

Technical Report**NOISE AT WORK ASSESSMENT FOR NORTHERN LINE TRAIN OPERATORS**

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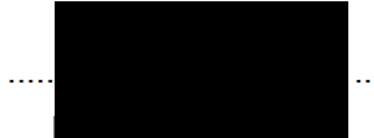
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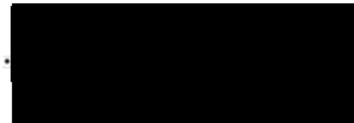
Issue Date: 9th May 2019

Reference: RP-R2591

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1. Introduction

The noise and vibration team in Technical Services was asked to measure noise levels in accordance with The Control of Noise at Work Regulations 2005 for train operators on the Northern line and to identify track sections where the noise levels were high.

2. Summary of the Control of Noise at Work Regulations 2005

The aim of the regulations is to protect persons against risk to their health and safety arising from exposure to noise at work. The general aspiration of the regulations is to reduce noise levels for all employees to as low a level as reasonably practicable. The following duties are placed on an employer:

- assessment of employees' risk and periodic review of the risks (this can include noise measurements),
- implementation of controls to eliminate the risk or reduce it to as low as possible (by either reducing the noise levels or exposure time),
- provision of personal hearing protectors as appropriate to the exposure level determined,
- health surveillance as appropriate, and
- provision of information, instruction and training to employees at risk.

The regulations define noise exposure limit values and action values. These are provided in Table 1.

Table 1 – Noise exposure limit values and action values

	Daily Personal Noise Exposure $L_{EP,d}$	Peak Sound Pressure L_{Cpeak}
Lower Exposure Action Values	80 dB(A)	135 dB(C)
Upper Exposure Action Values	85 dB(A)	137 dB(C)
Exposure Limit Values	87 dB(A)	140 dB(C)

The equation used to calculate a daily personal noise exposure, $L_{EP,d}$ is defined as

$$L_{EP,d} = L_{Aeq,Te} + 10 \log \left(\frac{T_e}{T_0} \right)$$

where,

$L_{Aeq,Te}$ is the equivalent continuous A-weighted sound pressure level,

T_e is the duration of exposure to the noise, in seconds, and

T_0 is the reference duration of 8 hours (28,800 seconds).

Hearing protection should only be considered when organisational and technical methods to reduce noise levels to as low as possible have been found not to be reasonably practical. In such circumstances, employees exposed to levels at or above the lower action values shall be advised of the risks and personal hearing protectors shall be made available to them.

Their employer must provide employees exposed to levels at or above the upper action values with personal hearing protectors. The employer is required to enforce their mandatory use.

The employer must ensure that employees are not exposed to noise above the exposure limit values, which includes allowing the employer to take into account the noise reduction provided by hearing protection.

3. Measurements and Results

The LU HSE team asked Technical Services to carry out the monitoring of train operator's noise levels for the Northern line. This is carried out to ensure that train operator noise exposure is minimised and controlled in line with the Control of Noise at Work Regulations 2005.



A train operator's daily noise exposure level is a log average of all the noise levels he/she is exposed to throughout an 8-hour shift. If the amount of time spent at high noise levels can be reduced, either by reducing the noise levels or exposure time this will reduce the daily noise exposure level. The highest noise levels a train operator is exposed to are when he/she is in the cab and the train is moving. These cab noise levels can be broken down into inter-station noise levels.

The measurements were carried out on 26th, 27th, 28th March and 30th April 2019 using one handheld sound level meter (SLM), with the microphone located next to the most exposed driver's ear. The details regarding the meter can be found in Appendix A.

Each direction was measured multiple times in randomly selected cabs. The photograph in Appendix C, displays the assembly used for the measurements.

The average levels for all cab runs are presented in the tables below. These measurements start when the train starts moving at the start station and finish when the train comes to rest at the end station. These overall levels do not include the dwell time spent at stations, i.e. noise exposure is likely to be lower if rest periods and dwell times are included.

Table 2 – Interstation noise levels for the northbound road between Morden and Edgware (via Bank)

Interstation Section	L _{Aeq} dB(A)	L _{Cpeak} dB(C)	A-Weighted Noise Spectral Analysis in Octave (Hz)							
			63	125	250	500	1000	2000	4000	8000
Morden to South Wimbledon	78.3	106.2	54.9	65.1	68.8	76.3	72.1	64.8	58.0	45.6
South Wimbledon to Colliers Wood	80.6	107.2	51.9	64.0	72.0	78.2	75.0	66.2	60.7	55.7
Colliers Wood to Tooting Broadway	78.6	107.6	53.9	65.9	72.6	75.5	71.5	64.6	57.9	45.4
Tooting Broadway to Tooting Bec	82.9	106.2	50.1	58.5	72.4	80.9	78.7	65.9	58.2	50.1
Tooting Bec to Balham	74.4	102.6	52.1	62.5	67.2	70.7	68.7	62.8	58.8	55.1
Balham to Clapham South	78.6	108.4	52.9	65.9	68.8	76.0	72.9	65.5	60.4	53.4
Clapham South to Clapham Common	75.1	110.3	53.7	63.4	67.9	71.5	69.1	62.6	57.3	48.5
Clapham Common to Clapham North	75.8	105.1	53.3	59.0	65.7	74.4	68.9	61.1	56.8	46.1
Clapham North to Stockwell	83.7	111.9	50.8	62.1	71.1	81.5	80.1	68.7	59.7	46.1
Stockwell to Oval	75.4	106.0	52.3	62.6	66.5	71.0	71.7	62.8	56.3	43.7
Oval to Kennington	75.9	109.5	56.6	65.4	69.2	71.7	70.3	64.5	57.8	44.7
Kennington to Elephant and Castle	76.9	105.9	53.5	61.9	68.8	74.7	69.4	63.4	62.4	53.6
Elephant and Castle to Borough	76.4	106.6	55.0	62.2	66.9	74.8	69.0	62.5	57.0	48.1
Borough to London Bridge	74.3	101.3	51.1	58.6	64.3	71.2	69.3	61.3	59.5	50.0
London Bridge to Bank	79.8	110.0	54.3	66.8	70.9	76.6	74.3	68.7	63.5	57.2
Bank to Moorgate	77.4	109.2	56.9	64.5	68.4	75.3	70.2	64.4	58.5	48.7
Moorgate to Old Street	79.6	107.4	49.9	59.3	67.3	78.5	74.1	62.5	58.8	51.9
Old Street to Angel	75.8	108.6	53.7	62.1	67.1	72.5	70.8	64.4	59.9	51.4
Angel to King's Cross St. Pancras	76.3	107.0	52.5	63.0	66.8	73.3	71.0	63.3	58.5	51.1
King's Cross St. Pancras to Euston	78.2	108.8	56.7	67.2	70.3	74.5	72.6	66.7	60.9	53.6
Euston to Camden Town	88.4	114.9	56.3	66.5	73.9	84.9	85.6	77.3	65.9	53.1
Camden Town to Chalk Farm	77.2	108.9	56.5	66.4	69.1	73.0	72.2	65.9	60.6	56.1
Chalk Farm to Belsize Park	75.7	105.8	51.7	63.4	67.7	72.4	70.0	63.4	57.7	50.0
Belsize Park to Hampstead	75.3	104.3	53.3	64.1	67.4	71.4	69.8	64.6	58.5	46.7
Hampstead to Golders Green	79.7	111.2	55.3	66.8	70.6	76.3	74.4	70.6	61.0	48.9
Golders Green to Brent Cross	69.8	103.6	49.2	59.0	63.9	65.8	63.0	59.3	54.8	45.2
Brent Cross to Hendon Central	65.5	101.5	48.7	55.5	57.3	60.5	60.1	56.7	51.6	39.8
Hendon Central to Colindale	79.1	108.0	51.2	64.9	66.9	75.9	75.6	64.9	55.5	42.0
Colindale to Burnt Oak	64.6	102.1	46.3	54.7	56.8	59.2	59.2	55.9	51.6	41.5
Burnt Oak to Edgware	64.5	101.4	47.3	54.6	56.4	60.1	58.6	55.1	50.1	37.7

Table 3 – Interstation noise levels for between Finchley Central and Mill Hill East

Interstation Section	L _{Aeq} dB(A)	L _{Cpeak} dB(C)	A-Weighted Noise Spectral Analysis in Octave (Hz)							
			63	125	250	500	1000	2000	4000	8000
Finchley Central to Mill Hill East	66.7	106.4	48.4	60.0	58.6	60.4	61.1	57.9	55.2	45.2



Table 4 – Interstation noise levels for the northbound road between Kennington and High Barnet (via Charing Cross)

