey

A noise measurement survey was undertaken during the period 10:45 on 24 June to 14:37 on 2 July 2020. All measurements were undertaken by consultants competent in environmental noise monitoring and completed in accordance with the principles of BS 7445:2003[1]. All acoustic measurement equipment used during the noise survey was designed to be in conformance with the BS EN ISO 61672-2:2013[2] to the requirements of the Class 1 standard.

All meters and field calibrators used held current calibration certificates obtained under laboratory conditions traceable to UK and International Standards. Before and after the measurement session the reference calibration level of the sound level meter was checked using a field calibrator.

At each position the microphone was supported using a tripod and was fitted with a windshield suitable for outdoor use. The sound level meters were positioned at ground floor level with the microphone at a height of 1.5m above local ground level. All positions .

A full inventory of this equipment is shown in Table 2.1 below.

Table 2.1: Inventory of Noise Measurement Equipment

Item	Make & Model	Serial Number	Calibration Due
Calibrator	Larson and Davies CAL200	5132	19/08/2020
Sound level meter (SLM) 1 (ST1-4)	Rion NL-52	743137	18/12/2020
Sound level meter (SLM) 2 (LT1)	Rion NL-52	1265461	25/04/2021
Sound level meter (SLM) 3 (LT2)	Rion NL-52	1143538	05/02/2022

2.2 Measurement Locations

Two unattended noise loggers were deployed for one week between 24 June to 2 July 2020. One was located on the first-floor terrace of the existing County Hall building. The second was located in the back garden of a nearby residence on Albert Square, Cardiff Bay.

Noise sensitive receptors surround the proposed site on the north, east and west sides. Long-term measurement positions 1 and 2 (referenced LT1 and LT2 respectively) were selected to be representative of the background noise level at the nearest noise sensitive receptors, as well as recording the noise levels incident upon that part of the proposed site. These positions were also chosen from very few secure positions available to locate the equipment to ensure it was not disturbed. Both of the long term measurement positions were free-field.

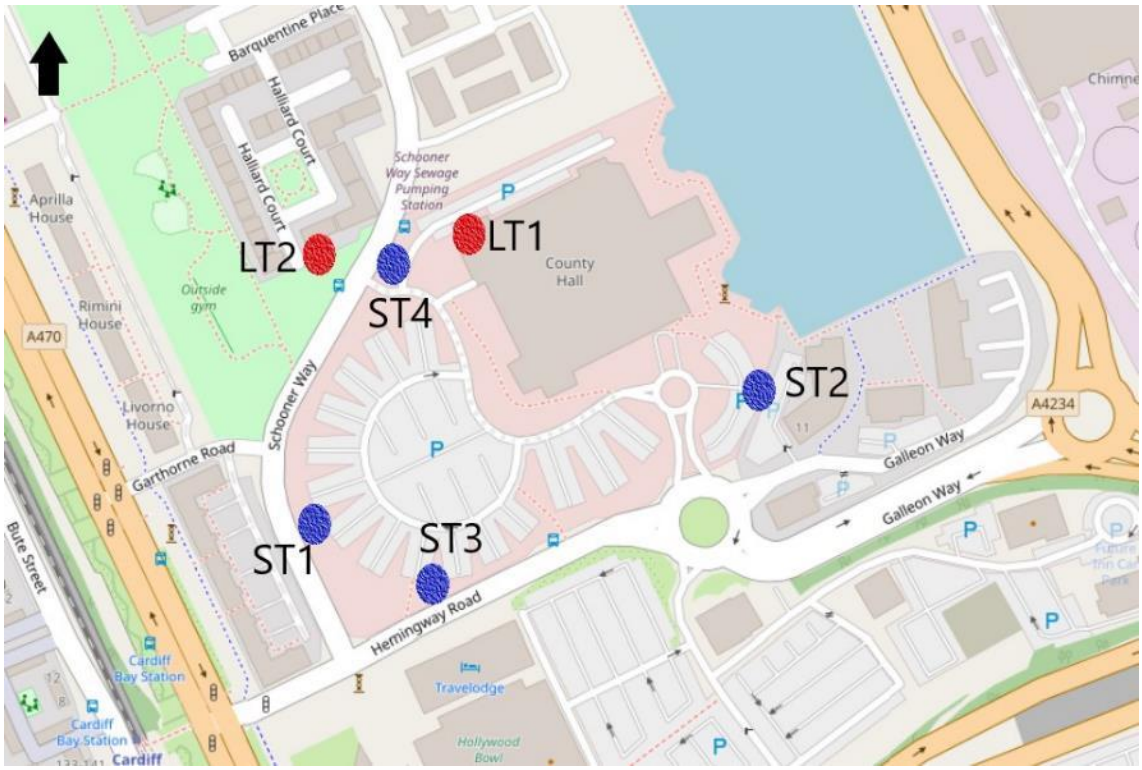
The short-term attended noise measurements were carried out at a number of additional locations around the site (referenced ST1 – ST4). These locations were selected to quantify likely noise levels incident upon all areas of the proposed site, and to provide a concurrent comparison to the long-term measurements. All short-term measurement locations were free-field i.e. at least 3.5m from acoustically reflective surfaces.

[1] British Standards BS7445:2003 '*Description and measurement of environmental noise*'

[2] British Standards BS EN ISO 61672-2:2013 '*Electroacoustics. Sound level meters. Specifications*'

All measurement positions are shown in Figure 2.1 below. Photographs of each measurement position are provided in Appendix B.

Figure 2.1: Survey Locations at the Proposed Site



Source: Adapted from © OpenStreetMap contributors 2020

2.3 Measurement Conditions

The weather conditions during the survey were dry and hot between 24 - 25 June 2020 with temperatures in the range 15°C – 30°C. The remainder of the survey period (26 June to 2 July 2020) contained some periods of heavy rain with temperatures between 12°C and 15°C. Data from 27 and 28 June has been excluded from the long-term unattended measurements dataset due to high rain and strong winds.

The survey area is coastal and is commonly subject to moderate wind speeds. During the attended short-term measurements wind speeds of up to 3.5ms^{-1} was recorded, although generally speeds were between 0-2.5 ms^{-1}. As the site is located within a coastal region windspeeds were considered typical for this area. Road surfaces were dry and cloud cover was between 0 and 70%. The conditions were considered to be suitable for noise measurement.

2.4 Observations

The site is currently in use as Cardiff City Council's offices (County Hall) and includes a large car park. At the time of the survey, partial travel restrictions were in place due to the COVID-19 lockdown. Therefore, the car park was predominantly empty, and both local and distant traffic that was occurring during the survey is likely to have been less than pre-lockdown. A traffic count of vehicles passing each short-term attended measurement at ST1, ST3 and ST4 was undertaken during each survey (Table 3.4). Measurement position ST2 did not have a road passing the measurement position therefore it was not subject to a traffic count. This data may enable a comparison to be done once traffic calculations are completed for this project.

