

115 Frognal, London NW3 6XR

Plant Noise Assessment

Report 18/0066/R1

115 Frogna1, London NW3 6XR

Plant Noise Assessment

Report 18/0066/R1

Will Potter Partnership

60 Arley Hill
Bristol
BS6 5PP

Revision	Description	Date	Prepared	Approved
0	1 st issue	22 February 2019	Philip Hankin	Richard Masey
1	1 st Revision	25 February 2019	Philip Hankin	Richard Masey

This report and associated surveys have been prepared and undertaken for the private and confidential use of our client only. If any third party whatsoever comes into possession of this report, they rely on it at their own risk and Cole Jarman Limited accepts no duty or responsibility (including in negligence) to any such third party.



Plant Noise Assessment

Table of Contents

1	Introduction	3
2	Site Description	3
3	Planning Condition	4
4	Noise Survey	5
4.1	Methodology	5
4.2	Results	6
5	Plant Noise Emission Limits	7
6	Plant Noise Assessment	7
7	Conclusions	9

Attachments

Glossary of Acoustic Terms

18/0066/F1

Site plan showing noise survey measurement and noise impact assessment positions

18/0066/TH01 and TH02

Time history plot of noise survey results at positions P1 and P2

18/0066/SCH1

Results of as-installed plant noise measurements

Appendix A

Plant manufacturers setback operation mode details

Appendix B

Plant noise assessment calculations

 End of Section



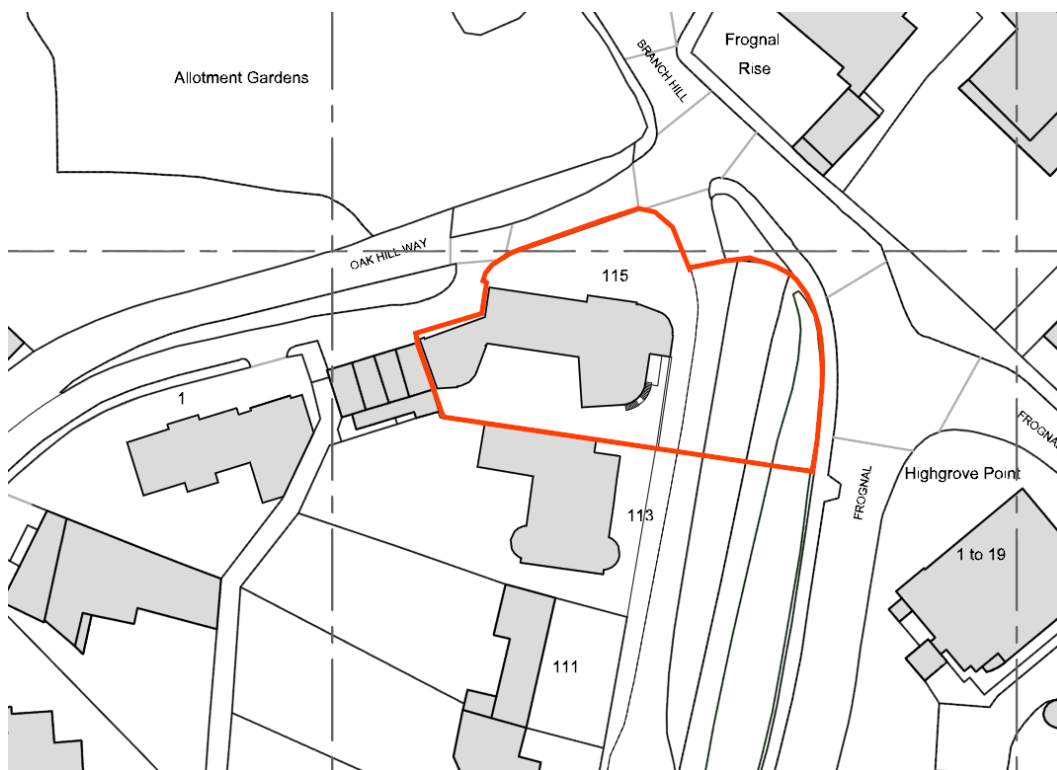
Plant Noise Assessment

1 Introduction

- 1.1 Planning permission was previously granted for the demolition and reconstruction of a single dwelling on a site at 115 Frognal, NW3 6XR. A condition specifically relating to noise from mechanical services plant was attached to the condition, which required measurements to be made in order to demonstrate compliance prior to the replacement residence being occupied.
- 1.2 This report sets out the results of a noise survey that has been carried out on site in order to quantify the existing noise climate, and noise emission from the units as installed.
- 1.3 A suitable assessment is then presented in order to demonstrate that the plant complies with the requirements of the condition.

2 Site Description

- 2.1 The site of the residence is in the London Borough of Camden, at the junction between Frognal and Oak Hill Way, as shown in the aerial photo below.



Site location and adjacent properties

- 2.2 The area is residential in nature, there are a set of allotments to the immediate north of the site beyond Oak Hill Way.