Interstation Section	L _{Aeq} dB(A)	L _{Cpeak} dB(C)	A-Weighted Noise Spectral Analysis in Octave (Hz)							
			63	125	250	500	1000	2000	4000	8000
Kennington to Waterloo	80.0	110.2	55.8	67.7	72.6	76.3	74.6	69.9	61.0	48.3
Waterloo to Embankment	80.8	109.2	55.5	68.5	71.4	78.1	75.6	67.9	61.2	45.4
Embankment to Charing Cross	75.3	108.6	58.3	67.1	68.6	70.2	69.4	63.9	57.5	45.2
Charing Cross to Leicester Square	80.6	110.1	58.5	68.7	74.3	75.9	74.5	71.4	66.5	53.3
Leicester Square to Tottenham Court Road	73.0	104.4	54.0	63.0	66.1	68.6	67.5	61.3	54.4	40.2
Tottenham Court Road to Goodge Street	80.2	108.3	53.4	65.5	72.8	78.0	74.0	66.5	57.9	44.7
Goodge Street to Warren Street	75.7	108.3	56.1	67.0	67.9	71.5	70.3	63.9	55.4	41.6
Warren Street to Euston	83.6	116.0	65.9	72.6	74.3	78.1	79.6	74.6	67.1	52.6
Euston to Mornington Crescent	82.8	113.0	52.3	63.9	76.3	80.1	76.8	68.3	59.8	48.8
Mornington Crescent to Camden Town	76.7	109.1	57.2	67.4	70.0	72.0	70.8	66.7	59.0	45.5
Camden Town to Kentish Town	89.4	115.2	51.1	63.1	74.1	84.9	87.1	79.2	64.7	48.5
Kentish Town to Tufnell Park	85.8	113.3	58.1	68.4	74.9	82.9	82.0	72.7	60.7	46.6
Tufnell Park to Archway	77.4	109.0	58.1	68.2	69.9	75.8	75.3	67.8	58.5	45.5
Archway to Highgate	77.4	109.0	54.4	65.2	69.2	73.1	72.7	67.5	57.7	45.6
Highgate to East Finchley	76.5	106.8	52.3	60.5	63.7	69.8	73.5	69.8	56.4	42.8
East Finchley to Finchley Central	66.6	103.5	47.9	55.0	55.3	62.7	61.3	58.6	48.4	36.2
Finchley Central to West Finchley	66.4	102.1	49.0	57.4	55.7	63.6	59.5	53.1	46.3	36.8
West Finchley to Woodside Park	64.5	99.3	48.5	54.4	53.9	57.0	58.7	59.9	50.4	31.3
Woodside Park to Totteridge & Whetstone	64.3	100.9	50.0	56.4	55.6	58.2	58.7	56.8	45.2	33.2
Totteridge & Whetstone to High Barnet	64.0	100.7	49.4	55.7	55.1	58.4	58.2	56.5	44.1	33.6

Table 5 – Interstation noise levels for the southbound road between Edgware and Morden (via Bank)

Interstation Section	L _{Aeq} dB(A)	L _{Cpeak} dB(C)	A-Weighted Noise Spectral Analysis in Octave (Hz)							
			63	125	250	500	1000	2000	4000	8000
Edgware to Burnt Oak	67.6	108.8	47.0	55.5	56.8	62.1	62.7	60.5	55.5	45.2
Burnt Oak to Colindale	65.9	103.3	45.6	54.8	57.0	61.0	61.3	56.3	52.5	42.1
Colindale to Hendon Central	76.2	115.2	51.7	61.6	63.8	72.9	71.9	64.5	57.1	45.4
Hendon Central to Brent Cross	66.9	101.4	47.3	55.5	57.2	61.6	62.7	57.9	53.9	44.2
Brent Cross to Golders Green	69.8	104.4	48.6	59.3	64.3	65.7	63.7	57.9	53.0	42.4
Golders Green to Hampstead	80.2	115.5	55.1	68.9	71.0	77.4	75.1	67.6	58.4	46.4
Hampstead to Belsize Park	74.8	104.8	52.1	64.3	67.0	70.9	69.6	64.2	56.8	48.3
Belsize Park to Chalk Farm	75.1	110.5	50.8	63.5	66.7	71.4	70.0	64.0	56.1	46.2
Chalk Farm to Camden Town	77.3	111.8	56.0	69.3	69.1	73.2	71.9	64.3	57.2	47.1
Camden Town to Euston	85.8	112.7	53.7	67.8	73.7	83.4	81.8	71.7	60.2	47.7
Euston to King's Cross St. Pancras	72.4	105.9	54.4	64.3	66.2	67.5	65.8	61.3	56.9	48.3
King's Cross St. Pancras to Angel	75.5	108.4	52.2	63.7	66.4	69.7	67.8	61.9	54.6	43.2
Angel to Old Street	79.5	114	58.0	69.4	70.0	75.9	74.9	67.7	59.5	46.8
Old Street to Moorgate	71.3	103.8	51.6	62.2	65.3	67.1	64.7	59.3	54.1	42.4
Moorgate to Bank	76.4	106.9	53.2	62.7	64.7	72.9	73.0	63.6	57.7	42.2
Bank to London Bridge	80.1	111.9	57.8	69.1	72.8	77.5	74.2	66.5	59.3	49.7
London Bridge to Borough	78.9	108.6	53.2	66.7	71.6	76.0	73.3	63.8	56.8	47.0
Borough to Elephant and Castle	73.6	106.0	52.5	60.0	63.8	71.7	66.6	59.8	54.8	46.6
Elephant and Castle to Kennington	81.1	112.7	54.0	62.2	73.0	78.9	74.9	66.0	56.2	42.6
Kennington to Oval	73.6	112.4	53.9	65.2	67.1	68.9	67.5	62.2	55.2	42.3
Oval to Stockwell	72.8	115.4	52.8	64.1	66.3	68.6	66.7	61.0	53.6	43.9
Stockwell to Clapham North	78.9	105.8	50.2	66.1	64.8	76.7	74.0	62.7	53.9	41.7
Clapham North to Clapham Common	73.8	104.2	53.4	62.2	64.7	71.1	67.7	60.5	54.8	43.4
Clapham Common to Clapham South	74.7	109.1	52.7	62.5	65.5	72.4	68.2	61.3	53.4	41.5
Clapham South to Balham	74.5	106.9	51.2	63.0	66.2	70.8	69.4	63.2	57.5	49.5
Balham to Tooting Bec	74.4	105.2	53.7	65.1	67.0	69.7	69.0	64.0	57.1	48.0
Tooting Bec to Tooting Broadway	72.8	106.4	51.9	63.7	66.3	68.6	66.7	61.0	54.1	45.4
Tooting Broadway to Colliers Wood	74.0	112.7	52.3	64.0	67.4	69.7	67.8	63.8	56.7	43.9
Colliers Wood to South Wimbledon	74.0	107.9	52.2	63.2	67.1	69.3	68.2	65.0	58.6	46.7
South Wimbledon to Morden	84.1	112.8	50.5	62.7	71.2	80.8	80.9	73.6	60.0	45.4



Table 6 – Interstation noise levels for between Mill Hill East and Finchley Central

Interstation Section	L _{Aeq} dB(A)	L _{Cpeak} dB(C)	A-Weighted Noise Spectral Analysis in Octave (Hz)							
			63	125	250	500	1000	2000	4000	8000
Mill Hill East to Finchley Central	63.9	105.1	46.8	54.5	55.8	58.3	58.8	55.0	51.8	41.6

Table 7 – Interstation noise levels for the southbound road between High Barnet and Kennington (via Charing Cross)

Interstation Section	L _{Aeq} dB(A)	L _{Cpeak} dB(C)	A-Weighted Noise Spectral Analysis in Octave (Hz)							
			63	125	250	500	1000	2000	4000	8000
High Barnet to Totteridge & Whetstone	67.0	104.5	48.0	56.0	58.0	62.4	61.3	59.2	53.1	38.4
Totteridge & Whetstone to Woodside Park	66.9	107.2	50.1	57.6	58.1	61.4	61.3	58.7	54.7	45.5
Woodside Park to West Finchley	64.4	97.2	48.8	55.2	56.0	59.3	59.4	54.8	48.5	37.0
West Finchley to Finchley Central	67.1	104.2	48.5	58.6	59.7	63.0	60.3	55.9	50.4	40.9
Finchley Central to East Finchley	68.3	104.5	50.4	58.1	58.5	63.4	63.8	58.7	52.1	42.4
East Finchley to Highgate	74.3	109.3	49.8	59.2	63.4	68.9	70.9	65.8	56.9	41.0
Highgate to Archway	79.1	108.3	53.3	65.0	70.2	76.1	73.8	67.7	59.1	46.8
Archway to Tufnell Park	79.5	109.2	53.2	66.2	71.1	76.2	74.6	67.3	59.4	46.9
Tufnell Park to Kentish Town	77.8	106.7	54.0	67.1	69.6	73.9	72.2	66.7	60.3	50.7
Kentish Town to Camden Town	88.5	114.5	52.5	64.9	73.9	84.5	85.9	78.1	64.3	47.4
Camden Town to Mornington Crescent	75.8	106.7	53.0	64.7	69.4	73.1	68.0	62.4	55.5	43.3
Mornington Crescent to Euston	82.3	115.5	62.3	73.9	75.2	77.4	76.9	71.4	64.0	52.4
Euston to Warren Street	84.2	115.3	63.8	74.3	75.7	80.4	78.9	72.9	64.8	54.4
Warren Street to Goadge Street	76.1	109.2	54.9	66.8	69.9	70.8	70.7	65.9	58.6	45.8
Goadge Street to Tottenham Court Road	76.2	105.3	53.0	66.7	69.5	70.8	71.1	66.4	59.6	45.4
Tottenham Court Road to Leicester Square	75.0	106.4	54.5	67.7	67.6	68.9	70.4	63.4	56.4	43.0
Leicester Square to Charing Cross	78.3	105.9	53.6	64.7	70.9	75.5	71.6	66.5	61.3	51.6
Charing Cross to Embankment	77.3	108.9	54.2	67.7	70.1	72.9	71.4	66.6	59.6	47.1
Embankment to Waterloo	76.1	104.7	52.6	63.8	68.6	71.9	71.0	66.1	58.5	46.3
Waterloo to Kennington (SB)	81.6	112.9	59.6	69.4	73.1	78.1	76.8	70.8	62.5	49.9
Kennington (SB) to Kennington (NB)	72.1	113.1	53.1	60.4	63.7	67.0	65.6	64.3	62.7	48.5

Charts 1 to 4 show the average weighted noise levels of all runs on each inter station section in a graphical representation. These values are taken from Tables 2 to 7. Levels at stations are not shown since these were often a result of sources such as radio communications, alarms and warnings.

