



**CLIENT: LONDON UNDERGROUND LIMITED**



**CONTRACT REF: TLL 7917**

**NORTHERN LINE EXTENSION**

**MAIN WORKS CONTRACT**

## **Battersea Unattended Noise Monitoring**



Prepared by	Checked by	Approved by	Date	Rev
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## **1 INTRODUCTION**

Ferrovial Laing O'Rourke (FLO) is currently undertaking works as part of the London Underground Extension of the Northern Line (NLE) running from Kennington to Battersea (Charing Cross branch).

Unattended noise monitoring stations have been set up in order to assess construction noise levels of the current activities at the nearest sensitive receptors located around the site boundary.

This report provides a summary of the unattended noise monitoring. The analysed monitoring period spanned hours between Sunday 12<sup>th</sup> November 2017 and Saturday 9<sup>th</sup> December 2017.

## 2 MONITORING PROGRAMME

### 2.1 Receptors

The unattended monitoring positions are representative of the following sensitive receptors:

- Residential receptors on Battersea Park Road (Viridian Apartments) (R1)
- Residential receptors on Battersea Park Road (Savona House) (R2)
- Residential receptors on Battersea Park Road (Duchess) (R3)
- Battersea Dogs & Cats Home (R4)

### 2.2 Monitoring Locations

Three monitoring units were installed on Friday 6<sup>th</sup> November 2015. The measurement positions are located within the NLE construction site at a height of approx. 2.9m and are considered to be free field measurements. They are illustrated in the layout plan presented in **Appendix I** and are as follows:

Table 1

MONITORING LOCATIONS		
Location	Coordinates	Representative sensitive receptor
NLE site – South East (MP1)	529210, 177354	R1
NLE site – South (MP2)	529111, 177269	R2, R3
NLE site –West (MP3)	528945, 177260	R4

### 2.3 Equipment

The measurement equipment used is detailed in **Table 2**. The measurement system was field calibrated before the start of the unattended monitoring and on-site calibrations are conducted monthly. All the measurement equipment is subject to current certificates of periodic validation traceable to national and international standards. Copies of calibration certificates are available upon request.

Table 2

SURVEY EQUIPMENT			
Manufacture	Item	Type	Serial Number
Sigicom	Sound Level Meter	INFRA S50	5565
Sigicom	Sound Level Meter	INFRA S50	7376
Sigicom	Sound Level Meter	INFRA S50	5343

### 3 NOISE MONITORING RESULTS

The results of the monthly noise monitoring are presented below in **Table 3**, **Table 4** and **Table 5**. The measured noise levels have been corrected in order to predict noise levels from site activities at associated sensitive receptors. In addition, a façade correction which takes into account the reflections from the building façade of 3 dB(A) has been applied to the corrected noise levels.

The descriptions of the assessment periods are outlined in **Appendix IV**.

Table 3

Monthly Noise Levels at R1							
		L <sub>morn</sub>	L <sub>day</sub>	L <sub>eve</sub>	Max LEN	Max LLN	Typical LLN
Sun	12/11/17	-	59.5	-	61.0	59.8	57.5
Mon	13/11/17	59.3	62.1	59.2	59.1	60.6	58.6
Tue	14/11/17	62.2	62.4	57.3	56.6	58.3	56.4
Wed	15/11/17	59.1	61.3	56.4	56.9	57.9	55.7
Thu	16/11/17	58.6	61.8	57.4	58.3	58.4	57.0
Fri	17/11/17	59.3	60.6	56.5	55.3	57.2	55.9
Sat	18/11/17	57.8	61.4	56.1	57.2	57.3	54.4
Sun	19/11/17	-	55.7	-	57.3	56.7	54.1
Mon	20/11/17	57.5	60.9	55.9	55.5	55.7	54.3
Tue	21/11/17	57.5	60.9	59.2	56.3	56.4	55.0
Wed	22/11/17	58.5	61.4	56.4	57.2	58.5	55.4
Thu	23/11/17	58.7	61.7	58.1	57.1	56.7	55.4
Fri	24/11/17	57.5	62.1	57.2	55.8	55.8	55.1
Sat	25/11/17	58.5	62.8	55.3	58.4	56.7	55.1
Sun	26/11/17	-	56.5	-	60.0	57.0	55.2
Mon	27/11/17	59.3	62.4	59.0	57.0	58.5	54.9
Tue	28/11/17	58.2	62.5	58.0	56.2	57.4	55.3
Wed	29/11/17	58.3	62.4	57.1	55.6	56.6	54.5
Thu	30/11/17	59.1	61.2	57.7	59.3	58.2	57.3
Fri	01/12/17	58.3	62.7	59.4	59.7	60.8	59.1
Sat	02/12/17	59.6	61.2	60.2	61.2	61.7	59.3
Sun	03/12/17	-	60.4	-	62.6	61.7	58.1
Mon	04/12/17	60.9	63.2	58.8	56.7	56.7	54.3
Tue	05/12/17	56.4	62.5	57.9	60.1	60.9	57.5
Wed	06/12/17	57.0	61.5	58.3	56.9	59.4	56.2
Thu	07/12/17	56.7	62.2	58.7	57.1	56.5	55.4
Fri	08/12/17	57.5	62.2	57.9	57.0	56.9	55.8
Sat	09/12/17	56.5	61.7	58.3	60.5	57.5	57.0