Plant Noise Assessment

- 2.3 The closest residential properties and those most likely to be affected by noise from the plant serving 115 Frognal are a three storey detached residence to the south, 113 Frognal, and another three storey detached dwelling to the west at 1 Oak Hill Way.
- 2.4 The property at 1 Oak Hill Way has accommodation in the main house and we understand also has a flat above the garage. We have considered noise to a single window in the north garage roof, all of the other windows being on the other side of the garage and completely screened from the 115 Frognal site.

3 Planning Condition

- 3.1.1 Planning permission for the development was granted by Camden Council in August 2017, application reference 2017/2917/P.
- 3.1.2 Condition 17 attached to the permission specifically addressed noise from mechanical services plant associated with the development as follows:

Prior to first occupation of the replacement dwelling, details shall be submitted to and approved in writing by the Council, of the external noise levels emitted from plant/machinery/equipment and mitigation measures as appropriate. The measures shall ensure that the external noise levels emitted from plant, machinery/equipment will be lower than the lowest existing background noise levels by at least 10dBA, by 15dBA where the source is tonal, as assessed according to BS4142:2014 at the nearest and/or most affected noise sensitive premises, with machinery operating together at maximum capacity. A post installation noise assessment shall be carried out as required to confirm compliance with the noise criteria and additional steps to mitigate noise shall be taken, as necessary.

Approved details shall be implemented prior to occupation of the development and thereafter be permanently maintained.

- 3.1.3 The only items of mechanical services plant to which this condition is relevant are a row of five air source heat pump units, located on the single storey garage roof on the western side of the property. These units provide heating and cooling to the property and can operate at any time of the day or night.
- 3.1.4 In order to demonstrate compliance of the installation with the condition, direct measurement of noise at the nearest properties as a result of plant operation was not considered practicable, as they are in private ownership and access was not possible. Furthermore, attempting to measure noise at a level which does not change the prevailing background is inherently difficult.
- 3.1.5 Instead the approach taken was as follows:
- Undertake a survey in order to quantify the existing day and night time lowest background noise levels at locations representative of the neighbouring properties.



Plant Noise Assessment

- Undertake measurements of the plant as installed at a suitable location around the plant deck.
- Calculate resultant noise levels to the neighbouring properties, including mitigation measures as appropriate.

4 Noise Survey

4.1 Methodology

- 4.1.1 Attended noise measurements were undertaken to quantify noise from the condensing units, on 20th February 2019. Measurements were made on the first floor garage roof where the units were located, at a distance of 2m from the units, with three of them operational at normal duty.
- 4.1.2 Measurements were also undertaken of ambient noise with the units switched off (and with building work at the property stopped), to allow the effects of ambient noise to be corrected for and to give an as-installed operational noise level for a single unit. The results of these measurements can be found in the attached schedule 18/0066/SCH1.
- 4.1.3 In order to quantify the existing noise climate in the absence of plant operation, an unattended noise survey was also undertaken over a period of around 30 hours, starting at 1100 hours on 20th February 2019.
- 4.1.4 Measurements were taken at two locations, as shown on the attached figure 18/0066/F1 and selected to be representative of the background noise levels at the neighbouring properties, having due regard for the need to avoid the equipment being stolen and the fact that measurements any closer to the properties was not practicable as they are in private ownership:
 - P1; On a scaffolding at first floor level in a free field position at the western site boundary, noise levels taken to be representative of those at the front facade of the adjacent property at 1 Oak Hill Way.
 - P2; On a scaffolding at first floor level in a free field position at the southern site boundary, noise levels taken to be representative of those at the front facade of the adjacent property at 113 Frognal.
- 4.1.5 Measurements of the L_{Amax} , L_{Aeq} and L_{A90} indices were taken over continuous 10 minute periods (see Glossary for detailed descriptions of acoustic terms used).
- 4.1.6 Noise measurements were made using the equipment listed in table T1.



Plant Noise Assessment

Item	Manufacturer	Type
Sound Level Analyser	Norsonic	118
Sound Level Analyser	Norsonic	140
Weatherproof Windshield X2	Norsonic	1212
Acoustic Calibrator	Norsonic	1251

T1 Equipment used during noise survey.

- 4.1.7 The microphones were fitted with a weatherproof windshield and the analysers calibrated before and after the survey, no significant drift was noted to have occurred. Calibration certificates traceable to National Standards are available for all equipment on request.
- 4.1.8 The weather during the survey period was generally noted to have been mild, dry and calm throughout.

4.2 Results

- 4.2.1 The results of the attended measurements described above can be found within the attached schedule 18/0066/SCH1.
- 4.2.2 The results of the unattended measurements at locations P1 and P2 are presented in time history format in the attached figures 18/006/TH01 and TH02.
- 4.2.3 The noise climate observed on site was generally controlled by traffic on the local roads in the immediate surrounding area. Noise from the building works at the 115 Frognal site itself were clearly audible during the daytime, so only the data during the evening and night time when the site was quiet have been utilised in the assessment of noise impact from the plant.
- 4.2.4 The minimum background noise levels recorded during the day and night time hours are set out in table T2 below.

Location	Minimum Recorded L_{A90} (dB)	
	Daytime (0700-2300)	Night time (2300-0700)
Position P1 – 1 Oak Hill Way	43	38
Position P2 – 113 Frognal	42	37

T2 Lowest recorded background noise levels at the nearest residential properties.