The charts also include the noise levels measured in the previous assessment, undertaken in April 2018, to understand how the noise exposure has changed during the last 12 months.



Chart 1 - Average weighted noise levels on the Northern northbound road between Morden and Edgware (via Bank) and the Mill Hill East branch

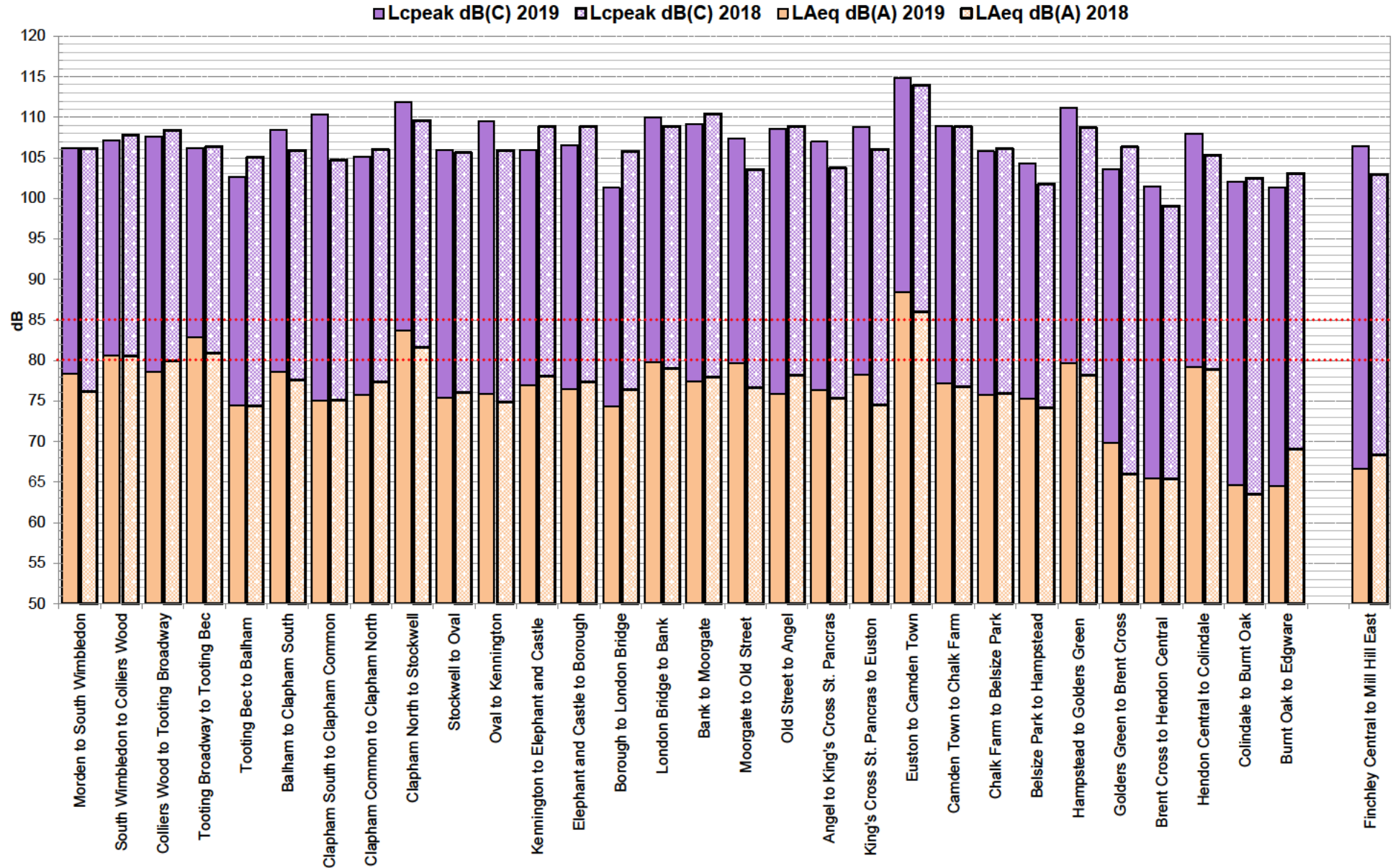




Chart 2 – Average weighted noise levels, on the Northern northbound road between Kennington and High Barnet (via Charing Cross)

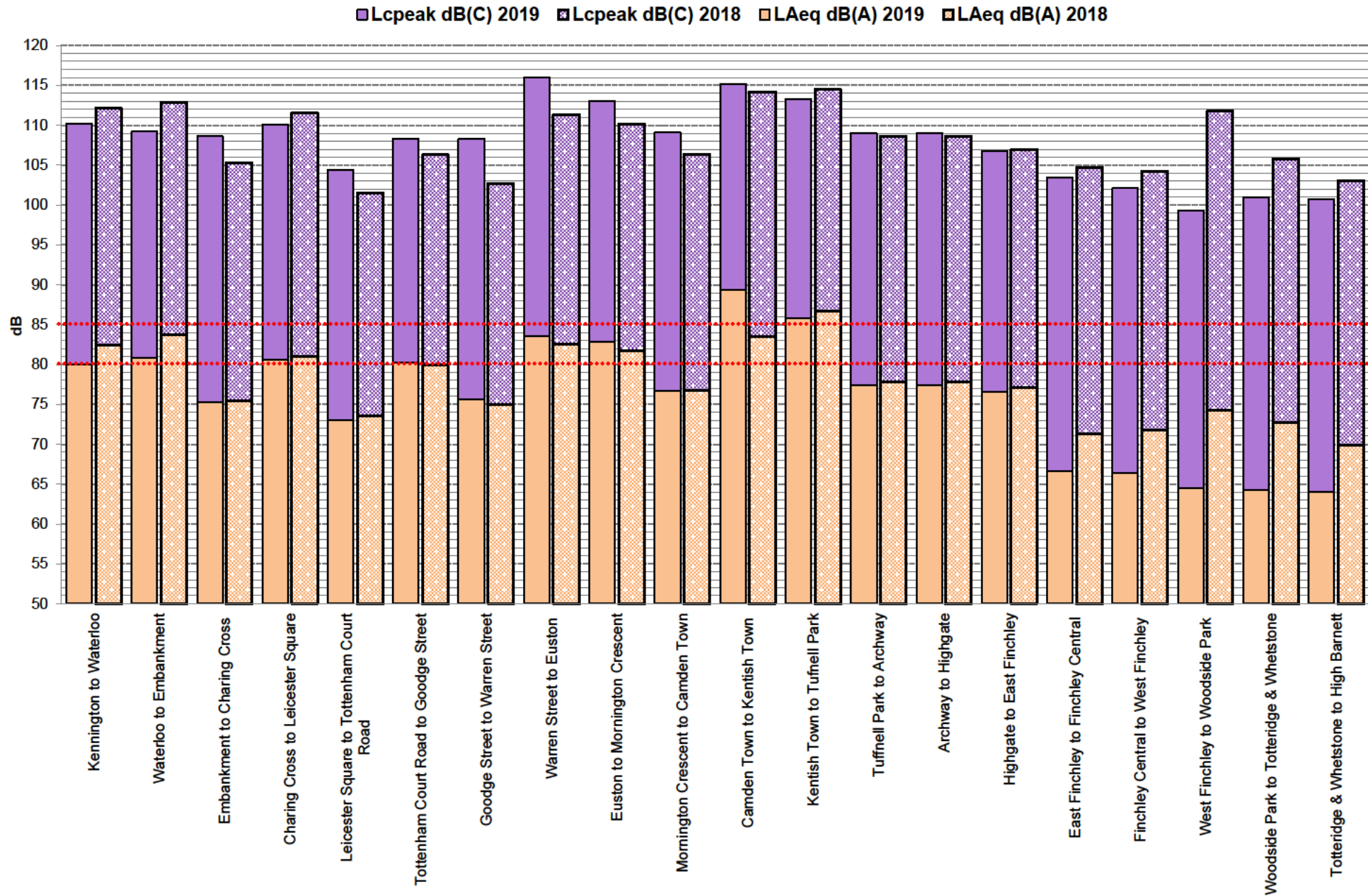




Chart 3 – Average weighted noise levels, on the Northern southbound road between Edgware and Morden (via Bank)