Table 4

Monthly Noise Levels at R2 & R3							
		L <sub>morn</sub>	L <sub>day</sub>	L <sub>eve</sub>	Max LEN	Max LLN	Typical LLN
Sun	12/11/17	-	67.9	-	68.7	69.0	65.8
Mon	13/11/17	69.0	71.9	68.4	67.5	69.5	66.2
Tue	14/11/17	71.3	70.1	69.2	68.2	70.0	66.9
Wed	15/11/17	69.9	70.1	68.6	68.0	68.7	66.3
Thu	16/11/17	69.2	70.3	69.2	67.7	69.1	67.1
Fri	17/11/17	69.9	70.4	68.7	67.7	67.9	66.5
Sat	18/11/17	68.0	69.4	68.9	70.4	67.5	66.2
Sun	19/11/17	-	67.8	-	69.2	70.6	66.3
Mon	20/11/17	70.3	69.9	69.5	67.8	69.1	66.2
Tue	21/11/17	69.8	69.9	69.4	67.7	69.1	66.1
Wed	22/11/17	69.7	69.5	68.8	68.0	70.0	67.8
Thu	23/11/17	70.3	69.9	71.0	68.7	69.6	67.6
Fri	24/11/17	70.1	70.6	70.5	68.6	68.9	67.6
Sat	25/11/17	68.9	71.1	68.8	69.4	69.4	67.2
Sun	26/11/17	-	68.6	-	69.5	71.0	68.4
Mon	27/11/17	72.3	70.7	69.6	69.0	70.0	67.0
Tue	28/11/17	70.2	70.6	70.8	68.9	69.7	67.4
Wed	29/11/17	70.1	70.1	69.6	68.6	69.9	67.6
Thu	30/11/17	70.8	70.0	69.1	69.0	69.3	68.2
Fri	01/12/17	69.7	69.7	68.1	69.0	69.3	68.2
Sat	02/12/17	68.9	70.7	68.6	70.5	68.9	68.0
Sun	03/12/17	-	69.0	-	70.0	69.5	66.9
Mon	04/12/17	68.5	70.9	70.9	68.7	69.4	66.9
Tue	05/12/17	69.5	70.3	70.6	69.3	69.4	67.3
Wed	06/12/17	69.3	69.7	70.1	68.4	69.9	67.5
Thu	07/12/17	69.6	71.4	72.9	68.7	69.7	68.2
Fri	08/12/17	70.9	70.9	69.4	69.3	68.9	68.5
Sat	09/12/17	69.3	70.4	69.1	73.4	68.8	67.8