Plant Noise Assessment

5 Plant Noise Emission Limits

- 5.1 Based upon the requirements of planning condition 17, table T3 overleaf contains plant noise emission limits at the adjacent dwellings (shown on figure 18/0066/F1).

Location	Plant Noise Emission Limit, $L_{A,T,r}$ dB	
	Daytime (0700-2300 only)	Night time (24-hour)
Position AP1 and AP3 – 1 Oak Hill Way	33	28
Position AP2 – 113 Frognal	32	27

T3 Plant noise emission limits at the nearest residential properties.

6 Plant Noise Assessment

- 6.1 An assessment of noise has been undertaken using the measured data from the plant units on site, for comparison against the limits in table T3.
- 6.2 Calculations are presented in Appendix A which take into account losses due to additional distance to the receiver locations, screening from the roof parapet to position AP2, on time corrections (as units gently run up and down depending on local load of the area inside the building and don't all run simultaneously all of the time) and setback duty corrections. Assessment position AP3 has no direct view of the plant and the calculations take account of screening provided by the sloping roof ridge which cuts off any view to the plant.
- 6.3 Measurements of the plant noise were made with the units operating at full duty. The units have been programmed to run at a reduced duty in order to reduce operational noise levels. Appendix A shows the manufacturers data for this duty change and each of the three setback steps reduces noise levels by 3dB to a maximum of 9dB overall.
- 6.4 In this instance, it has been confirmed to us that the control system for the units has been permanently programmed to run on setback three (-9dB) setting at all times.
- 6.5 On this basis, table T4 overleaf shows the results of the assessment.



Plant Noise Assessment

Location	Assessed Plant Noise Level, dB(A) (<i>Noise Limit</i>)	
	Daytime (0700-2300 only)	Night time (24-hour)
Position AP1 – 1 Oak Hill Way (Main House)	27 (33)	27 (28)
Position AP2 – 113 Frogna1	26 (32)	26 (27)
Position AP3 – 1 Oak Hill Way (window in north facing garage roof)	26 (33)	26 (28)

T4 Assessed plant noise levels at the nearest residential properties.

- 6.6 Noise from the units was observed during the measurements to be broadband in nature. Having due regard to the methodology in BS4142:2014 there were no particular tonal, impulsive or intermittent characteristics of note that would be expected to draw attention to the noise and thus no character correction to the noise was deemed necessary.
- 6.7 As the noise limits are assessed as being met at the closest properties using as installed noise data and an up to date survey of existing background noise levels, the requirements of the local authority planning condition 17 are deemed to have been satisfied.
- 6.8 It is reasonable to conclude that the noise limits would also be met at all other locations due to additional distance and screening losses from intervening structures between the proposed plant items and other residences.



Plant Noise Assessment

7 Conclusions

- 7.1 Planning permission was previously granted for the demolition and reconstruction of a single dwelling on a site at 115 Frognal, NW3 6XR. A condition specifically relating to noise from mechanical services plant was attached to the condition, which required measurements to be made in order to demonstrate compliance prior to the replacement residence being occupied.
- 7.2 An environmental noise survey has been undertaken at the site, the sources and nature of the existing noise climate have been quantified. Measurements of 5 external air source heat pump units (the plant to which the planning condition relates) have been undertaken, as installed.
- 7.3 Suitable corrections have been made in order to determine the resultant noise levels at the two adjacent residential dwellings, during plant operation. This is deemed the only realistically practical way to demonstrate compliance given the lack of access to neighbouring private properties, and the low plant noise levels which are required to be inaudible below the lowest existing measured background levels and thus very difficult to measure at the receiver directly.
- 7.4 With the units programmed to operate in stage 3 setback, the requirements of planning condition 17 are satisfied.

■ End of Section



Plant Noise Assessment

Glossary of Acoustic Terms

L_{Aeq} :

The notional steady sound level (in dB) which over a stated period of time, would have the same A-weighted acoustic energy as the A-weighted fluctuating noise measurement over that period. Values are sometimes written using the alternative expression dB(A) L_{eq} .

L_{Amax} :

The maximum A-weighted sound pressure level recorded over the period stated. L_{Amax} is sometimes used in assessing environmental noise when occasional loud noises occur, which may have little effect on the L_{Aeq} noise level. Unless described otherwise, L_{Amax} is measured using the “fast” sound level meter response.

L_{A10} & L_{A90} :

If non-steady noise is to be described, it is necessary to know both its level and degree of fluctuation. The L_{An} indices are used for this purpose. The term refers to the A-weighted level (in dB) exceeded for n% of the time specified. L_{A10} is the level exceeded for 10% of the time and as such gives an indication of the upper limit of fluctuating noise. Similarly, L_{A90} gives an indication of the lower levels of fluctuating noise. It is often used to define the background noise.