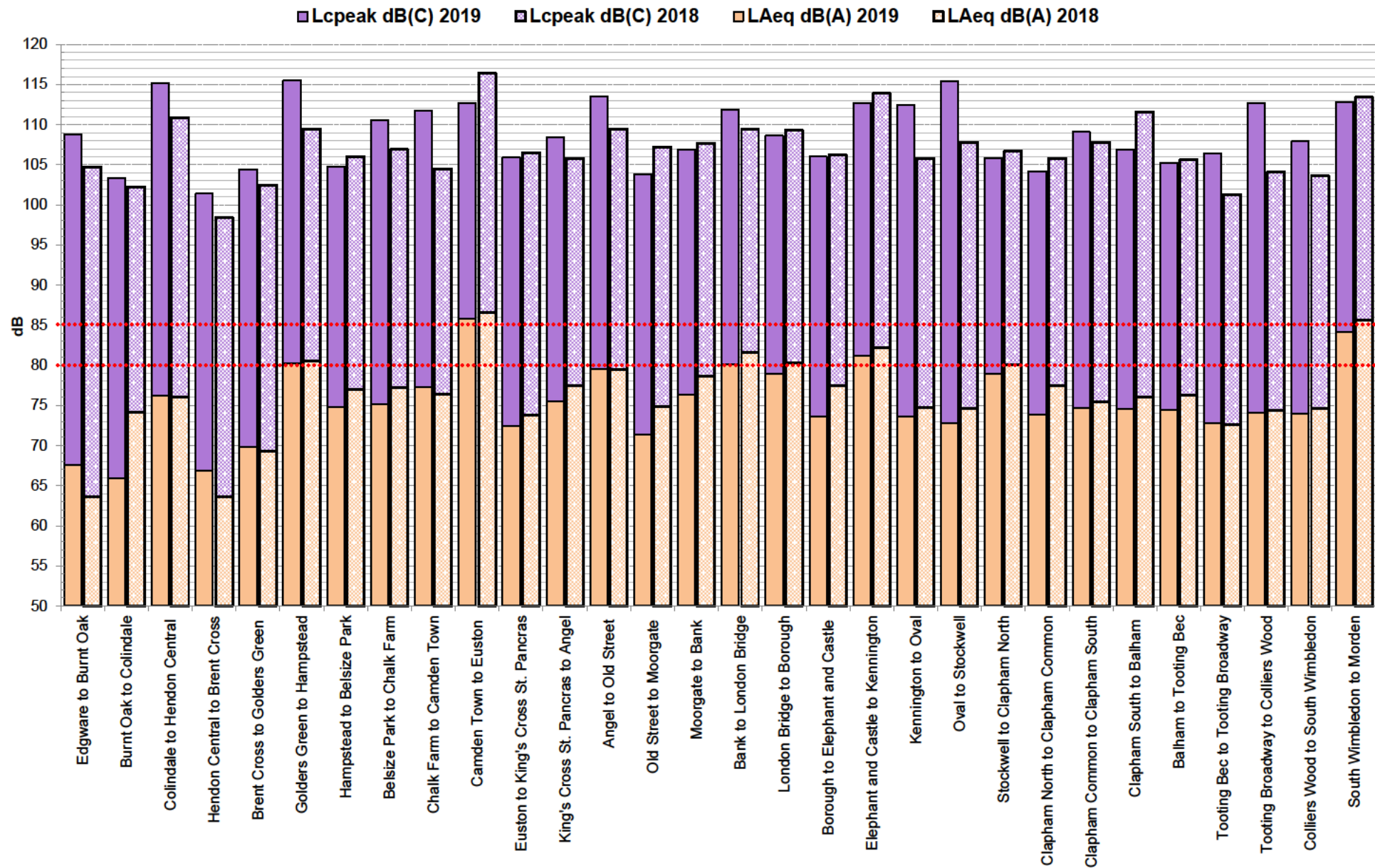
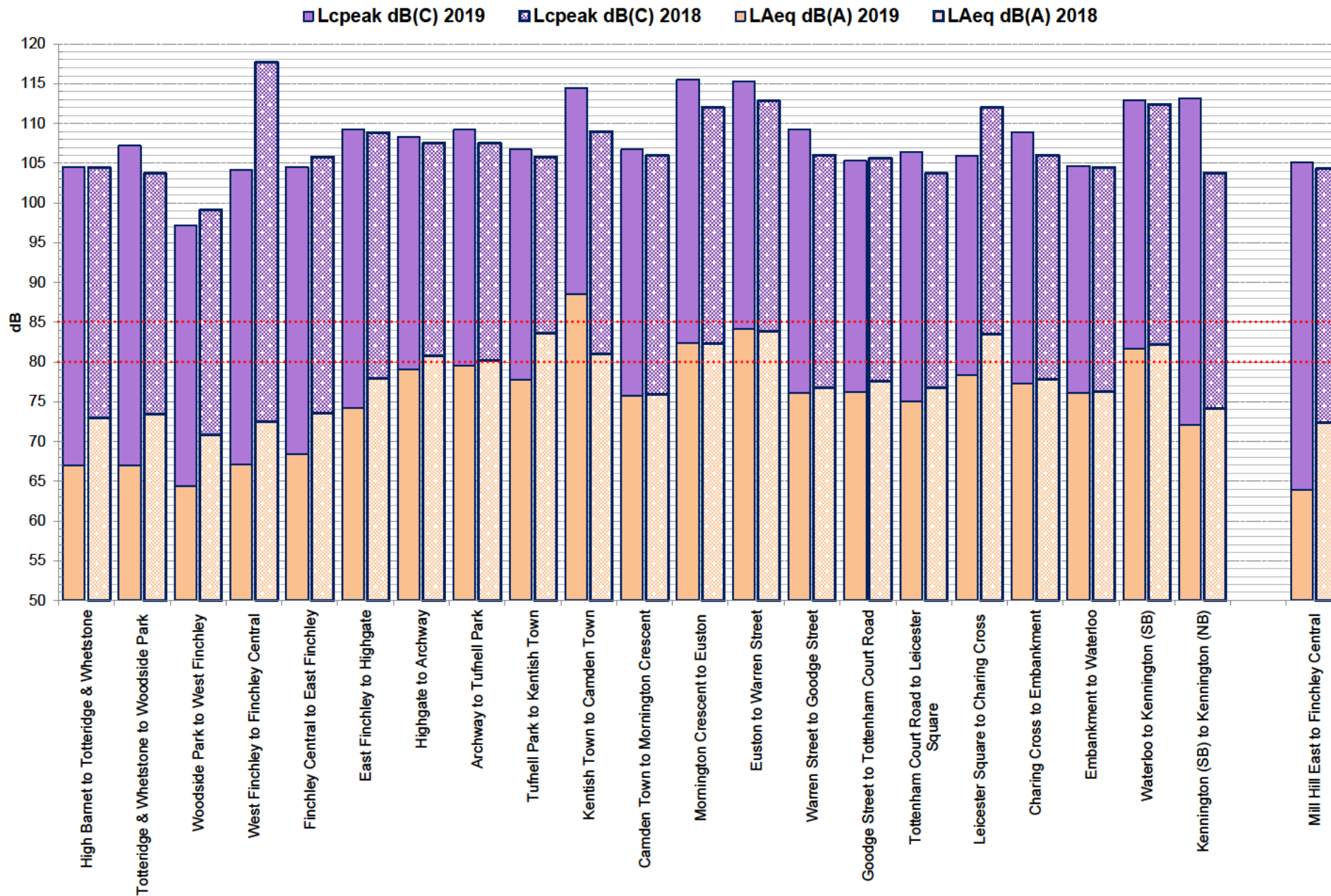




Chart 4 – Average weighted noise levels, on the Northern southbound road between High Barnet and Kennington (via Charing Cross)





The main differences between measurements on the same day are differences in the measured cabs, as each run is on a different train. The track condition on the same day is very unlikely to change. Other things that could affect the results are train speed, cab announcements, drivers talking on the radio and stops at signals.

The calculated daily noise exposure level for train operators is based on the noise level at ear level and is a log average of all the inter-station sections travelled as well as the noise when stopped at signals. The noise level during breaks and stops as well as the noise level at stations are ignored in this report, as these levels are considerably lower when compared to the cab noise levels when the train is moving.

Tables 2 to 7, show that several inter-station sections **reached or exceeded 80dB_{L_{Aeq}}**; **eight on the northbound Charing Cross branch, seven on the northbound Bank branch, six on the southbound Bank branch and five on the southbound Charing Cross branch.**

Regarding sections that **reached or exceeded 85dB L_{Aeq}**, **two on the northbound Charing Cross branch, two on the southbound Bank branch and one on the southbound Charing Cross branch** met this condition.

The top three inter station sections with the highest noise levels for each of the measured directions are shown below.

- **Northbound** – Camden Town to Kentish Town; Euston to Camden Town ; and Kentish Town to Tufnell Park
- **Southbound** – Kentish Town to Camden Town; Camden Town to Euston; Euston to Warren Street

4. Daily Exposure L_{EP,d} Levels

The daily exposure L_{EP,d} levels for train operators of the Northern line, found in table 8, were based on the train operator duties. The duty books all apply from 28th January 2018 until further notice (working Timetable 57).

The calculations were based on a sample of 36 duties. These were representative of the spread of duration of the different duties and the different start and end points of the runs. The duties selected ranged between 4 to 8h in duration.

In order to calculate the L_{EP,d} of each trip, they were partitioned into inter station sections. Each inter station exposure level was calculated based on the average value of all runs and the average time between station taken from all runs.

To obtain the total exposure level, all the partial exposures comprised in a specific duty were added, and a L_{EP,d} exposure level was achieved. The table below shows the total duration of the duties chosen for the analysis.