During day-time hours the existing noise climate at the site was dominated by distant road traffic noise from the A4234. Frequent noise from local traffic (Schooner Way and Hemingway Road) also contributed to the sound environment, depending on the position within the site. Birds and leaf rustle were also audible, along with local neighbourhood noise such as children and pedestrians passing and car doors slamming.

Carriageway surfacing treatment works took place along Schooners Way on Thursday 25 July 2020 between the hours of 08:00-20:00[3]. This can be seen within the visual representation of Section 3 of this report, predominantly between the hours of 07:15 to 12:00. No exclusions have been made within the dataset for this event as the daytime results at both LT1 and LT2 are of a similar magnitude to the rest of the survey duration.

2.5 Uncertainty in Acoustic Measurements

Inevitably there is a degree of uncertainty in measured noise levels. Contributory factors to this uncertainty include tolerances in instrumentation readings, meteorological conditions and the inherent variation in the acoustic environment during the course of a day and indeed over longer periods as the noise sources influencing a given location vary. Any acoustic measurement is a snapshot of the noise climate at the time of the measurement. Every effort has been made to limit uncertainty in the measurements reported. Measures taken to limit uncertainty include:

- Undertaking surveys with appropriately qualified and trained acoustic engineers;
- Use of measurement equipment calibrated to appropriate standards by accredited bodies and checked on site using calibrated reference sound sources;
- Following best practice methodology for environmental noise measurement set out in BS7445; and,
- Measuring under appropriate meteorological conditions.

[3] Cardiff City Council (Cardiff Highway Improvement Programme 2020-21 https://www.cardiff.gov.uk/ENG/resident/Parking-roads-and-travel/highway-improvements/Documents/Highway%20Improvements%202020.pdf

3 Noise Measurement Results

The unattended noise measurements are summarised graphically in Figure 3.1 and Figure 3.2. These figures show the full dataset, including data from 27 and 28 June 2020 which has been excluded from processing of the long-term unattended measurements dataset due to high rain and strong winds that occurred during this period.

A summary of the long-time noise measurements is provided in Table 3.1.

The data has been calculated to align with BS 5228-1:2009+A1:2014[4] with the daytime (07:00-19:00) evening (19:00-23:00) and night-time $L_{Aeq,T}$ values provided in Table 3.1 and Table 3.2 for LT1 and LT2 respectively. Daytime Saturday (07:00), weekend (Saturday: 13:00-23:00 and Sunday 07:00-230:00), and night-time (23:00-07:00) values have been provided in Table 3.3 and Table 3.4. Logarithmic averages for each time period has also been summarised.

The data presented in Table 3.5 and Table 3.6 has been calculated to align with BS 4142:2014+A1:2019[5] with daytime (07:00-23:00) and night-time (23:00-07:00) modal $L_{A90,15min}$ and logarithmic $L_{Aeq,T}$ values provided, along with the logarithmic and modal summaries.

Broadband and octave band noise measurement data from the short term attended measurements is summarised in Tables 3.7 and 3.8. Traffic counts that were taken at the time of the short-term surveys can be found within Table 3.9.

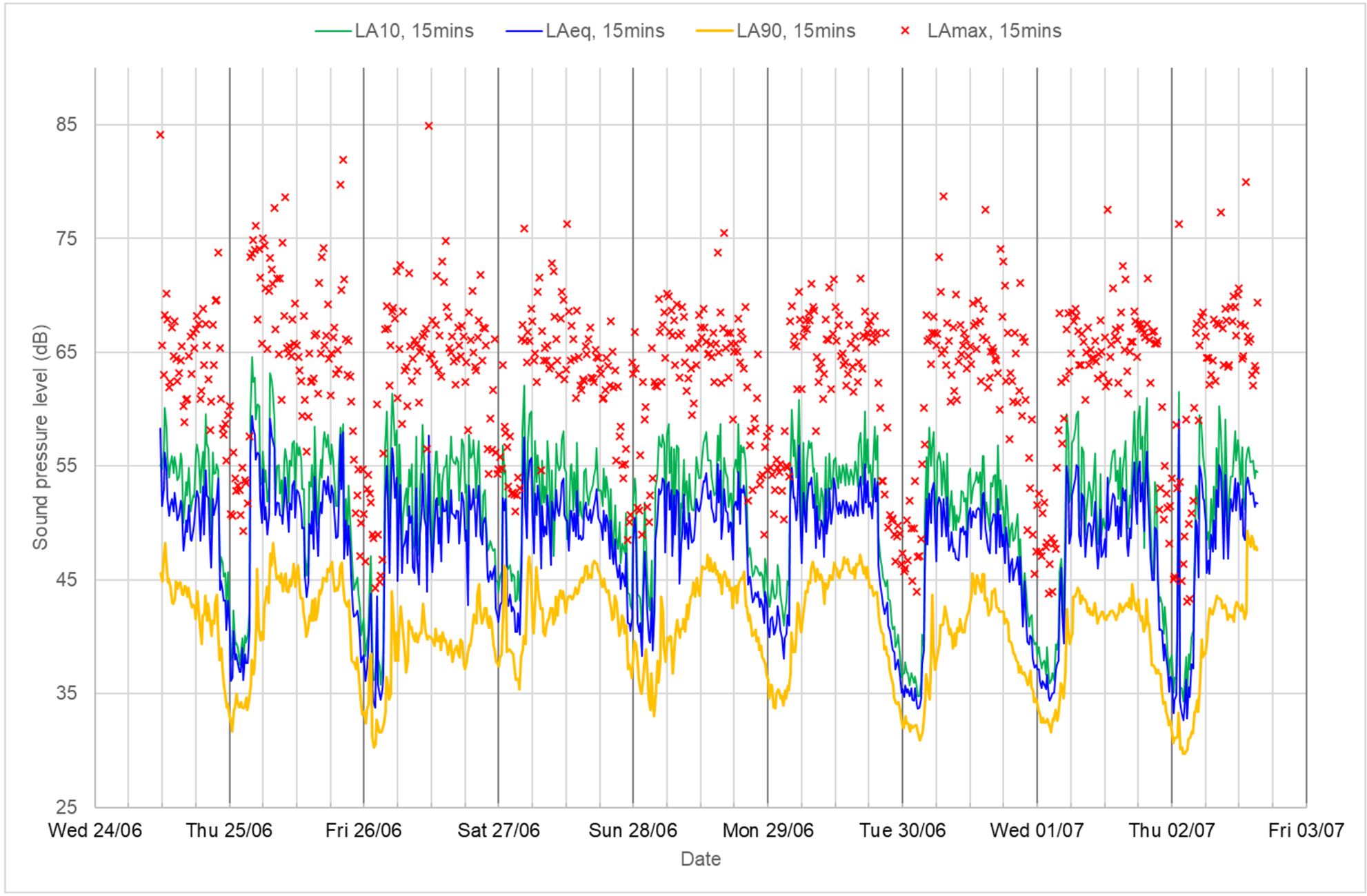
Full noise measurement data is provided in Appendix C.