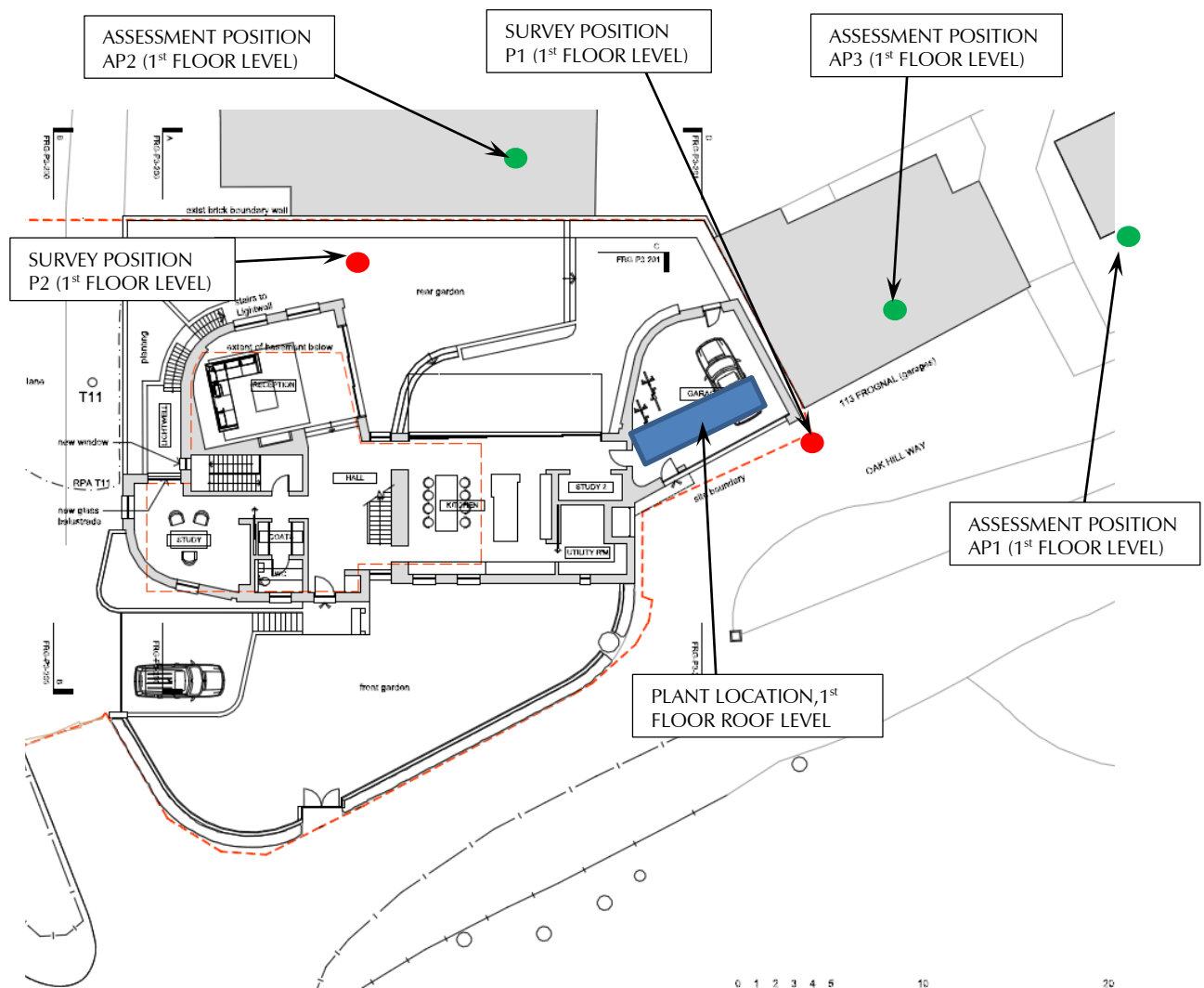
L_{A10} is commonly used to describe traffic noise. Values of dB L_{An} are sometimes written using the alternative expression dB(A) L_n .

L_{AX} , L_{AE} or SEL

The single event noise exposure level which, when maintained for 1 second, contains the same quantity of sound energy as the actual time varying level of one noise event. L_{AX} values for contributing noise sources can be considered as individual building blocks in the construction of a calculated value of L_{Aeq} for the total noise. The L_{AX} term can sometimes be referred to as Exposure Level (L_{AE}) or Single Event Level (SEL).

■ End of Section

Figure 18/0066/F1



Title: Site plan showing plant location, noise survey measurement locations and assessment positions