Table 8 – Duration of the duties chosen for the daily exposure calculations

	Driving time (h:min)	L _{EP,d} dB(A)		Driving time (h:min)	L _{EP,d} dB(A)		Driving time (h:min)	L _{EP,d} dB(A)		Driving time (h:min)	L _{EP,d} dB(A)
401	03:43	76	601	02:47	75	301	03:48	76	801	02:47	75
402	03:51	76	602	03:28	75	302	03:46	76	802	04:08	76
403	04:11	76	603	03:26	76	303	04:28	77	803	02:55	75
404	03:06	75	604	03:26	76	304	04:10	76	804	02:47	75
405	03:28	75	605	03:28	75	305	03:24	76	805	04:09	76
406	03:28	75	606	04:52	77	306	04:15	77	806	03:50	77
407	03:07	75	607	02:44	75	307	03:06	75	807	02:40	75
413	04:18	76	610	02:44	75	308	03:15	75	808	03:26	75
415	03:18	76	612	03:28	75	315	03:46	76	809	04:01	76



5. Conclusions

- **The daily exposure levels presented in Table 8 is a worst-case scenario. If dwell times at stations, meal breaks and time waiting to pick up trains were to be included in the measurements, the overall noise exposure would be lower, albeit negligibly. As such, the presented exposure levels are only representative of train operation.**
- **Daily exposure levels are greatly influenced by interstation sections with noise levels above 80dB(A).**
- The 1995 Tube Stock cab noise is dominated by rolling contact noise. This airborne noise outside the train influences the noise levels inside the cab.
- There are two methods to reduce the rolling noise in the cab: the noise can be reduced at source and/or the transmission path can be inhibited.
- The transmission path of the airborne rolling noise includes paths through the cab side doors. Reduced cab sealing will increase noise levels. It should be noted that the microphone position during the measurements, was located next to the left hand side ear of the train operator, i.e. close to the ear closest to the cab door and most affected by noise.
- There are sections of the Northern line track that have corrugation (high rail roughness). Corrugation increases rolling noise and thus cab noise levels. In addition, resilient track has been installed in certain sections to cope with groundborne noise, which had a side effect of increased in-tunnel noise.
- As the daily exposures show, overall noise levels were generally lower, when compared to April 2018. The greater differences were found north of East Finchley with reductions of up to 10dB. However, on the interstation section of Camden Town to Kentish Town, a 6 and 7dB increase was measured on the north and south bound road respectively.
- Several inter-station sections exceeded 80dB L_{Aeq} . However, only five inter-station sections exceeded 85dB L_{Aeq} , namely two on the northbound Charing Cross branch, two on the southbound Bank branch and one on the southbound Charing Cross branch.
- All duties presented a daily exposure level below the Lower Exposure Action Value (LEAV) for continuous noise at an $L_{EP,d}$ of 80dB(A).
- If considered, noise levels during breaks and dwelling in stations would result in lower daily exposure levels. However, a conservative approach should be considered given the uncertainty of the measurements and calculations, despite the reduced likelihood of levels exceeding 80dB(A). Information should be provided to TOP's and hearing protection should be made available for their comfort.
- Provided ear defenders should have low attenuation (5-10 dBA) to avoid over-protection, which could lead to train operators having difficulties with communication and hearing warning signals. They may also become isolated from their environment, leading to safety risks.
- **Nevertheless, train operators are not at risk of reaching or exceeding the daily UEAV within an 8-hour working day.**
- All of the measured inter-station sections measured below the LEAV for impulsive noise, namely an instantaneous C-weighted peak level (L_{Cpk}) of 135 dB(C). The highest peak level, 116dB(C), was recorded between Warren Street and Euston.



6. References

1. Statutory Instrument 2005 No. 1643. The Control of Noise at Work Regulations 2005.
2. Controlling Noise at Work, Guidance Document L108, Health and Safety Executive 2005.
3. Health and Safety Executive Daily Noise Exposure Calculator
www.hse.gov.uk/noise/dailycalc.xls



APPENDIX A – Equipment Details

Table A.1 – Equipment used for the train operator noise exposure measurements

Item	Make	Model	Serial No.
Sound Level Meter	01dB	Fusion	11489



APPENDIX B – Full Line Testing Results

Table B.1 – Inter-station noise levels on the Northern northbound road between Morden and Edgware (via Bank) and the Mill Hill East branch

Interstation section	L _{Aeq} dB(A)	L _{Cpeak} dB(C)	Noise Spectral Analysis in Octave (Hz)							
			63	125	250	500	1000	2000	4000	8000
Morden To South Wimbledon	78.7	106.2	52.8	64.2	69.2	76.7	72.1	65.7	59.5	45.7
	77.9	105.7	55.4	65	68.3	76	71.7	63.7	56.6	45
	78.4	106.2	55.8	65.9	68.8	76.3	72.4	64.8	57.4	46
South Wimbledon to Colliers Wood	81.4	107.2	51.6	63.9	72.5	79.0	75.6	67.6	60.9	51.5
	80.3	106.9	52.1	64	71.8	77.9	74.6	65.1	61	57.6
	80.1	105.4	52	64.2	71.5	77.6	74.6	65.6	60.2	56
Colliers Wood To Tooting Broadway	78.8	107.0	52.5	65.3	72.9	75.5	71.8	65.7	59.8	46.7
	78.6	107.6	54.7	66.2	72.7	75.7	71.4	64.1	56.9	45.0
	78.3	105.5	54.2	66.1	72.3	75.3	71.3	63.7	56.1	44.0
Tooting Broadway to Tooting Bec	83.2	106.2	49.6	59.5	73.5	81.3	78.4	66.7	59.4	46.1
	82.8	105.5	50.5	58.0	72.4	81.0	78.5	65.7	58.0	52.8
	82.7	106.2	50.2	57.9	71.1	80.4	79.2	65.2	57.0	48.8
Tooting Bec To Balham	74.6	102.6	50.4	62.1	67.8	70.8	68.5	64.1	59.0	47.5
	74.1	102.4	52.6	62.5	66.8	70.6	68.3	61.5	58.5	56.7
	74.6	102.0	52.8	63.0	66.9	70.6	69.2	62.5	59.0	56.5
Balham To Clapham South	79.0	108.4	51.6	66.3	69.5	76.3	73.1	66.7	61.2	47.5
	78.6	105.9	53.5	65.6	68.5	76.0	73.0	64.8	60.2	56.2
	78.3	105.3	53.3	65.8	68.3	75.6	72.6	64.8	59.5	52.7
Clapham South to Clapham Common	75.7	107.5	52.1	63.4	68.4	72.0	69.8	64.3	59.3	48.0
	74.8	109.1	54.2	63.3	67.7	71.5	68.7	61.5	56.1	50.9
	74.7	110.3	54.4	63.6	67.7	71.1	68.8	61.5	55.4	44.1
Clapham Common to Clapham North	76.2	104.0	53.0	59.8	66.7	74.7	68.8	62.6	58.4	44.7
	75.8	105.1	53.3	58.3	65.4	74.7	68.9	60.4	57.1	49.1
	75.4	104.8	53.6	58.8	64.9	73.9	69	59.9	53.6	40.7
Clapham North to Stockwell	83.0	109.4	49.9	62	71.3	80.7	79.1	69.5	61.9	45.4
	83.8	111.9	50.9	61.6	71.2	82.2	79.5	68.1	57.9	46.4
	84.2	110.3	51.4	62.6	70.9	81.5	81.4	68.5	58.2	46.4
Stockwell to Oval	76.0	105.4	51.5	62.7	67.3	71.5	72.1	64.4	58.7	45.5
	74.8	106.0	52.6	62.4	66	70.5	71.1	61.7	54.3	42.6
	75.2	105.2	52.7	62.8	66.1	70.8	71.8	61.6	54.2	42.1
Oval to Kennington	75.9	107.4	54.5	64.9	69.5	71.8	70.0	64.8	59.2	45.5
	75.8	109.4	57.2	65.5	69.0	71.7	70.0	63.7	56.3	44.2
	76.1	109.5	57.4	65.8	69.2	71.6	70.8	65.0	57.5	44.3
Kennington to Elephant and Castle	78.2	105.9	52.1	61.9	69.5	76.6	69.6	64.0	60.8	49.4
	76.4	105.3	53.9	61.8	68.6	73.5	70.2	63.5	63.3	55.3
	75.8	104.1	54.1	62.0	68.3	73.3	68.0	62.6	62.8	54.1
Elephant and Castle to Borough	77.2	105.2	53.4	62.4	67.7	75.7	69.4	63.6	59.0	48.2
	76.0	106.6	55.7	62.0	66.5	74.5	68.1	61.7	56.0	48.8
	76.0	105.4	55.6	62.3	66.4	74.2	69.3	62.0	55.1	47.3
Borough to London Bridge	75.3	101.3	49.5	59.1	65.4	72.0	70.1	63.4	63.6	54.0
	73.3	100.9	51.2	58.0	63.3	70.5	68.3	59.7	53.3	45.9
	74.0	100.2	52.3	58.6	63.8	71.1	69.4	59.6	52.5	40.5
London Bridge to Bank	81.3	110.0	53.5	66.8	71.8	78.0	76.2	70.8	63.6	52.2
	78.8	107.9	54.5	66.6	70.2	75.7	72.9	67.0	63.7	59.2
	78.9	107.9	54.7	67.1	70.5	75.7	72.8	67.1	63.3	57.5
Bank to Moorgate	79.2	109.2	56.3	64.2	68.9	77.7	70.6	65.7	60.0	49.3
	76.2	108.7	57.1	64.4	68.0	73.4	70.2	63.9	58.1	49.1
	76.1	108.8	57.3	64.9	68.2	73.3	69.6	63.1	56.8	47.3
Moorgate to Old Street	80.1	107.4	48.9	59.8	68.2	79.3	73.5	63.6	57.9	46.1
	79.2	107.0	49.9	58.8	66.8	77.9	74.0	62.1	59.8	54.6
	79.5	107.0	50.8	59.3	66.6	78.2	74.6	61.5	58.4	51.3