[4] British Standards BS5228-1:2009+A1:2014 '*Noise Control on Construction and Open Sites'*

[5] British Standards BS4142:2014+A1:2019 '*Methods for rating and assessing industrial and commercial sound'*

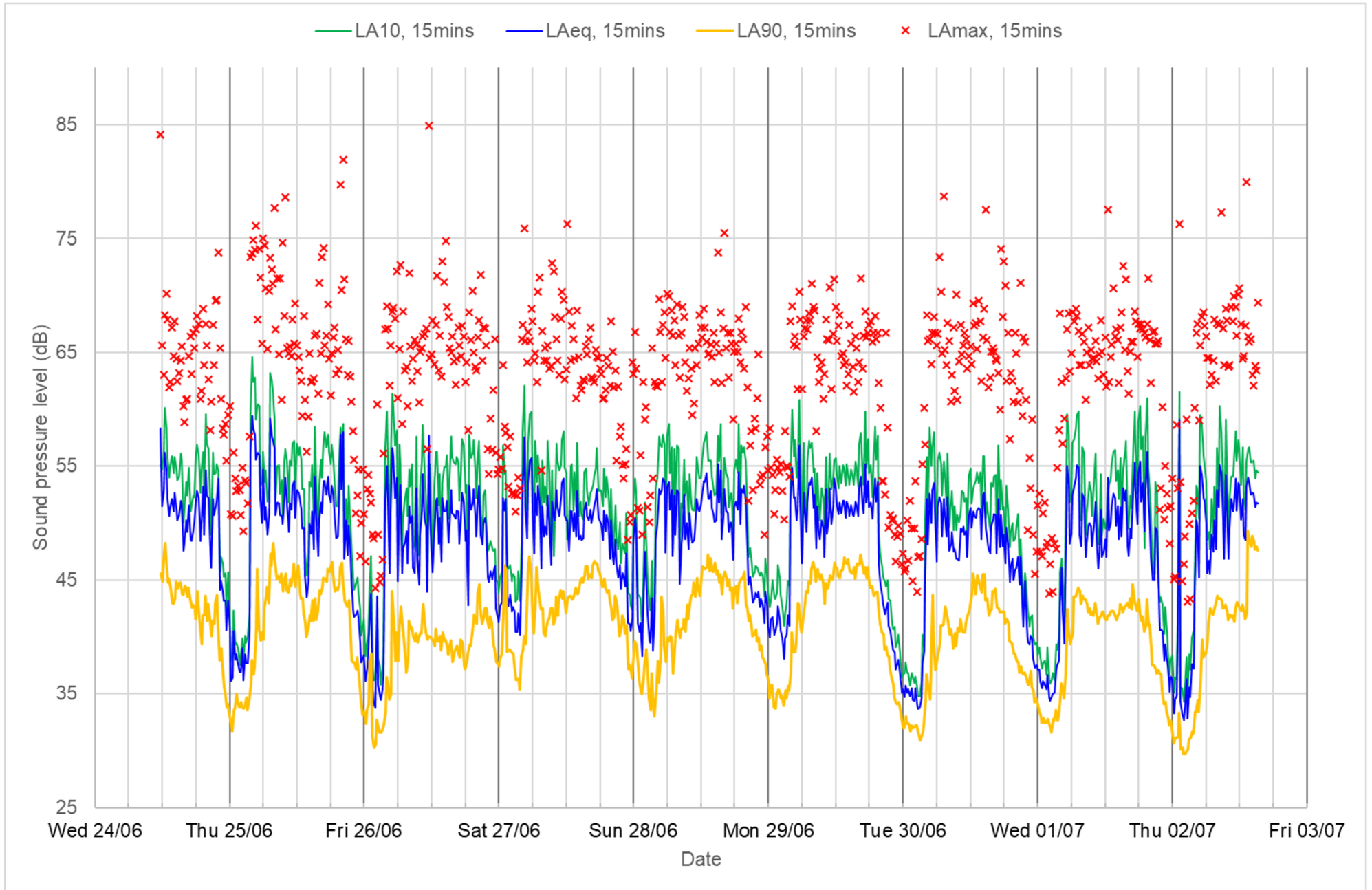
3.1 Long Term Measurement Results

Figure 3.1: Measured Noise Levels (dB) for Long Term Measurement Position LT1



Source: Mott MacDonald 2020

Figure 3.2: Measured Noise Levels (dB) for Long Term Measurement Position LT2



Source: Mott MacDonald 2020

Table 3.1: LT1 BS5228 Day, Evening and Night-Time Summary - $L_{Aeq,T}$

Day	Date	$L_{Aeq,12h}$ daytime dB	$L_{Aeq,4h}$ evening dB	$L_{Aeq,8h}$ night-time dB
		0700-1900	**1900-2300**	**2300-0700**
Wednesday	24/06/2020	53	51	47
Thursday	25/06/2020	54	50	45
Friday	26/06/2020	51	50	51
Saturday	27/06/2020	55	54	51
Sunday	28/06/2020	55	53	51
Monday	29/06/2020	56	51	46
Tuesday	30/06/2020	52	49	46
Wednesday	01/07/2020	53	50	48
Thursday	02/07/2020	54	---	---
Summary		**54**	**51**	**49**
Weekday Summary		**54**	**51**	**48**
Weekend Summary		**53**	**53**	**51**

Source: Mott MacDonald 2020. Shaded areas are weekend data processed on weekday working hours. See Table 3.3 for data processed for weekend working hours.

Table 3.2: LT2 BS5228 Day, Evening and Night-Time Summary - $L_{Aeq,T}$

Day	Date	$L_{Aeq,12h}$ daytime dB	$L_{Aeq,4h}$ evening dB	$L_{Aeq,8h}$ night-time dB
		0700-1900	**1900-2300**	**2300-0700**
Wednesday	24/06/2020	52	51	52
Thursday	25/06/2020	53	51	49
Friday	26/06/2020	51	50	50
Saturday	27/06/2020	51	48	49
Sunday	28/06/2020	51	49	49
Monday	29/06/2020	52	47	47
Tuesday	30/06/2020	50	45	47
Wednesday	01/07/2020	51	49	48
Thursday	02/07/2020	52	---	---
Summary		**51**	**49**	**49**
Weekday Summary		**52**	**49**	**49**
Weekend Summary		**51**	**49**	**50**

Source: Mott MacDonald 2020. Shaded areas are weekend data processed on weekday working hours. See Table 3.3 for data processed for weekend working hours.