Project: 115 Frognal, London NW3 6XR

Date: February 2019

Scale: Not to scale



Figure 18/0066/TH01

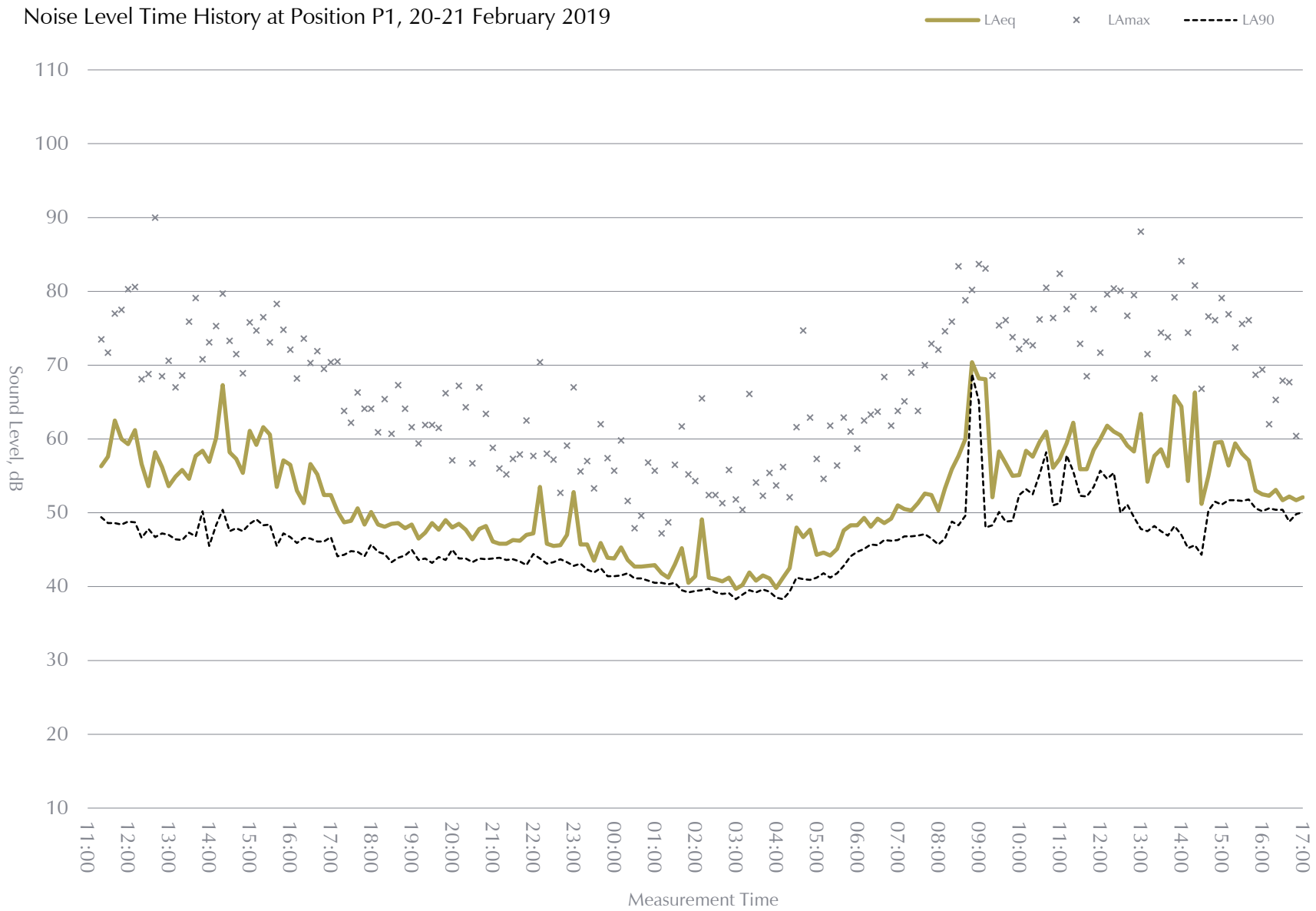
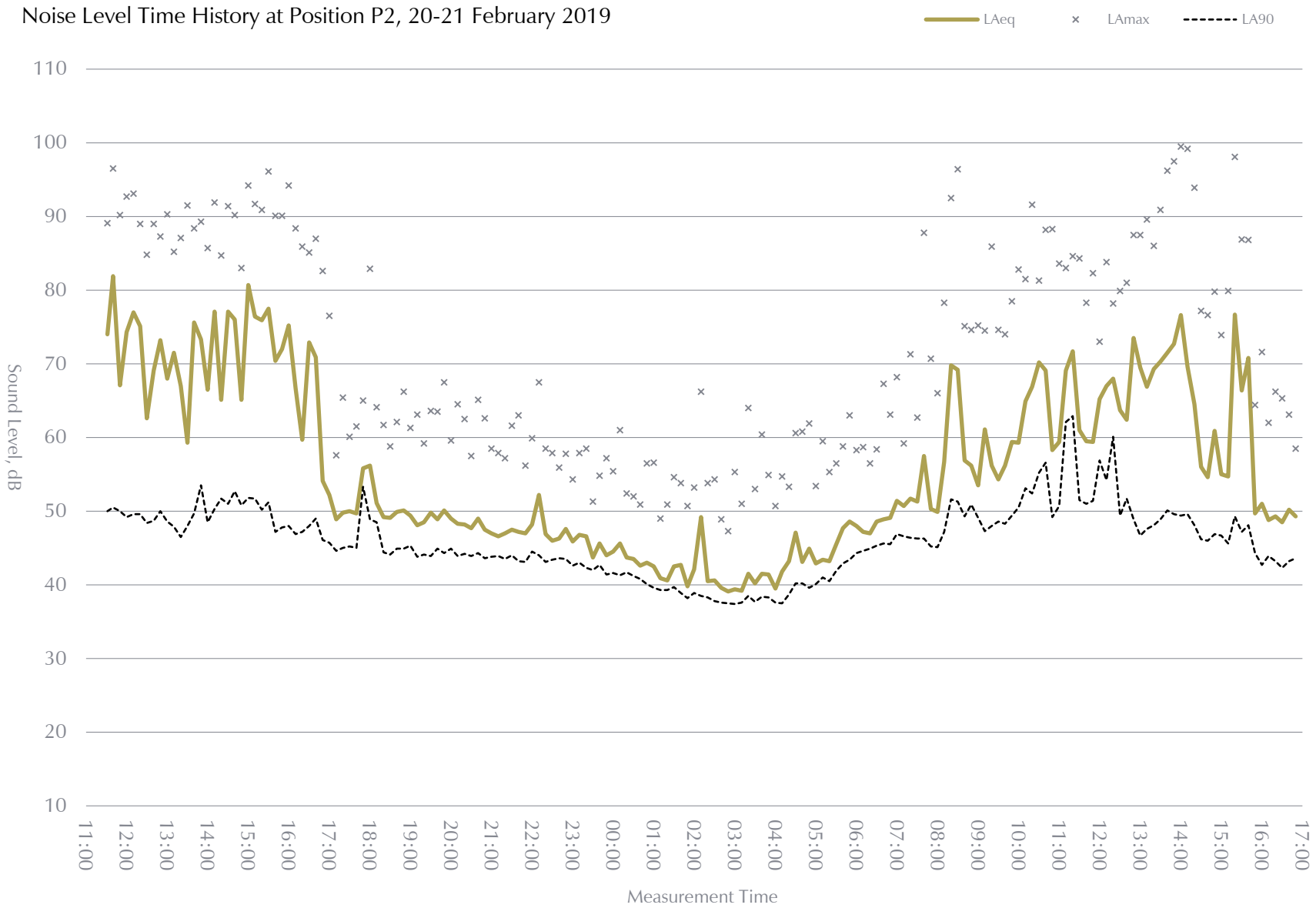