Interstation section	L _{Aeq} dB(A)	L _{Cpeak} dB(C)	Noise Spectral Analysis in Octave (Hz)							
			63	125	250	500	1000	2000	4000	8000
Old Street to Angel	76.2	106.1	52.5	62.3	67.7	72.9	70.8	65.6	61.4	49.4
	75.4	108.6	53.7	61.7	66.5	71.9	70.7	63.6	58.5	51.6
	75.9	107.3	54.6	62.3	66.9	72.6	71.0	63.7	59.1	52.6
Angel to King's Cross St. Pancras	76.9	107.0	51.2	63.0	67.6	74.1	71.1	64.7	60.1	50.0
	75.7	104.6	52.8	62.8	66.3	72.3	71.2	62.3	55.7	43.5
	76.2	106.5	53.2	63.3	66.5	73.3	70.8	62.3	58.5	54.2
King's Cross St. Pancras to Euston	79.1	106.7	56.1	67.1	71.0	75.8	73.1	67.8	62.3	55.6
	77.7	107.3	56.9	67.0	69.8	73.9	72.4	65.9	59.1	49.0
	77.7	108.8	57.0	67.5	70.1	73.6	72.2	66.1	60.7	53.8
Euston to Camden Town	88.6	112.8	55.1	66.4	73.6	85.4	85.5	77.3	66.4	52.2
	88.7	114.7	56.8	66.3	74.1	84.8	86.1	77.9	66.4	54.3
	87.9	114.9	56.8	66.9	74.1	84.4	85.1	76.5	64.8	52.5
Camden Town to Chalk Farm	77.6	106.5	54.6	66.0	69.7	73.8	72.1	66.6	61.2	53.4
	77.2	108.6	57.3	66.3	68.7	73.0	72.4	65.6	60.2	57.0
	76.9	108.9	57.1	66.8	68.8	72.2	72.2	65.5	60.2	57.1
Chalk Farm to Belsize Park	76.5	105.8	50.7	63.2	68.2	73.5	70.5	64.9	59.4	48.5
	75.3	104.8	52.0	63.2	67.3	72.1	69.7	62.5	57.0	52.3
	75.2	105.1	52.2	63.9	67.5	71.4	69.7	62.4	55.9	47.8
Belsize Park to Hampstead	76.0	104.3	51.6	63.5	68.0	71.9	70.2	66.9	60.6	47.6
	75.0	103.0	53.9	64.2	67.0	71.3	69.6	62.8	56.8	47.6
	74.9	103.6	53.9	64.6	67.0	70.9	69.7	62.7	57.0	43.8
Hampstead to Golders Green	80.9	110.6	54.2	67.1	71.1	77.5	74.9	73.8	63.7	48.3
	79.1	110.1	56.0	66.5	70.4	76.1	74.1	67.5	59.0	49.8
	78.7	111.2	55.5	66.9	70.3	75.0	74.3	66.5	58.2	48.3
Golders Green to Brent Cross	72.5	102.1	51.2	59.9	65.0	69.1	65.8	62.9	57.7	44.9
	67.8	103.6	48.0	58.6	63.0	62.5	61.0	56.3	54.3	48.2
	67.0	101.9	47.3	58.2	63.6	61.8	59.7	52.8	45.9	33.2
Brent Cross to Hendon Central	67.4	101.5	49.6	57.2	59.9	62.3	61.1	59.4	55.7	43.7
	64.6	99.0	48.2	54.6	55.1	59.6	60.3	54.8	44.9	34.5
	63.4	97.0	48.2	53.8	54.7	58.9	58.5	53.4	45.1	34.2
Hendon Central to Colindale	78.4	107.3	51.1	65.5	67.5	75.2	74.6	64.5	57.8	43.5
	79.6	107.8	51.5	64.7	66.6	76.1	76.4	64.1	53.3	39.2
	79.3	108.0	51.1	64.4	66.4	76.2	75.7	66.0	53.9	42.2
Colindale to Burnt Oak	66.4	99.6	48.3	56.8	59.5	61.2	59.8	58.1	54.5	41.1
	64.4	102.1	45.1	53.4	54.5	58.4	60.3	56.2	51.3	44.4
	61.8	101.0	44.6	52.8	54.1	56.8	56.9	50.7	43.4	32.7
Burnt Oak to Edgware	66.6	101.4	49.2	56.6	59.4	61.8	59.9	58.3	54.3	41.3
	64.0	100.3	47.0	53.7	54.7	60.3	58.8	53.1	43.4	33.7
	61.3	99.9	44.2	52.3	52.0	57.1	56.3	49.5	42.4	32.3

Table B.2 – Inter-station noise levels on the Northern northbound road between Kennington and High Barnet (via Charing Cross)

Interstation section	L _{Aeq} dB(A)	L _{Cpeak} dB(C)	Noise Spectral Analysis in Octave (Hz)							
			63	125	250	500	1000	2000	4000	8000
Kennington to Waterloo	80.6	110.0	56.3	67.4	73.0	76.9	75.4	70.5	59.9	48.0
	78.4	110.1	54.3	67.3	71.1	74.9	72.3	67.8	59.5	45.7
	80.7	110.2	56.4	68.2	73.5	76.7	75.4	70.7	62.9	50.2
Waterloo to Embankment	80.9	108.0	56.4	67.7	71.7	78.1	76.1	67.1	62.5	46.5
	79.9	106.1	53.8	67.8	70.2	77.4	73.7	68.8	61.2	43.3
	81.5	109.2	55.8	69.7	72.1	78.7	76.6	67.5	59.5	45.7
Embankment to Charing Cross	75.7	107.8	58.2	66.5	68.7	70.4	70.7	64.9	58.8	46.8
	73.9	106.0	56.2	66.2	67.2	69.7	67.0	61.7	55.4	43.3
	75.9	108.6	59.8	68.3	69.5	70.5	69.8	64.5	57.6	44.7
Charing Cross to Leicester Square	81.3	110.1	58.4	68.1	74.8	76.2	74.9	73.9	69.9	55.4
	78.8	107.6	57.3	68.2	73.0	74.8	72.1	67.1	61.0	49.8
	81.2	109.8	59.5	69.7	74.9	76.6	75.8	70.8	64.0	52.9
Leicester Square to Tottenham Court Road	73.8	104.4	54.8	63.0	66.6	69.3	68.9	62.2	53.8	39.1
	70.8	101.6	52.8	61.7	64.0	66.8	64.3	59.4	52.8	39.5
	73.7	103.4	54.2	63.9	67.2	69.3	68.1	61.9	55.9	41.5



Interstation section	L _{Aeq} dB(A)	L _{Cpeak} dB(C)	Noise Spectral Analysis in Octave (Hz)							
			63	125	250	500	1000	2000	4000	8000
Tottenham Court Road to Goodge Street	80.8	107.7	53.7	65.0	73.1	78.8	74.6	66.5	56.4	43.1
	78.8	107.3	52.4	65.2	71.5	76.7	71.6	65.0	56.9	43.5
	80.8	108.3	54.0	66.3	73.5	78.1	75.0	67.7	59.7	46.6
Goodge Street to Warren Street	76.6	106.2	56.4	66.8	68.4	72.1	72.1	65.1	54.9	39.9
	74.1	105.0	54.3	66.2	66.2	70.5	67.5	62.2	54.3	39.6
	75.9	108.3	57.2	67.8	68.7	71.8	70.0	63.8	56.7	43.9
Warren Street to Euston	84.3	112.9	66.3	72.3	75.3	78.9	80.5	75.6	68.5	51.0
	81.2	111.3	64.6	71.2	72.1	76.7	76.3	71.0	64.2	52.2
	84.5	116.0	66.5	73.8	74.8	78.4	80.8	75.7	67.5	54.0
Euston to Mornington Crescent	82.9	113.0	52.1	63.4	76.7	80.2	77.0	68.5	59.2	49.4
	81.5	108.3	52.0	63.6	75.0	79.2	74.8	66.1	57.5	45.1
	83.7	110.8	52.8	64.6	76.9	80.8	78.0	69.7	61.6	50.3
Mornington Crescent to Camden Town	77.9	109.1	57.3	67.1	71.0	73.0	72.2	69.3	61.4	47.2
	74.8	106.4	55.1	66.2	68.3	71.1	67.2	62.4	55.8	43.4
	76.9	108.7	58.5	68.5	70.3	71.6	71.5	65.9	58.1	44.9
Camden Town to Kentish Town	90.5	115.2	52.1	63.4	74.8	85.9	88.3	80.4	64.8	48.8
	87.8	114.3	49.7	62.8	73.3	83.5	85.5	77.4	64.5	48.2
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Kentish Town to Tufnell Park	86.9	113.3	58.9	68.8	75.8	84.1	83.2	73.7	60.4	45.2
	84.2	110.6	57.1	68.0	73.8	81.3	80.2	71.5	60.9	47.7
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Tufnell Park to Archway	80.5	112.1	59.0	68.5	70.7	76.4	76.8	68.6	58.5	44.8
	78.4	108.4	56.9	67.9	68.8	75.2	73.1	66.7	58.4	46.1
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Archway to Highgate	78.6	108.4	55.0	65.6	70.3	74.2	74.4	68.5	58.3	46.5
	75.6	109.0	53.7	64.8	67.6	71.6	69.8	66.1	57.1	44.5
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Highgate to East Finchley	78.0	106.8	53.4	61.1	64.7	70.2	75.3	71.7	56.7	43.7
	74.3	104.2	50.9	59.8	62.4	69.4	70.5	66.2	56.0	41.6
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East Finchley to Finchley Central	68.6	103.5	47.8	55.3	56.3	65.0	63.3	60.7	50.2	37.9
	62.8	102.6	48.0	54.6	53.9	57.2	57.5	54.6	45.2	33.2
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Finchley Central to West Finchley	67.2	101.9	48.6	57.6	55.9	64.3	61.2	54.8	48.1	38.7
	65.3	102.1	49.4	57.2	55.4	62.8	56.6	50.4	43.0	33.3
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West Finchley to Woodside Park	62.8	98.1	47.4	55.1	54.4	56.4	58.2	54.3	44.2	32.5
	65.7	99.3	49.4	53.5	53.4	57.5	59.1	62.3	52.8	29.7
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Woodside Park to Totteridge & Whetstone	65.1	100.9	51.0	57.6	56.7	58.4	59.7	57.9	45.4	34.2
	63.2	97.7	48.8	54.7	54.0	57.9	57.3	55.4	45.0	31.9
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Totteridge & Whetstone to High Barnett	64.6	100.7	50.2	56.4	56.0	58.8	59.0	57.1	44.5	34.3
	63.3	99.8	48.3	54.8	54.0	58.0	57.3	55.7	43.7	32.7
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Finchley Central to Mill Hill East	63.1	102.4	45.8	53.0	53.7	58.5	59.6	49.7	41.4	30.4
	68.8	102.0	49.4	63.4	60.2	61.5	62.8	61.0	58.1	48.8
	66.4	106.4	49.2	57.7	59.5	60.6	60.2	57.1	55.2	43.3