Table 5

Monthly Noise Levels at R4							
		L <sub>morn</sub>	L <sub>day</sub>	L <sub>eve</sub>	Max LEN	Max LLN	Typical LLN
Sun	12/11/17	-	62.2	-	68.9	56.2	49.6
Mon	13/11/17	59.6	66.4	57.0	52.3	56.8	51.9
Tue	14/11/17	60.5	66.4	56.3	51.8	55.0	51.2
Wed	15/11/17	58.4	64.9	55.0	52.1	56.4	51.4
Thu	16/11/17	66.8	68.4	63.6	53.3	63.1	53.4
Fri	17/11/17	64.5	64.8	61.1	56.3	60.6	52.1
Sat	18/11/17	58.3	64.9	56.9	62.8	54.7	50.4
Sun	19/11/17	-	55.2	-	59.7	55.8	49.3
Mon	20/11/17	56.7	62.6	60.8	53.8	56.1	51.4
Tue	21/11/17	58.4	63.4	61.8	59.3	59.5	53.3
Wed	22/11/17	56.3	64.5	60.7	55.1	56.9	54.2
Thu	23/11/17	58.5	63.2	62.9	56.1	55.5	52.5
Fri	24/11/17	57.4	63.7	61.0	53.9	58.0	51.4
Sat	25/11/17	56.4	65.1	54.8	58.9	55.7	50.7
Sun	26/11/17	-	55.1	-	56.4	57.7	51.5
Mon	27/11/17	59.9	65.8	59.0	54.2	57.5	50.7
Tue	28/11/17	58.7	63.4	63.5	54.2	56.9	51.0
Wed	29/11/17	59.5	64.8	59.5	58.3	60.6	53.3
Thu	30/11/17	61.0	63.7	62.0	59.9	52.6	50.4
Fri	01/12/17	57.7	63.6	54.3	54.4	58.1	52.9
Sat	02/12/17	56.4	64.4	50.8	60.3	63.3	52.6
Sun	03/12/17	-	55.7	-	58.3	55.4	49.9
Mon	04/12/17	57.0	63.8	61.8	55.3	56.3	51.8
Tue	05/12/17	56.4	63.3	59.9	55.0	56.1	50.8
Wed	06/12/17	56.6	64.7	63.8	57.6	55.1	52.2
Thu	07/12/17	56.2	65.4	63.7	56.4	56.3	52.5
Fri	08/12/17	59.5	64.0	60.0	56.0	57.7	53.2
Sat	09/12/17	55.9	63.3	55.0	58.9	50.6	49.7

## 4 TRIGGER RESPONSE LOG

Exceedances above the limits set out in the Noise and Vibration Mitigation Scheme, included as **Appendix II** are identified along with the action taken in **Table 6** below:

Table 6

NOISE TRIGGER LOG					
Date	Recept or	Time period	Noise Level $L_{Aeq,T}$ , dB (exceedance above trigger level)	Cause	Best Practicable Means check
-	-	-	-	-	-

No exceedances occurred during the monitoring period.