Figure 18/0066/TH02





Plant Noise Measurement Results

Parameter	L _{eq} (dB) @ Octave Band Centred Frequency (Hz)							
	63	125	250	500	1k	2k	4k	(A)
L _p @ 2m with three units running	64.0	63.1	58.5	54.2	54.0	49.2	43.9	58.2
Ambient L _p , units switched off	58.2	52.4	50.1	46.4	44.6	41.1	36.8	49.7
Plant noise with ambient noise subtracted	62.7	62.7	57.8	53.4	53.5	48.5	43.0	57.6
Correction for 3 units to 1 unit	-4.8	-4.8	-4.8	-4.8	-4.8	-4.8	-4.8	
Level for 1 unit	57.9	57.9	53.1	48.6	48.7	43.7	38.2	52.9



Plant Noise Assessment

Appendix A

Plant manufacturers setback operation mode details

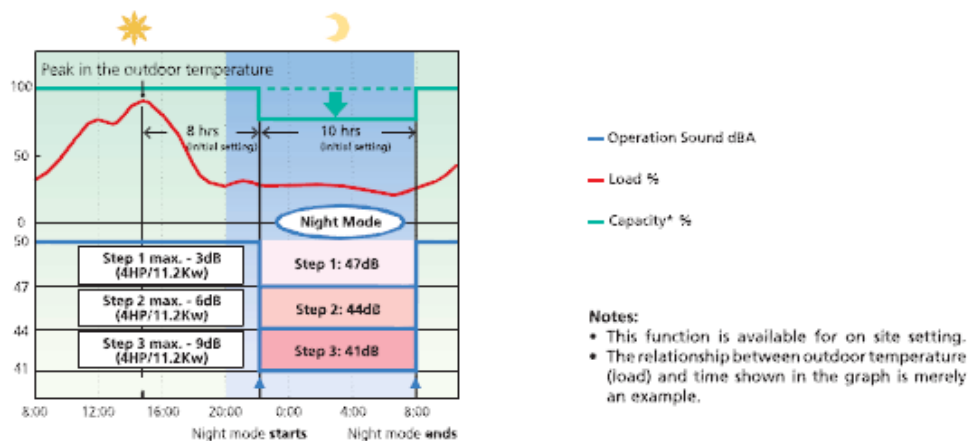
VRV III-S

p. 8

• SUPER SILENT OPERATION

Quietness is another important feature. To reduce noise and ensure comfortable operation, the latest technologies and features have been applied to the outdoor units.

Night quiet function (max. -9dBA)



During the night the sound level of the outdoor unit can be reduced for a certain period: starting time and ending time can be input

2 modes- with low sound level at night:

→ Mode 1 Automatic mode

Set on the outdoor PCB. Time of maximum temperature is memorised. The low operating mode will become active 8 hours after the peak temperature in the daytime and operation will return to normal after 9 hours.

→ Mode 2 Customized mode

Starting and ending times can be input. (External control adapter for outdoor unit, DTA104A61 or DTA104A62 and a separately ordered timer are necessary.)

Notes:

- *1. Determine which mode to select depending on the climatic characteristics of each country.
- *2. Initial setting. Can be selected from 6, 8 and 10 hours.
- *3. Initial setting. Can be selected from 8, 9 and 10 hours.