Table 3.3: LT1 BS5228 Weekend and Night-Time Summary - $L_{Aeq,T}$

Day	Date	$L_{Aeq,6h}$ daytime dB	$L_{Aeq,T}$ weekend dB	$L_{Aeq,8h}$ night-time dB
		0700-1300	**Sat: 1300-2300 Sun: 0700-23:00**	**2300-0700**
Saturday	27/06/2020	52	55	51
Sunday	28/06/2020	---	55	51

Source: Mott MacDonald 2020

Table 3.4: LT2 BS5228 Weekend and Night-Time Summary- $L_{Aeq,T}$

Day	Date	$L_{Aeq,6h}$ daytime dB	$L_{Aeq,T}$ weekend dB	$L_{Aeq,8h}$ night-time dB
		0700-1300	Sat: 1300-2300 Sun: 0700-23:00	2300-0700
Saturday	27/06/2020	51	50	49
Sunday	28/06/2020	---	51	49

Source: Mott MacDonald 2020

Table 3.5: LT1 BS4142 Daytime and Night-Time Summary – L_{A90}

Day	Date	Modal $L_{A90,15min}$ daytime dB	Modal $L_{A90,15min}$ night-time dB	$L_{Aeq,16h}$ daytime dB	$L_{Aeq,8h}$ night-time dB
		0700-2300	2300-0700	0700-2300	2300-0700
Wednesday	24/06/2020	44	35	52	47
Thursday	25/06/2020	46	38	54	45
Friday	26/06/2020	46	46	51	51
Saturday	27/06/2020	49	46	54	51
Sunday	28/06/2020	51	46	55	51
Monday	29/06/2020	52	37	55	46
Tuesday	30/06/2020	46	41	51	46
Wednesday	01/07/2020	48	38	53	48
Thursday	02/07/2020	48	---	54	---
Average		**48**	**38**	**53**	**49**

Source: Mott MacDonald 2020

Table 3.6: LT2 BS4142 Daytime and Night-Time Summary– L_{A90}

Day	Date	Modal $L_{A90,15min}$ daytime dB	Modal $L_{A90,15min}$ night-time dB	$L_{Aeq,16h}$ daytime dB	$L_{Aeq,8h}$ night-time dB
		0700-2300	2300-0700	0700-2300	2300-0700
Wednesday	24/06/2020	44	34	52	52
Thursday	25/06/2020	46	32	52	49
Friday	26/06/2020	40	39	51	50
Saturday	27/06/2020	44	38	50	49
Sunday	28/06/2020	45	35	51	49
Monday	29/06/2020	46	32	51	47
Tuesday	30/06/2020	42	33	49	47
Wednesday	01/07/2020	42	33	51	48
Thursday	02/07/2020	43	---	52	---
Average		**43**	**34**	**51**	**49**

Source: Mott MacDonald 2020

3.2 Short Term Measurement Results

Table 3.7: Summary of Short-Term Attended Broadband Measurements During Daytime (All Free Field)

Position	Measurement Date and Time	Measurement Duration Hr:min:sec	$L_{Aeq,15min}$ (dB)	$L_{A01,\ 15\ min}$ (dB)	$L_{A90,15min}$ (dB)
ST1	24/06/2020 11:00	00:15:00	58.1	68.6	50.0
	24/06/2020 13:43	00:15:00	58.5	69.4	48.0
	24/06/2020 15:04	00:15:00	57.5	69.8	49.6
ST2	24/06/2020 12:22	00:15:00	57.1	61.6	54.7
	24/06/2020 14:22	00:15:00	57.4	62.3	53.9
	24/06/2020 15:40	00:15:00	56.9	62.1	53.6
ST3	24/06/2020 13:25	00:15:00	65.7	74.4	48.9
	24/06/2020 14:46	00:15:00	61.4	70.3	47.7
	02/07/2020 12:40	00:15:00	63.1	70.2	52.4
ST4	24/06/2020 14:02	00:15:00	63.4	75.7	45.0
	24/06/2020 15:21	00:15:00	61.3	75.0	46.0
	02/07/2020 12:58	00:15:00	59.1	70.6	46.5

Source: Mott MacDonald 2020

Table 3.8: Summary of Short-Term Attended Octave Band Measurements (All Free Field)

Position	Measurement Start Date and Time	Maximum Octave Band $L_{eq,30min}$ (dB)							
		63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	$L_{Aeq,15min}$ dB
ST1	24/06/2020 11:00	34.4	39.0	41.8	46.1	51.1	44.2	39.3	58.1
	24/06/2020 13:43	33.7	38.1	42.5	46.1	52.2	44.0	36.9	58.5
	24/06/2020 15:04	33.3	37.0	40.3	44.0	51.7	43.0	35.5	57.5
ST2	24/06/2020 12:22	32.0	37.2	41.1	42.7	51.9	41.0	31.4	57.1
	24/06/2020 14:22	32.5	36.4	41.2	43.6	51.7	45.1	33.1	57.4
	24/06/2020 15:40	30.8	35.6	43.3	42.2	51.6	40.4	29.7	56.9
ST3	24/06/2020 13:25	38.6	46.0	53.1	52.1	57.9	50.8	43.6	65.7
	24/06/2020 14:46	35.2	40.0	47.6	48.4	54.8	47.9	41.8	61.4
	02/07/2020 12:40	37.1	44.2	46.8	49.8	56.7	49.7	44.4	63.1
ST4	24/06/2020 14:02	31.6	37.0	47.2	50.3	58.3	47.5	37.2	63.4
	24/06/2020 15:21	33.0	39.0	44.5	48.3	55.9	46.6	39.0	61.3
	02/07/2020 12:58	32.6	34.3	42.6	46.6	52.3	45.8	38.8	59.1

Source: Mott MacDonald 2020

Table 3.9: Short-Term Attended Traffic Count

Position	Measurement Start Date and Time	Traffic count time period (hr:min:sec)	Road	Cars	HGV	Motorbike
ST1	24/06/2020 11:00	00:15:00	Schooner Way	23	3	0
	24/06/2020 13:43	00:15:00		35	1	1
	24/06/2020 15:04	00:15:00		19	0	0

Position	Measurement Start Date and Time	Traffic count time period (hr:min:sec)	Road	Cars	HGV	Motorbike
ST2			No nearby roads at this location			
ST3	24/06/2020 13:25	00:15:00	Hemingway Road	111	6	1
	24/06/2020 14:46	00:15:00		79	2	1
	02/07/2020 12:40	00:15:00		92	3	0
ST4	24/06/2020 14:02	00:15:00	Schooner Way	24	1	0
	24/06/2020 15:21	00:15:00		19	0	2
	02/07/2020 12:58	00:15:00		31	2	0

Source: Mott MacDonald 2020

4 Summary

Mott MacDonald was commissioned to gather baseline data of the existing Cardiff City Councils County Hall building and car park for a proposed Cardiff Arena.

The main contributing noise source at this site is road traffic on the A4234 and the surrounding residential roads. Noise from the rail line and station was not audible during the daytime but may be audible at night-time when the local road network is reduced.

A noise survey was completed to establish existing external noise levels across the site to inform future design of the proposed arena. Two long-term unattended noise meters were set up to gather long-term baseline data between 24 June to 2 July 2020. In addition, a series of short-term attended measurements were undertaken in four locations that were undertaken on 24 June 2020 and 2 July 2020.

This report summarises the results of the baseline noise survey. The scope of this report does not include the assessment of the results of the survey or suitability of the site. However, the data has been summarised to provide noise levels for BS4142 and BS5228 purposes.