**APPENDIX I – SITE PLAN**

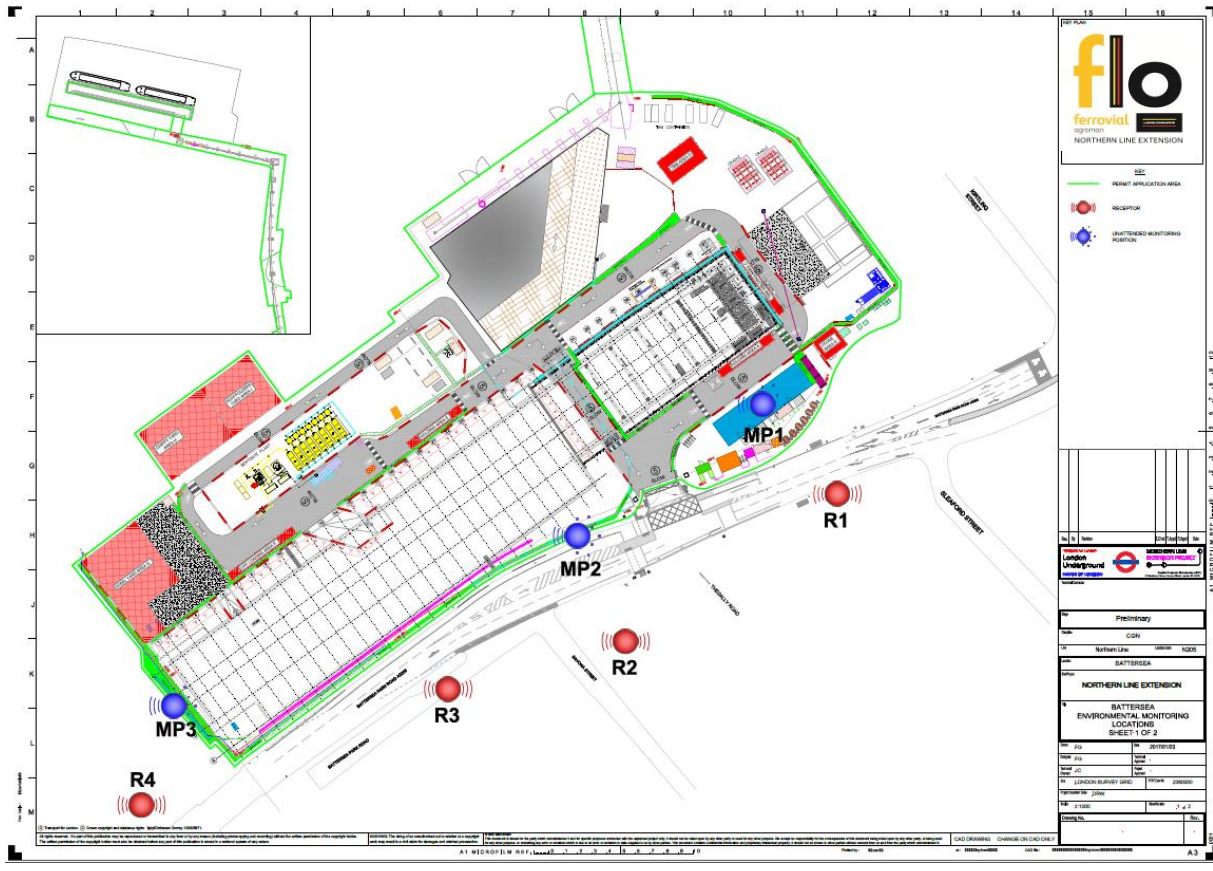


Figure 1 – NLE site plan and sensitive receptor locations

## APPENDIX II – NORTHERN LINE EXTENSION: CONSTRUCTION NOISE AND VIBRATION MITIGATION SCHEME

### Noise Insulation

A dwelling will be eligible for noise insulation where the total noise level due to construction of the railway (pre-existing ambient plus airborne NLE construction noise), measured or predicted at a point one metre in front of the most exposed of any windows and doors in any façade of a building which is an eligible dwelling, exceeds whichever is the higher of either: a) any of the following criteria in **Table 7**.

Table 7

<b>NOISE INSULATION TRIGGER LEVEL TABLE</b>			
<b>Time</b>	<b>Relevant Time Period</b>	<b>Averaging Time Period</b>	<b>Noise Insulation Trigger Level (<math>L_{Aeq, \tau}</math>) dB</b>
Monday to Friday	07:00 – 08:00	1 hr	70
	08:00 – 18:00	10 hr	75
	18:00 – 19:00	1 hr	70
	19:00 – 22:00	3 hr	65
	22:00 – 07:00	1 hr	55
Saturday	07:00 – 08:00	1 hr	70
	08:00 – 13:00	5 hr	75
	13:00 – 14:00	1 hr	70
	14:00 – 22:00	3 hr	65
	22:00 – 07:00	1 hr	55
Sunday and Public Holidays	07:00 – 22:00	1 hr	65
	22:00 – 07:00	1 hr	55

Or

(b) 5 dB above the pre-existing airborne noise level for the corresponding times of day (i.e. the Relevant Time Periods presented in column 2 of Table 7);

And

for a period of 10 or more days of working in any 15 consecutive days or for a period of 3 or more nights (22:00-07:00) of working in any 7 consecutive nights or for a total of days exceeding 40 in any six consecutive months.