End of Section



Plant Noise Assessment

Appendix B

Plant noise assessment calculations

Calculation 18/006/C01

Atmospheric Plant Noise Assessment Calculation to Neighbouring property to west, 1 Oak Hill Way (daytime 0700-2300)

Item Ref	Operting (Y/N)	Sound pressure level Lp @ 2m								dB(A)
		63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	
										-
Unit No.1	Y	57.9	57.9	53.1	48.6	48.7	43.7	38.2	30.0	52.9
Unit No.2	Y	57.9	57.9	53.1	48.6	48.7	43.7	38.2	30.0	52.9
Unit No.3	Y	57.9	57.9	53.1	48.6	48.7	43.7	38.2	30.0	52.9
Unit No.4	Y	57.9	57.9	53.1	48.6	48.7	43.7	38.2	30.0	52.9
Unit No.5	Y	57.9	57.9	53.1	48.6	48.7	43.7	38.2	30.0	52.9
										-
										-
										-
										-
										-

Distance (Source, Receive,Barrier, Horizontal, Vertical)			
Src-Rec H.	Src-Rec V.	Src-Bar H.	Src-Bar V.
28			
27.5			
26			
25			
23.5			

Calculation 18/006/C01, continued

		Frequency	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
		Wavelength @ 344m/s	5.46	2.75	1.38	0.69	0.34	0.17	0.09	0.04

Item Ref	Description	Other corrections							
		63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
Unit No.1	Stage 3 duty setback	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0
Unit No.2	Stage 3 duty setback	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0
Unit No.3	Stage 3 duty setback	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0
Unit No.4	Stage 3 duty setback	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0
Unit No.5	Stage 3 duty setback	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0

Distance Attenuation	Barrier Attenuation							
	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
-	-	-	-	-	-	-	-	-
-22.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
-22.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
-22.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
-21.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
-21.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-

Calculation 18/006/C01, continued

Item Ref	Description	Silencer insertion loss							
		63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
Unit No.1									
Unit No.2									
Unit No.3									
Unit No.4									
Unit No.5									

Description	Other Losses							
	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
On time correction 66%	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8
On time correction 66%	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8
On time correction 66%	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8
On time correction 66%	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8
On time correction 66%	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8

Calculation 18/006/C01, continued

Item ref	Resultant Lp								dB(A)
	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	
0	-	-	-	-	-	-	-	-	-
Unit No.1	24.2	24.2	19.4	14.9	15.0	10.0	4.5	-3.7	19.2
Unit No.2	24.3	24.3	19.5	15.0	15.1	10.1	4.6	-3.6	19.3
Unit No.3	24.8	24.8	20.0	15.5	15.6	10.6	5.1	-3.1	19.8
Unit No.4	25.2	25.2	20.4	15.9	16.0	11.0	5.5	-2.7	20.2
Unit No.5	25.7	25.7	20.9	16.4	16.5	11.5	6.0	-2.2	20.7
0	-	-	-	-	-	-	-	-	-
0	-	-	-	-	-	-	-	-	-
0	-	-	-	-	-	-	-	-	-
0	-	-	-	-	-	-	-	-	-
0	-	-	-	-	-	-	-	-	-

SUMMARY	Resultant Lp								dB(A)
	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	
Overall Plant Noise Level (freefield)	31.9	31.9	27.0	22.6	22.7	17.7	12.2	4.0	27
No facade correction as 90 degree incidence angle									
Plant Noise Emission Limit Daytime 0700-2300									33

Calculation 18/006/C02

Atmospheric Plant Noise Assessment Calculation to Neighbouring property to west, 1 Oak Hill Way (night time 2300-0700)

Item Ref	Operting (Y/N)	Sound pressure level Lp @ 2m								dB(A)
		63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	
										-
Unit No.1	Y	57.9	57.9	53.1	48.6	48.7	43.7	38.2	30.0	52.9
Unit No.2	Y	57.9	57.9	53.1	48.6	48.7	43.7	38.2	30.0	52.9
Unit No.3	Y	57.9	57.9	53.1	48.6	48.7	43.7	38.2	30.0	52.9
Unit No.4	Y	57.9	57.9	53.1	48.6	48.7	43.7	38.2	30.0	52.9
Unit No.5	Y	57.9	57.9	53.1	48.6	48.7	43.7	38.2	30.0	52.9
										-
										-
										-
										-
										-

Distance (Source, Receive,Barrier, Horizontal, Vertical)			
Src-Rec H.	Src-Rec V.	Src-Bar H.	Src-Bar V.
28			
27.5			
26			
25			
23.5			

Calculation 18/006/C02, continued

Item Ref	Description	Other corrections							
		63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
Unit No.1	Stage 3 duty setback	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0
Unit No.2	Stage 3 duty setback	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0
Unit No.3	Stage 3 duty setback	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0
Unit No.4	Stage 3 duty setback	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0
Unit No.5	Stage 3 duty setback	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0

Frequency		63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
Wavelength @ 344m/s		5.46	2.75	1.38	0.69	0.34	0.17	0.09	0.04

Distance	
Attenuation	
	-
	-22.9
	-22.8
	-22.3
	-21.9
	-21.4
	-
	-
	-
	-
	-

Barrier Attenuation							
63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
-	-	-	-	-	-	-	-
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-