A. Glossary of Terms

A-weighting	The human ear also has a non-linear frequency response, being most sensitive in the frequency range 1 kHz to 4 kHz and is less sensitive at higher and lower frequencies. The A-weighting is a frequency function commonly applied to the linear output of a microphone to simulate the subjective response of the ear. A-weighted levels are usually indicated by a subscript A or postscript (A).
Ambient noise	This is the total sound for a given scenario where the acoustic field is affected by a variety of sources.
Decibel	Sound and noise are commonly described using the decibel (dB) scale, which is logarithmic in nature to relate to the response of the human ear. The range of human hearing commonly varies from the threshold of audibility (0 dB) to the threshold of pain (120 dB). Such limits are seldom experienced in practice and typical levels might vary between 30 dB in a quiet bedroom at night to 90 dB at the kerbside of a busy road.
Equivalent continuous noise level L_{eq}	Time-varying noise such as that from industrial or construction operations may not best be described using the statistical approach described above. The equivalent continuous noise level, $L_{Aeq,T}$, may be used, which is the notional level of a steady sound which, at a given position and over the same period of time (T), would deliver the same sound energy as the fluctuating one.
Façade sound level	The received sound level which is measured or calculated immediately adjacent to a building façade, normally at 1m distance. Sound is reflected by the hard surfaces of a façade producing a slightly higher sound level (2.5 to 3.0 dB) than would occur in the absence of the building.
Free field sound level	The sound level which is measured or calculated within an acoustic field which is free of significantly reflective surfaces (except the ground plane).
Maximum sound pressure level $L_{(max)}$	The highest A-weighted sound level reached within the measurement period. “Fast” denotes that the level is weighted to the response time of the ear (125 ms) instead of to 1 second (denoted “Slow”).
Rating noise level	Noise level of an industrial noise source with any appropriate corrections applied for the presence of distinct acoustic features.

Sound power level

This is a measure of the sound energy radiated by an acoustic source per unit time. It is a characteristic of the source alone and independent of the properties of the acoustic field.

Statistical noise level L_N

Noise which fluctuates with time may be described using a statistical approach. The statistical level LAN is the level in dB exceeded for N % of the overall measurement period. L_{A90} is the noise level exceeded for 90 % of the sampling period and is a measure the lower levels in the absence of higher level transient events. It is commonly used to describe the ambient or background noise. The L_{A10} is the noise level exceeded for 10 % of the sampling period and is a measure the higher levels. In the UK, it is commonly used to describe road traffic noise and, when considered over the 18-hour period 06:00 to 24:00 is referred to as the traffic noise index.

B. Photographs of Noise Measurement Positions

Unfortunately photographs for measurement positions ST2, ST3 and ST4 were unable to be retrieved.

Figure B.1: LT1 – Long Term Measurement Position 1

Source: Mott MacDonald Survey 2020

Figure B.2: LT2 – Long term measurement position 2

Source: Mott MacDonald Survey 2020

Figure B.3: ST1 – Short term measurement position 1

Source: Mott MacDonald Survey 2020

C. Full Noise Measurement Data

C.1 Long-Term Unattended Data

Table C.1: Measurements from Unattended Measurement Position LT1

Data / Time	$L_{Aeq,1hour}$	$L_{A(max),\ 1hour}$	$L_{A,90,1hour}$
24/06/2020 10:45:00	52.0	79.7	44.5
24/06/2020 11:45:00	53.3	67.4	45.6
24/06/2020 12:45:00	52.9	72.4	45.0
24/06/2020 13:45:00	52.0	65.4	44.1
24/06/2020 14:45:00	51.3	67.0	43.7
24/06/2020 15:45:00	51.7	64.5	43.8
24/06/2020 16:45:00	53.8	74.9	44.1
24/06/2020 17:45:00	52.7	71.9	43.9
24/06/2020 18:45:00	50.6	65.0	42.7
24/06/2020 19:45:00	52.2	68.7	44.1
24/06/2020 20:45:00	51.6	69.2	43.5
24/06/2020 21:45:00	50.9	66.9	42.1
24/06/2020 22:45:00	49.1	67.8	37.6
24/06/2020 23:45:00	47.7	68.3	35.4
25/06/2020 00:45:00	43.1	65.0	34.7
25/06/2020 01:45:00	40.2	62.5	33.8
25/06/2020 02:45:00	42.3	64.3	34.9
25/06/2020 03:45:00	48.7	62.9	38.0
25/06/2020 04:45:00	47.0	70.9	39.4
25/06/2020 05:45:00	49.8	70.0	40.4
25/06/2020 06:45:00	58.4	76.4	44.2
25/06/2020 07:45:00	59.8	79.4	46.8
25/06/2020 08:45:00	54.8	69.1	46.3
25/06/2020 09:45:00	54.4	69.2	45.0
25/06/2020 10:45:00	53.6	69.0	45.1
25/06/2020 11:45:00	52.5	74.8	44.4
25/06/2020 12:45:00	52.2	74.4	44.5
25/06/2020 13:45:00	48.8	72.4	43.4
25/06/2020 14:45:00	50.4	70.4	43.7
25/06/2020 15:45:00	50.0	63.2	45.8
25/06/2020 16:45:00	50.9	62.0	46.6
25/06/2020 17:45:00	51.1	71.6	46.4
25/06/2020 18:45:00	51.0	72.0	46.2
25/06/2020 19:45:00	50.0	69.8	45.8
25/06/2020 20:45:00	50.4	71.3	45.4
25/06/2020 21:45:00	47.9	70.0	41.7
25/06/2020 22:45:00	45.8	58.3	39.9
25/06/2020 23:45:00	43.2	60.8	38.0
26/06/2020 00:45:00	45.8	63.0	38.7

26/06/2020 01:45:00	42.6	62.9	35.8
26/06/2020 02:45:00	38.5	56.4	35.0
26/06/2020 03:45:00	47.6	68.9	37.3
26/06/2020 04:45:00	45.6	63.4	38.7
26/06/2020 05:45:00	47.8	64.1	41.7
26/06/2020 06:45:00	51.0	71.3	43.3
26/06/2020 07:45:00	51.4	67.3	45.7
26/06/2020 08:45:00	51.5	66.8	47.1
26/06/2020 09:45:00	52.2	67.3	47.6
26/06/2020 10:45:00	52.4	75.4	48.1
26/06/2020 11:45:00	50.8	65.4	46.5
26/06/2020 12:45:00	52.2	68.6	46.1
26/06/2020 13:45:00	51.8	73.8	46.3
26/06/2020 14:45:00	51.3	76.8	45.6
26/06/2020 15:45:00	49.2	66.5	43.7
26/06/2020 16:45:00	50.9	66.7	45.1
26/06/2020 17:45:00	49.5	70.2	43.5
26/06/2020 18:45:00	51.3	79.2	43.9
26/06/2020 19:45:00	50.2	73.6	45.5
26/06/2020 20:45:00	49.5	67.5	44.9
26/06/2020 21:45:00	49.5	63.6	45.4
26/06/2020 22:45:00	49.7	74.8	43.5
26/06/2020 23:45:00	45.8	63.0	41.5
27/06/2020 00:45:00	54.6	68.6	47.2
27/06/2020 01:45:00	48.8	60.5	45.3
27/06/2020 02:45:00	46.7	56.4	42.0
27/06/2020 03:45:00	50.3	64.8	42.9
27/06/2020 04:45:00	51.5	67.0	46.1
27/06/2020 05:45:00	50.8	71.9	46.3
27/06/2020 06:45:00	52.5	64.6	49.0
27/06/2020 07:45:00	50.1	66.4	46.2
27/06/2020 08:45:00	50.9	66.0	47.4
27/06/2020 09:45:00	52.4	76.1	47.1
27/06/2020 10:45:00	52.2	63.1	48.9
27/06/2020 11:45:00	52.1	64.6	48.2
27/06/2020 12:45:00	52.9	65.6	49.4
27/06/2020 13:45:00	54.4	67.7	50.1
27/06/2020 14:45:00	55.9	69.2	51.9
27/06/2020 15:45:00	57.0	70.9	52.1
27/06/2020 16:45:00	58.0	70.4	53.0
27/06/2020 17:45:00	56.6	73.6	52.1
27/06/2020 18:45:00	55.3	71.7	50.3
27/06/2020 19:45:00	53.7	70.8	48.9
27/06/2020 20:45:00	54.8	70.8	48.8
27/06/2020 21:45:00	52.5	64.3	48.0
27/06/2020 22:45:00	51.0	62.3	45.4
27/06/2020 23:45:00	54.0	68.6	45.8