Table B.3 – Inter-station noise levels on the Northern southbound road between Edgware and Morden (via Bank) and the Mill Hill East branch

Interstation section	L _{Aeq} dB(A)	L _{Cpeak} dB(C)	Noise Spectral Analysis in Octave (Hz)							
			63	125	250	500	1000	2000	4000	8000
Edgware to Burnt Oak	69.4	103.8	47.3	57.2	60.3	64.0	64.7	60.9	57.3	47.7
	67.9	105.3	47.1	55.0	53.3	62.2	62.4	62.6	56.6	44.1
	63.6	108.8	46.7	53.7	52.1	58.4	59.8	54.5	48.3	41.7
Burnt Oak to Colindale	69.1	103.0	46.0	56.9	60.6	63.6	64.6	60.2	56.8	46.4
	62.3	103.3	45.3	53.8	52.2	58.0	57.6	50.5	43.2	31.7
	62.8	101.3	45.4	52.7	52.4	59.5	58.0	50.8	44.5	35.7
Colindale to Hendon Central	75.6	115.2	53.4	63.6	65.1	71.1	71.7	65.1	59.5	48.1
	76.6	109.9	50.9	60.7	63.1	73.9	71.9	62.5	52.0	41.2
	76.2	109.2	50.1	59.5	62.9	73.2	72.0	65.4	56.9	44.2
Hendon Central to Brent Cross	70.5	101.4	48.3	57.6	60.8	65.1	66.6	61.8	58.2	48.5
	62.5	98.6	47.4	54.5	53.0	57.7	57.6	52.0	42.2	30.6
	61.9	97.6	45.8	53.1	52.5	57.4	56.9	52.4	47.2	38.1
Brent Cross to Golders Green	70.8	104.1	49.6	60.4	64.9	65.5	65.1	60.9	57.2	46.6
	69.3	104.4	47.8	59.2	64.5	65.3	63.2	55.2	46.1	34.5
	69.0	103.1	48.1	58.0	63.5	66.3	62.2	54.6	45.9	35.6
Golders Green to Hampstead	79.9	115.5	55.4	69.9	71.5	75.8	75.4	68.7	60.0	47.5
	80.2	110.2	55.0	68.9	70.7	77.3	75.0	67.2	57.8	45.7
	80.6	110.0	54.9	67.7	70.6	78.6	74.9	66.6	56.9	45.9
Hampstead to Belsize Park	75.1	104.8	52.2	65.5	67.6	69.8	70.3	65.8	58.0	47.5
	74.7	103.2	52.4	64.2	66.8	70.8	69.4	63.3	55.8	46.3
	74.7	104.1	51.8	62.8	66.4	71.8	68.9	62.7	56.3	50.1
Belsize Park to Chalk Farm	75.1	110.5	51.8	64.9	67.3	70.0	70.5	65.2	57.5	44.1
	75.1	105.6	50.2	63.1	66.4	71.6	69.9	63.5	55.4	46.4
	75.1	103.8	50.1	61.9	66.2	72.3	69.6	62.8	55.1	47.4
Chalk Farm to Camden Town	77.3	111.8	56.5	70.2	69.9	71.7	72.4	65.8	57.9	43.6
	77.0	108.7	55.7	69.2	68.9	73.0	71.5	63.4	55.9	46.1
	77.5	107.6	55.6	68.2	68.5	74.5	71.7	63.3	57.5	49.6
Camden Town to Euston	85.0	111.5	53.8	69.0	74.6	82.2	81.2	71.0	59.7	46.9
	86.8	111.9	54.0	67.9	74.0	84.4	82.6	72.9	61.7	49.6
	85.4	112.7	53.2	66.1	72.1	83.4	81.4	70.9	58.6	45.7
Euston to King's Cross St. Pancras	73.1	105.3	54.7	65.5	67.0	66.6	67.2	63.0	58.2	46.4
	72.8	105.9	55.2	64.8	66.6	68.1	66.0	61.2	57.1	50.3
	71.1	104.5	53.0	61.7	64.7	67.7	63.6	58.9	54.7	47.3
King's Cross St. Pancras to Angel	73.6	108.4	52.5	64.6	66.9	68.4	68.4	63.1	56.3	43.1
	73.6	107.7	52.0	63.8	66.1	69.9	67.7	61.4	53.1	40.9
	77.9	105.9	54.4	67.0	70.2	73.8	72.6	66.8	60.9	53.9
Angel to Old Street	78.7	113.5	57.9	70.0	70.4	74.5	73.8	67.3	59.2	47.7
	79.6	111.3	58.2	69.6	69.8	75.8	74.9	69.3	61.4	47.8
	80.0	110.9	57.8	68.3	69.8	77.1	75.7	66.0	56.7	44.0
Old Street to Moorgate	71.8	102.5	51.6	63.0	66.0	66.4	65.8	61.3	57.0	45.6
	72.2	103.8	52.2	63.4	66.0	68.3	65.3	58.5	49.7	35.2
	69.5	102.8	50.9	59.3	63.4	66.2	62.2	56.7	52.6	41.0
Moorgate to Bank	75.3	105.9	53.8	64.2	65.9	72.5	70.2	62.3	55.8	43.3
	76.9	106.9	53.9	63.6	65.3	73.5	73.8	61.9	53.7	42.2
	76.7	106.5	51.6	58.3	62.1	72.7	74.0	65.6	60.6	40.7
Bank to London Bridge	81.4	111.9	59.9	72.7	75.0	77.3	75.7	69.2	61.5	52.0
	79.2	107.7	56.4	65.4	70.8	76.9	73.7	65.0	59.4	49.7
	79.5	106.7	55.9	63.8	71.1	78.2	72.8	63.1	54.7	44.4
London Bridge to Borough	79.1	108.2	53.7	68.1	72.0	75.6	74.0	65.0	58.5	48.5
	78.6	105.6	53.3	66.3	70.9	76.0	72.1	62.5	55.2	45.2
	79.1	108.6	52.5	65.0	71.9	76.3	73.5	63.5	56.0	46.6
Borough to Elephant and Castle	72.8	102.6	53.2	60.8	64.1	69.7	66.9	61.2	57.3	48.8
	73.6	105.1	52.2	60.1	63.6	71.7	66.3	59.0	53.0	45.0
	74.4	106.0	52.0	58.7	63.7	73.1	66.6	58.6	52.4	44.9
Elephant and Castle to Kennington	81.3	112.7	55.4	63.4	73.9	78.5	75.7	67.3	58.0	44.8
	81.1	110.9	53.1	62.4	71.9	79.0	74.8	65.7	55.6	41.9
	81.0	112.1	53.1	60.4	73.1	79.3	73.9	64.6	54.1	39.5



Interstation section	L _{Aeq} dB(A)	L _{Cpeak} dB(C)	Noise Spectral Analysis in Octave (Hz)							
			63	125	250	500	1000	2000	4000	8000
Kennington to Oval	74.4	112.4	54.7	66.4	68.1	68.5	68.7	64.0	58.2	44.7
	74.2	106.1	54.0	65.7	67.4	69.9	67.9	62.1	52.9	40.1
	71.8	105.4	52.6	62.6	65.2	68.1	65.3	59.2	51.6	40.6
Oval to Stockwell	73.3	115.4	53.7	65.5	67.1	67.7	67.5	62.4	55.8	44.8
	73.1	107.6	53.2	64.2	66.3	68.8	66.9	60.6	52.1	43.6
	71.8	105.4	51.1	61.7	65.5	69.1	65.5	59.3	51.6	43.1
Stockwell to Clapham North	78.8	105.8	51.0	67.0	65.1	75.8	74.6	64.1	56.1	42.7
	79.4	105.1	49.4	66.0	64.6	77.4	74.0	62.2	52.6	41.4
	78.5	103.9	49.9	65.1	64.7	76.7	73.2	61.2	51.5	40.7
Clapham North to Clapham Common	73.8	102.8	54.5	63.6	65.7	70.0	68.4	61.9	57.1	43.4
	74.5	104.2	53.1	62.4	64.4	71.9	68.2	60.8	54.1	45.0
	73.1	101.1	52.3	60.0	63.7	71.1	66.1	57.9	51.4	40.6
Clapham Common to Clapham South	73.8	109.1	54.1	63.6	66.0	70.2	68.1	61.9	55.7	42.9
	75.3	106.1	51.7	62.3	65.1	73.4	68.4	61.3	51.6	39.9
	74.9	106.7	51.8	61.2	65.5	72.9	68.1	60.5	51.3	41.1
Clapham South to Balham	75.4	106.9	51.6	64.2	66.9	70.3	71.2	65.7	60.0	47.4
	74.2	102.7	51.0	62.9	66.0	70.8	68.6	61.8	56.5	51.7
	73.8	101.5	50.9	61.4	65.6	71.3	67.5	60.4	53.9	48.1
Balham to Tooting Bec	74.3	105.2	53.9	66.2	67.7	68.4	69.0	63.8	57.8	48.8
	74.1	104.1	53.8	65.1	66.9	69.6	68.2	62.8	57.2	48.1
	74.8	104.2	53.5	63.5	66.4	70.7	69.6	65.0	56.2	46.7
Tooting Bec to Tooting Broadway	73.0	106.4	52.5	64.8	66.9	67.4	67.2	62.1	56.0	44.6
	73.0	103.0	51.8	63.6	66.0	69.0	67.1	60.5	53.1	47.0
	72.4	102.4	51.4	62.2	65.8	69.1	65.8	60.0	52.3	43.9
Tooting Broadway to Colliers Wood	73.8	112.7	52.8	64.9	67.9	68.2	68.2	62.7	56.6	44.4
	74.8	106.7	52.3	64.1	67.4	70.4	68.3	66.3	59.0	44.9
	73.4	102.8	51.9	62.6	66.8	70.1	66.9	60.4	52.0	41.8
Colliers Wood to South Wimbledon	73.6	104.3	52.5	64.3	67.6	67.8	68.3	62.7	56.5	46.0
	74.3	107.9	51.8	62.9	66.7	69.6	67.7	66.8	60.3	49.0
	74.1	104.3	52.3	62.0	66.8	70.1	68.5	64.6	58.1	42.9
South Wimbledon to Morden	84.3	112.2	51.5	64.0	71.5	79.0	82.0	74.8	61.4	47.2
	84.1	112.8	50.0	62.4	71.0	81.0	80.7	73.5	59.7	44.7
	84.0	112.0	49.8	61.2	71.2	82.0	79.8	71.9	58.5	43.5
Mill Hill East to Finchley Central	63.2	102.9	46.9	54.8	55.3	58.0	58.6	51.3	44.8	35.4
	66.2	105.1	48.0	56.0	58.3	60.0	60.5	58.5	56.1	45.8
	60.7	101.2	45.0	51.5	50.6	55.8	56.4	50.1	41.8	33.1