## APPENDIX III – BASELINE SURVEY

### Attended Survey

Baseline noise measurements were taken in the area surrounding the Battersea worksite in October 2014. Measurement locations and results can be seen below; locations were chosen in order to cover the closest sensitive receptors around the ventilation shaft site. Further details related to the exercise are documented in the report 'T2385.1 – Northern Line Extension: Pre-construction Noise and Vibration Baseline Report'.

Table 8

ATTENDED BASELINE RESULTS			
ID	Address	Time Period	Typical L <sub>Aeq,T</sub> dB
BS1	169 Battersea Park Road, Battersea	Daytime	76.0
		Evening	68.3
		Night-time	64.2
BS2	Viridian Apartments, Battersea Park Road, Battersea	Daytime	78.5
		Evening	73.1
		Night-time	63.0
BS3	188 Kirtling Street, Battersea	Daytime	67.6
		Evening	66.9
		Night-time	59.3
BS4	Howard Bldg., Chelsea Bridge Wharf, Battersea	Daytime	60.2
		Evening	60.9
		Night-time	51.2

### Unattended Survey

In order to assess typical ambient noise levels outside core hours, data has been gathered by the monitoring system in place at the Battersea worksite. These levels have been taken from the period between 11<sup>th</sup> January 2016 and 3<sup>rd</sup> April 2016.

Table 9

UNATTENDED BASELINE RESULTS						
	M-F 1900-2200 (LEN) L <sub>Aeq,T</sub> dB	M-F 2200-0700 (LLN) L <sub>Aeq,T</sub> dB	Sat 1400-2200 (LEN) L <sub>Aeq,T</sub> dB	Sat 2200-0700 (LLN) L <sub>Aeq,T</sub> dB	Sun 0700-2200 (LEN) L <sub>Aeq,T</sub> dB	Sun 2200-0700 (LLN) L <sub>Aeq,T</sub> dB
R1	70.9	69.5	70.7	67.9	70.1	68.0
R2/R3	70.9	69.5	70.7	67.9	70.1	68.0
R4	68.3	64.2	68.3	64.2	68.3	64.2

## Trigger Levels

Trigger levels for each receptor, as stated in the Northern Line Extension: Construction Noise and Vibration Mitigation Scheme (**Appendix II**) can be seen in **Table 10** below:

Table 10

<b>TRIGGER LEVELS</b>								
	<b>Core Hours, L<sub>Aeq,T</sub> dB</b>	<b>M-F 07:00-08:00 18:00-19:00 (L<sub>morn, Leve</sub>) L<sub>Aeq,T</sub> dB</b>	<b>M-F 19:00-22:00 (LEN) L<sub>Aeq,T</sub> dB</b>	<b>M-F 22:00-07:00 (LLN) L<sub>Aeq,T</sub> dB</b>	<b>Sat 14:00-22:00 (LEN) L<sub>Aeq,T</sub> dB</b>	<b>Sat 22:00-07:00 (LLN) L<sub>Aeq,T</sub> dB</b>	<b>Sun 07:00-22:00 (LEN) L<sub>Aeq,T</sub> dB</b>	<b>Sun 22:00-07:00 (LLN) L<sub>Aeq,T</sub> dB</b>
R1	83.5	78.1	75.9	74.5	75.7	72.9	75.1	73.0
R2/R3	83.5	78.1	75.9	74.5	75.7	72.9	75.1	73.0
R4	81.0	73.3	73.3	69.2	73.3	69.2	73.3	69.2

## APPENDIX IV – GLOSSARY

Table 11

ABBREVIATIONS	
L <sub>morn</sub>	Morning values from 07:00 to 08:00 Monday to Saturday.
L <sub>day</sub>	Core hours from 08:00 to 18:00 Monday to Friday, 08:00 to 13:00 Saturday. 07:00 to 21:00 on Sunday is included but not considered to be Core hours.
L <sub>eve</sub>	Evening values from 18:00 to 19:00 Monday to Friday and from 13:00 to 14:00 Saturday.
Max LEN	Maximum early night values from 19:00 to 22:00 Monday to Friday, 14:00 to 22:00 Saturday and from 07:00 to 22:00 Sun.
Max LLN	Maximum late night values from 22:00 to 07:00 Monday to Sunday.
Typical LLN	Arithmetic average of the intervals for the late night time period.