28/06/2020 00:45:00	49.3	60.4	44.4
28/06/2020 01:45:00	52.0	73.6	45.8
28/06/2020 02:45:00	48.9	62.6	43.8
28/06/2020 03:45:00	49.9	62.8	43.8
28/06/2020 04:45:00	48.9	62.1	44.8
28/06/2020 05:45:00	53.3	83.8	45.6
28/06/2020 06:45:00	50.5	62.3	44.7
28/06/2020 07:45:00	52.1	73.7	46.3
28/06/2020 08:45:00	53.1	66.8	47.7
28/06/2020 09:45:00	54.2	67.9	49.6
28/06/2020 10:45:00	55.5	68.0	50.3
28/06/2020 11:45:00	55.9	71.7	51.0
28/06/2020 12:45:00	56.6	72.9	52.1
28/06/2020 13:45:00	57.1	72.2	52.5
28/06/2020 14:45:00	55.2	72.1	50.7
28/06/2020 15:45:00	55.3	69.5	51.0
28/06/2020 16:45:00	55.0	72.1	50.9
28/06/2020 17:45:00	54.4	65.8	49.4
28/06/2020 18:45:00	55.1	66.6	50.5
28/06/2020 19:45:00	54.0	71.5	49.3
28/06/2020 20:45:00	51.9	66.8	48.2
28/06/2020 21:45:00	51.6	72.9	46.9
28/06/2020 22:45:00	51.3	63.7	46.1
28/06/2020 23:45:00	49.7	65.9	44.0
29/06/2020 00:45:00	49.3	63.7	42.5
29/06/2020 01:45:00	49.7	63.5	43.4
29/06/2020 02:45:00	49.1	63.0	43.0
29/06/2020 03:45:00	51.4	66.8	44.8
29/06/2020 04:45:00	50.7	63.6	45.8
29/06/2020 05:45:00	51.7	64.8	47.0
29/06/2020 06:45:00	54.4	68.4	50.2
29/06/2020 07:45:00	55.6	73.2	51.8
29/06/2020 08:45:00	55.8	70.7	52.0
29/06/2020 09:45:00	54.7	70.7	50.3
29/06/2020 10:45:00	55.8	74.5	51.1
29/06/2020 11:45:00	57.1	80.1	52.2
29/06/2020 12:45:00	56.5	67.9	51.9
29/06/2020 13:45:00	57.3	79.2	52.6
29/06/2020 14:45:00	56.5	69.6	51.8
29/06/2020 15:45:00	56.1	67.9	52.4
29/06/2020 16:45:00	55.4	71.7	51.6
29/06/2020 17:45:00	55.0	73.2	50.8
29/06/2020 18:45:00	53.5	65.8	49.3
29/06/2020 19:45:00	51.9	66.0	47.6
29/06/2020 20:45:00	49.8	66.3	45.1
29/06/2020 21:45:00	47.2	60.8	42.1
29/06/2020 22:45:00	46.6	68.1	40.1

29/06/2020 23:45:00	42.9	59.4	38.0
30/06/2020 00:45:00	43.1	63.4	37.5
30/06/2020 01:45:00	42.9	60.5	37.7
30/06/2020 02:45:00	40.8	62.9	35.8
30/06/2020 03:45:00	47.7	65.1	38.6
30/06/2020 04:45:00	45.5	61.7	40.7
30/06/2020 05:45:00	48.0	65.4	42.9
30/06/2020 06:45:00	50.0	62.7	45.5
30/06/2020 07:45:00	51.4	68.0	46.0
30/06/2020 08:45:00	52.4	73.5	44.9
30/06/2020 09:45:00	50.2	63.1	45.8
30/06/2020 10:45:00	52.8	79.6	45.8
30/06/2020 11:45:00	51.0	70.6	45.9
30/06/2020 12:45:00	50.9	67.7	46.0
30/06/2020 13:45:00	51.4	67.9	46.4
30/06/2020 14:45:00	52.3	70.5	47.4
30/06/2020 15:45:00	52.9	65.7	48.9
30/06/2020 16:45:00	52.7	76.0	47.8
30/06/2020 17:45:00	52.9	73.8	47.8
30/06/2020 18:45:00	51.3	69.0	45.9
30/06/2020 19:45:00	50.0	68.1	44.4
30/06/2020 20:45:00	48.4	68.1	43.3
30/06/2020 21:45:00	48.1	65.2	42.4
30/06/2020 22:45:00	46.8	64.7	41.3
30/06/2020 23:45:00	44.3	63.1	39.6
01/07/2020 00:45:00	42.7	63.8	37.8
01/07/2020 01:45:00	41.9	60.8	37.2
01/07/2020 02:45:00	44.2	67.6	38.7
01/07/2020 03:45:00	46.9	70.1	40.3
01/07/2020 04:45:00	46.2	59.9	41.8
01/07/2020 05:45:00	49.4	63.9	44.7
01/07/2020 06:45:00	52.0	66.6	48.3
01/07/2020 07:45:00	53.6	71.7	49.2
01/07/2020 08:45:00	53.2	69.7	48.7
01/07/2020 09:45:00	52.7	74.9	48.3
01/07/2020 10:45:00	52.3	68.2	48.0
01/07/2020 11:45:00	54.5	79.9	48.3
01/07/2020 12:45:00	52.8	75.2	48.7
01/07/2020 13:45:00	52.2	65.2	48.1
01/07/2020 14:45:00	54.3	78.0	49.3
01/07/2020 15:45:00	53.6	73.4	49.6
01/07/2020 16:45:00	53.2	75.7	49.1
01/07/2020 17:45:00	52.3	67.4	48.0
01/07/2020 18:45:00	51.6	66.6	47.4
01/07/2020 19:45:00	51.9	72.2	45.7
01/07/2020 20:45:00	48.9	70.0	44.0
01/07/2020 21:45:00	48.0	69.4	42.4