Table B.4 – Inter-station noise levels on the Northern southbound road between High Barnet and Kennington (via Charing Cross)

Interstation section	L _{Aeq} dB(A)	L _{Cpeak} dB(C)	Noise Spectral Analysis in Octave (Hz)							
			63	125	250	500	1000	2000	4000	8000
High Barnet to Totteridge & Whetstone	69.7	102.6	46.7	55.1	57.1	65.3	64.5	62.8	57	40.5
	63.9	104.5	49.7	55	57.2	58.9	57.9	53.8	45.5	36.9
	65.2	98.9	46.9	57.4	59.4	60.1	58.1	55.1	48.9	36.5
Totteridge & Whetstone to Woodside Park	68.8	107.2	50.9	57.7	58	63.1	63.7	60.9	58.5	49.7
	64.3	99.6	49.9	55.3	55.5	59.1	58.4	56.1	46.7	35.6
	66.5	99.4	49.4	59	59.7	61	59.9	57.6	51.4	39.8
Woodside Park to West Finchley	65.7	97.2	47.8	54.3	54.3	61.4	61.3	55.3	49.8	39.0
	62.2	96.5	50.4	52.6	52.2	56.7	57.3	53.9	44.3	33.7
	64.7	95.3	47.8	57.3	58.8	58.6	58.6	55.1	49.6	36.9
West Finchley to Finchley Central	67.6	104.2	48.2	58.3	59.5	63.4	61.3	57.9	52.7	43.5
	66.2	99.7	48.8	57.5	58.4	62.7	58.9	53.6	46.7	38.2
	67.3	99.6	48.4	59.6	60.9	62.9	60.5	55.1	49.9	39.0
Finchley Central to East Finchley	69.9	104.5	50.8	57.6	58.1	64.8	66.1	60.8	54.0	45.1
	66.4	104.1	49.7	56.2	56.7	62.2	61.1	55.8	47.1	36.7
	68.0	101.2	50.5	59.8	60.1	62.8	62.5	58.2	52.6	41.9



Interstation section	L _{Aeq} dB(A)	L _{Cpeak} dB(C)	Noise Spectral Analysis in Octave (Hz)							
			63	125	250	500	1000	2000	4000	8000
East Finchley to Highgate	74.6	104.2	50.3	58.6	63.5	68.7	72.0	65.1	55.2	40.3
	72.9	109.3	49.6	58.8	61.6	68.4	68.9	63.8	54.4	39.9
	75.0	105.0	49.6	60.1	64.6	69.4	71.1	67.7	59.3	42.3
Highgate to Archway	79.4	107.0	53.7	64.9	70.6	76.3	74.5	68.1	58.5	48.3
	77.8	104.3	52.7	64.8	68.8	75.4	71.4	66.3	57.6	44.6
	79.8	108.3	53.5	65.4	70.8	76.6	74.8	68.5	60.7	46.8
Archway to Tufnell Park	79.5	108.1	53.4	66.0	71.2	76.0	74.9	67.6	58.4	47.6
	78.2	108.7	52.0	66.0	69.8	75.3	72.4	65.9	58.0	45.2
	80.6	109.2	53.9	66.5	71.9	77.2	75.9	68.2	61.1	47.5
Tufnell Park to Kentish Town	77.9	105.9	54.4	67.0	70.2	73.8	72.6	66.8	60.9	53.9
	77.0	105.5	52.6	67.1	68.4	73.4	70.8	65.8	58.4	44.5
	78.3	106.7	54.7	67.1	70.1	74.4	72.8	67.4	61.2	48.9
Kentish Town to Camden Town	88.6	112.8	52.9	65.2	74.1	85.2	85.9	76.2	61.4	46.0
	86.6	112.1	51.4	64.4	72.6	83.3	83.7	75.5	62.3	47.1
	89.7	114.5	52.9	65.2	74.8	84.7	87.4	80.6	67.0	48.7
Camden Town to Mornington Crescent	75.8	106.7	53.4	64.9	69.7	73.0	68.5	63.1	55.1	44.0
	75.1	104.8	52.5	64.1	68.1	73.0	66.5	60.7	53.9	41.4
	76.3	105.7	53.0	65.0	70.2	73.4	68.7	63.0	57.0	44.1
Mornington Crescent to Euston	82.9	115.2	62.3	74.0	75.7	77.9	77.8	72.1	63.3	52.1
	80.1	112.2	60.2	72.8	73.3	75.5	73.6	68.6	61.9	51.2
	83.3	115.5	63.7	74.8	76.1	78.2	78.0	72.6	65.9	53.5
Euston to Warren Street	83.9	113.5	63.4	73.7	76.2	79.6	79.0	72.6	63.7	53.9
	82.8	114.2	61.7	73.8	74.0	79.6	76.6	70.8	63.3	53.2
	85.5	115.3	65.5	75.2	76.6	81.7	80.4	74.5	66.7	55.6
Warren Street to Goodge Street	76.7	107.2	54.5	66.2	70.2	71.4	71.9	66.4	57.7	45.1
	74.3	106.3	54.2	66.1	68.7	69.0	67.7	64.0	56.9	43.9
	76.9	109.2	55.8	67.8	70.6	71.6	71.4	66.7	60.4	47.6
Goodge Street to Tottenham Court Road	77.5	105.2	53.0	66.6	69.9	71.8	72.8	69.1	62.6	47.6
	74.2	105.1	52.2	66.1	68.1	68.8	68.2	63.3	55.1	42.7
	76.4	105.3	53.6	67.2	70.3	71.3	71.2	64.6	57.8	44.3
Tottenham Court Road to Leicester Square	75.5	104.1	54.3	67.0	67.6	69.2	71.7	63.9	55.7	43.0
	73.8	104.7	53.2	67.0	66.4	68.0	68.6	62.7	55.4	41.7
	75.5	106.4	55.7	68.9	68.6	69.5	70.4	63.4	57.8	44.0
Leicester Square to Charing Cross	77.7	105.5	53.3	64.6	71.4	74.5	71.6	65.6	58.2	50.0
	78.2	104.0	52.5	64.2	69.5	76.2	70.6	65.1	57.7	46.2
	78.9	105.9	54.6	65.3	71.6	75.5	72.5	68.1	64.5	54.7
Charing Cross to Embankment	77.5	107.7	53.9	67.3	70.6	73.2	71.8	66.6	59.1	48.5
	75.7	105.5	53.0	67.1	68.2	71.7	69.0	64.8	57.6	43.5
	78.2	108.9	55.3	68.6	70.9	73.6	72.7	67.8	61.3	47.8
Embankment to Waterloo	76.3	104.7	52.4	63.3	68.6	72.3	71.5	66.2	57.8	47.9
	74.0	102.5	52.0	62.8	66.7	70.2	67.9	64.4	56.4	42.1
	77.3	104.6	53.3	64.9	70.0	72.9	72.5	67.2	60.4	46.9
Waterloo to Kennington (SB)	82.5	112.9	60.0	69.6	74.0	79.1	78.0	71.5	62.5	50.0
	80.1	110.7	58.1	68.9	71.5	77.2	74.1	68.7	60.9	48.9
	81.9	112.9	60.4	69.7	73.3	77.9	77.3	71.5	63.7	50.5
Kennington (SB) to Kennington (NB)	73.6	113.1	54.8	59.6	64.1	67.8	67.0	66.3	66.8	50.3
	70.4	102.7	52.3	60.6	62.5	66.7	64.0	58.7	53.6	48.0
	71.7	104.4	51.4	60.8	64.3	66.3	65.3	64.9	57.8	46.2

APPENDIX C – PHOTOGRAPH



Figure C1 - Northern line 1995 tube stock cab and microphone arrangement