01/07/2020 22:45:00	46.2	65.2	40.2
01/07/2020 23:45:00	43.2	65.0	38.7
02/07/2020 00:45:00	54.1	75.0	38.2
02/07/2020 01:45:00	41.3	59.9	37.4
02/07/2020 02:45:00	41.8	62.0	38.6
02/07/2020 03:45:00	47.4	63.5	40.5
02/07/2020 04:45:00	46.8	71.9	42.2
02/07/2020 05:45:00	48.8	63.4	44.2
02/07/2020 06:45:00	51.9	63.9	48.2
02/07/2020 07:45:00	52.9	65.4	49.1
02/07/2020 08:45:00	54.5	87.3	48.7
02/07/2020 09:45:00	52.1	74.6	47.9
02/07/2020 10:45:00	51.8	68.5	47.8
02/07/2020 11:45:00	52.9	66.4	49.0
02/07/2020 12:45:00	52.9	66.2	48.4
02/07/2020 13:45:00	51.7	69.4	47.7

Source: Mott MacDonald 2020

C.2 Long-Term Unattended Data

Table C.2: Measurements from Unattended Measurement Position LT2

Data / Time	$L_{Aeq,1hour}$	$L_{A(max),\ 1hour}$	$L_{A,90,1hour}$
24/06/2020 11:45:00	55.5	84.1	45.9
24/06/2020 12:45:00	52.5	70.2	45.0
24/06/2020 13:45:00	51.8	67.7	43.4
24/06/2020 14:45:00	51.2	65.5	44.3
24/06/2020 15:45:00	48.9	60.9	44.0
24/06/2020 16:45:00	49.7	66.7	43.1
24/06/2020 17:45:00	51.9	68.2	42.7
24/06/2020 18:45:00	50.6	68.8	40.9
24/06/2020 19:45:00	52.3	67.5	42.2
24/06/2020 20:45:00	50.6	69.5	41.0
24/06/2020 21:45:00	50.6	73.8	39.5
24/06/2020 22:45:00	42.9	58.7	35.1
24/06/2020 23:45:00	40.1	60.3	32.5
25/06/2020 00:45:00	38.8	56.2	34.0
25/06/2020 01:45:00	37.4	54.9	33.9
25/06/2020 02:45:00	38.8	57.6	34.0
25/06/2020 03:45:00	58.1	74.9	36.8
25/06/2020 04:45:00	55.3	76.1	40.6
25/06/2020 05:45:00	52.1	75.0	41.0
25/06/2020 06:45:00	56.1	73.3	44.6
25/06/2020 07:45:00	55.0	77.7	46.2
25/06/2020 08:45:00	50.8	74.6	44.9
25/06/2020 09:45:00	52.1	78.6	44.5
25/06/2020 10:45:00	52.6	67.9	45.2
25/06/2020 11:45:00	52.2	69.3	44.8
25/06/2020 12:45:00	49.4	68.2	42.1
25/06/2020 13:45:00	47.6	64.9	40.8
25/06/2020 14:45:00	51.4	66.6	42.1
25/06/2020 15:45:00	50.4	73.4	43.4
25/06/2020 16:45:00	53.6	74.2	45.2
25/06/2020 17:45:00	52.6	66.3	45.9
25/06/2020 18:45:00	50.1	67.2	44.2
25/06/2020 19:45:00	55.7	81.9	44.4
25/06/2020 20:45:00	48.9	66.2	42.4
25/06/2020 21:45:00	43.1	60.7	37.7
25/06/2020 22:45:00	40.7	54.7	35.2
25/06/2020 23:45:00	37.6	54.7	33.1
26/06/2020 00:45:00	41.2	54.2	32.5
26/06/2020 01:45:00	39.0	60.4	30.9
26/06/2020 02:45:00	35.4	56.1	31.8
26/06/2020 03:45:00	52.2	69.1	34.6
26/06/2020 04:45:00	54.5	68.9	37.6
26/06/2020 05:45:00	52.2	72.7	39.5

Data / Time	$L_{Aeq,1hour}$	$L_{A(max),\ 1hour}$	$L_{A,90,1hour}$
26/06/2020 06:45:00	47.9	68.6	38.5
26/06/2020 07:45:00	50.0	72.0	39.3
26/06/2020 08:45:00	49.1	66.1	39.8
26/06/2020 09:45:00	51.0	66.4	40.4
26/06/2020 10:45:00	53.1	84.9	40.3
26/06/2020 11:45:00	48.8	67.8	39.6
26/06/2020 12:45:00	51.0	71.7	40.0
26/06/2020 13:45:00	50.7	74.8	39.4
26/06/2020 14:45:00	51.1	69.0	39.0
26/06/2020 15:45:00	50.8	66.4	38.5
26/06/2020 16:45:00	50.9	67.3	38.9
26/06/2020 17:45:00	49.1	66.4	37.7
26/06/2020 18:45:00	52.4	70.4	40.0
26/06/2020 19:45:00	51.6	67.8	42.3
26/06/2020 20:45:00	49.5	71.8	41.8
26/06/2020 21:45:00	46.9	65.6	41.4
26/06/2020 22:45:00	45.0	66.2	38.9
26/06/2020 23:45:00	42.3	55.8	37.8
27/06/2020 00:45:00	50.8	63.9	40.6
27/06/2020 01:45:00	42.8	57.6	38.7
27/06/2020 02:45:00	41.3	54.0	36.4
27/06/2020 03:45:00	53.2	75.9	37.0
27/06/2020 04:45:00	53.0	66.8	41.9
27/06/2020 05:45:00	52.6	68.8	41.7
27/06/2020 06:45:00	51.2	71.6	43.5
27/06/2020 07:45:00	49.9	66.9	40.8
27/06/2020 08:45:00	50.7	72.8	41.9
27/06/2020 09:45:00	51.4	72.1	41.7
27/06/2020 10:45:00	52.8	70.3	43.6
27/06/2020 11:45:00	49.8	76.3	42.9
27/06/2020 12:45:00	50.6	67.3	43.5
27/06/2020 13:45:00	50.2	68.7	44.2
27/06/2020 14:45:00	50.3	65.5	45.2
27/06/2020 15:45:00	50.5	67.2	45.4
27/06/2020 16:45:00	51.9	65.2	46.5
27/06/2020 17:45:00	49.8	64.5	45.1
27/06/2020 18:45:00	50.3	64.5	44.3
27/06/2020 19:45:00	48.0	67.7	42.0
27/06/2020 20:45:00	46.8	63.4	41.5
27/06/2020 21:45:00	44.9	58.5	41.0
27/06/2020 22:45:00	43.6	56.5	37.6
27/06/2020 23:45:00	48.4	66.8	37.8
28/06/2020 00:45:00	40.4	56.0	35.7
28/06/2020 01:45:00	45.0	62.4	37.1
28/06/2020 02:45:00	40.8	65.4	34.2
28/06/2020 03:45:00	49.9	69.7	34.4

Data / Time	$L_{Aeq,1hour}$	$L_{A(max),\ 1hour}$	$L_{A,90,1hour}$
28/06/2020 04:45:00	53.3	68.5	39.9
28/06/2020 05:45:00	51.9	70.2	39.2
28/06/2020 06:45:00	51.0	68.7	38.1
28/06/2020 07:45:00	50.7	69.2	40.5
28/06/2020 08:45:00	50.3	69.0	41.0
28/06/2020 09:45:00	49.1	65.4	42.9
28/06/2020 10:45:00	50.5	65.8	44.3
28/06/2020 11:45:00	52.3	68.8	44.7
28/06/2020 12:45:00	53.2	67.2	46.2
28/06/2020 13:45:00	51.4	66.7	46.1
28/06/2020 14:45:00	53.4	73.8	45.3
28/06/2020 15:45:00	51.1	75.5	44.9
28/06/2020 16:45:00	50.1	66.7	44.4
28/06/2020 17:45:00	50.7	65.8	43.3
28/06/2020 18:45:00	52.8	68.0	45.0
28/06/2020 19:45:00	50.6	69.0	42.3
28/06/2020 20:45:00	44.2	59.2	40.6
28/06/2020 21:45:00	43.5	64.8	39.6
28/06/2020 22:45:00	42.9	56.7	38.2
28/06/2020 23:45:00	41.5	58.3	35.8
29/06/2020 00:45:00	40.9	55.6	34.3
29/06/2020 01:45:00	41.4	55.2	35.0
29/06/2020 02:45:00	40.3	58.1	34.6
29/06/2020 03:45:00	52.0	69.1	36.8
29/06/2020 04:45:00	53.4	70.3	40.2
29/06/2020 05:45:00	51.1	67.9	41.3
29/06/2020 06:45:00	52.3	68.4	44.3
29/06/2020 07:45:00	51.9	71.0	45.6
29/06/2020 08:45:00	50.0	64.6	45.4
29/06/2020 09:45:00	50.2	67.9	43.9
29/06/2020 10:45:00	51.4	70.7	45.0
29/06/2020 11:45:00	52.5	71.4	46.0
29/06/2020 12:45:00	51.7	68.3	45.8
29/06/2020 13:45:00	51.1	67.4	46.3
29/06/2020 14:45:00	51.2	66.4	45.5
29/06/2020 15:45:00	52.6	71.5	46.6
29/06/2020 16:45:00	52.7	68.6	45.8
29/06/2020 17:45:00	52.0	67.7	44.7
29/06/2020 18:45:00	52.9	68.2	43.8
29/06/2020 19:45:00	44.5	62.3	40.7
29/06/2020 20:45:00	42.2	66.7	38.6
29/06/2020 21:45:00	39.4	50.7	36.0
29/06/2020 22:45:00	37.4	49.8	34.0
29/06/2020 23:45:00	35.2	47.3	32.4
30/06/2020 00:45:00	35.2	52.0	32.1
30/06/2020 01:45:00	34.7	53.7	32.1

Data / Time	$L_{Aeq,1hour}$	$L_{A(max),\ 1hour}$	$L_{A,90,1hour}$
30/06/2020 02:45:00	35.3	55.2	31.2
30/06/2020 03:45:00	48.3	68.3	33.3
30/06/2020 04:45:00	52.4	68.1	36.6
30/06/2020 05:45:00	50.8	73.4	38.1
30/06/2020 06:45:00	51.0	78.7	41.3
30/06/2020 07:45:00	49.6	67.6	41.0
30/06/2020 08:45:00	47.9	70.1	39.5
30/06/2020 09:45:00	48.3	67.4	40.9
30/06/2020 10:45:00	48.9	66.7	40.9
30/06/2020 11:45:00	50.7	69.3	43.1
30/06/2020 12:45:00	50.9	69.5	44.5
30/06/2020 13:45:00	51.5	68.8	44.6
30/06/2020 14:45:00	48.4	77.5	42.6
30/06/2020 15:45:00	50.4	65.4	43.4
30/06/2020 16:45:00	49.9	74.1	42.4
30/06/2020 17:45:00	48.5	73.0	41.8
30/06/2020 18:45:00	46.7	66.7	39.8
30/06/2020 19:45:00	46.0	66.7	38.1
30/06/2020 20:45:00	44.4	71.1	37.0
30/06/2020 21:45:00	42.2	65.9	36.2
30/06/2020 22:45:00	39.0	59.1	35.2
30/06/2020 23:45:00	37.0	52.6	33.7
01/07/2020 00:45:00	35.7	51.8	32.6
01/07/2020 01:45:00	35.2	48.7	32.0
01/07/2020 02:45:00	36.3	54.9	32.8
01/07/2020 03:45:00	43.2	68.4	34.0
01/07/2020 04:45:00	51.9	68.4	36.1
01/07/2020 05:45:00	51.2	68.5	40.3
01/07/2020 06:45:00	53.8	68.8	44.0
01/07/2020 07:45:00	50.6	66.6	43.2
01/07/2020 08:45:00	49.5	67.2	42.4
01/07/2020 09:45:00	49.9	66.0	42.2
01/07/2020 10:45:00	48.3	67.8	41.6
01/07/2020 11:45:00	50.3	77.5	41.8
01/07/2020 12:45:00	51.0	70.6	42.2
01/07/2020 13:45:00	50.8	67.0	41.8
01/07/2020 14:45:00	51.6	72.6	42.5
01/07/2020 15:45:00	50.0	71.4	42.9
01/07/2020 16:45:00	52.8	68.6	43.0
01/07/2020 17:45:00	53.4	67.5	42.3
01/07/2020 18:45:00	53.7	67.5	41.1
01/07/2020 19:45:00	49.5	71.5	38.8
01/07/2020 20:45:00	48.0	66.9	37.1
01/07/2020 21:45:00	40.1	60.2	35.1
01/07/2020 22:45:00	37.7	55.0	32.9
01/07/2020 23:45:00	35.3	53.9	31.3

Data / Time	$L_{Aeq,1hour}$	$L_{A(max),\ 1hour}$	$L_{A,90,1hour}$
02/07/2020 00:45:00	53.1	76.3	30.9
02/07/2020 01:45:00	34.2	59.1	29.8
02/07/2020 02:45:00	35.5	50.9	30.8
02/07/2020 03:45:00	47.5	67.5	32.9
02/07/2020 04:45:00	52.9	68.5	35.6
02/07/2020 05:45:00	49.3	67.3	39.3
02/07/2020 06:45:00	48.4	67.9	42.2
02/07/2020 07:45:00	52.5	67.6	43.3
02/07/2020 08:45:00	52.4	77.3	42.7
02/07/2020 09:45:00	50.5	69.0	41.8
02/07/2020 10:45:00	52.1	69.9	42.1
02/07/2020 11:45:00	52.5	70.6	42.6
02/07/2020 12:45:00	48.7	67.3	41.9

Source: Mott MacDonald 2020

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