Calculation 18/006/C02, continued

Item Ref	Description	Silencer insertion loss							
		63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
Unit No.1									
Unit No.2									
Unit No.3									
Unit No.4									
Unit No.5									

Description	Other Losses							
	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
On time correction 66%	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8
On time correction 66%	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8
On time correction 66%	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8
On time correction 66%	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8
On time correction 66%	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8

Calculation 18/006/C02, continued

Item ref	Resultant Lp								dB(A)
	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	
0	-	-	-	-	-	-	-	-	-
Unit No.1	24.2	24.2	19.4	14.9	15.0	10.0	4.5	-3.7	19.2
Unit No.2	24.3	24.3	19.5	15.0	15.1	10.1	4.6	-3.6	19.3
Unit No.3	24.8	24.8	20.0	15.5	15.6	10.6	5.1	-3.1	19.8
Unit No.4	25.2	25.2	20.4	15.9	16.0	11.0	5.5	-2.7	20.2
Unit No.5	25.7	25.7	20.9	16.4	16.5	11.5	6.0	-2.2	20.7
0	-	-	-	-	-	-	-	-	-
0	-	-	-	-	-	-	-	-	-
0	-	-	-	-	-	-	-	-	-
0	-	-	-	-	-	-	-	-	-
0	-	-	-	-	-	-	-	-	-

SUMMARY	Resultant Lp								dB(A)
	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	
Overall Plant Noise Level (freefield)	31.9	31.9	27.0	22.6	22.7	17.7	12.2	4.0	27
No facade correction as 90 degree incidence angle									
Plant Noise Emission Limit Night Time 2300-0700									28

Calculation 18/006/C03

Atmospheric Plant Noise Assessment Calculation to Neighbouring property to south, 113 Frognal (daytime 0700-2300)

Item Ref	Operting (Y/N)	Sound pressure level Lp @ 2m								dB(A)
		63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	
										-
Unit No.1	Y	57.9	57.9	53.1	48.6	48.7	43.7	38.2	30.0	52.9
Unit No.2	Y	57.9	57.9	53.1	48.6	48.7	43.7	38.2	30.0	52.9
Unit No.3	Y	57.9	57.9	53.1	48.6	48.7	43.7	38.2	30.0	52.9
Unit No.4	Y	57.9	57.9	53.1	48.6	48.7	43.7	38.2	30.0	52.9
Unit No.5	Y	57.9	57.9	53.1	48.6	48.7	43.7	38.2	30.0	52.9
										-
										-
										-
										-
										-

Distance (Source, Receive,Barrier, Horizontal, Vertical)			
Src-Rec H.	Src-Rec V.	Src-Bar H.	Src-Bar V.
17.5	0.0	0.2	0.10
17.5	0.0	0.2	0.10
17.5	0.0	0.2	0.10
17.5	0.0	0.2	0.10
17.5	0.0	0.2	0.10

Calculation 18/006/C03, continued

Item Ref	Description	Other corrections							
		63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
Unit No.1	Stage 3 duty setback	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0
Unit No.2	Stage 3 duty setback	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0
Unit No.3	Stage 3 duty setback	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0
Unit No.4	Stage 3 duty setback	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0
Unit No.5	Stage 3 duty setback	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0

Frequency		63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
Wavelength @ 344m/s		5.46	2.75	1.38	0.69	0.34	0.17	0.09	0.04

Distance	
Attenuation	
	-
	-18.8
	-18.8
	-18.8
	-18.8
	-18.8
	-
	-
	-
	-
	-
	-

Barrier Attenuation							
63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
-	-	-	-	-	-	-	-
-5.0	-5.2	-5.7	-6.4	-7.6	-9.3	-11.5	-14.0
-5.0	-5.2	-5.7	-6.4	-7.6	-9.3	-11.5	-14.0
-5.0	-5.2	-5.7	-6.4	-7.6	-9.3	-11.5	-14.0
-5.0	-5.2	-5.7	-6.4	-7.6	-9.3	-11.5	-14.0
-5.0	-5.2	-5.7	-6.4	-7.6	-9.3	-11.5	-14.0
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-

Calculation 18/006/C03, continued

Item Ref	Description	Silencer insertion loss							
		63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
Unit No.1									
Unit No.2									
Unit No.3									
Unit No.4									
Unit No.5									

Description	Other Losses							
	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
On time correction 66%	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8
On time correction 66%	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8
On time correction 66%	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8
On time correction 66%	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8
On time correction 66%	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8

Calculation 18/006/C03, continued

Item ref	Resultant Lp								dB(A)
	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	
0	-	-	-	-	-	-	-	-	-
Unit No.1	23.3	23.1	17.8	12.6	11.5	4.8	-2.9	-13.6	16.2
Unit No.2	23.3	23.1	17.8	12.6	11.5	4.8	-2.9	-13.6	16.2
Unit No.3	23.3	23.1	17.8	12.6	11.5	4.8	-2.9	-13.6	16.2
Unit No.4	23.3	23.1	17.8	12.6	11.5	4.8	-2.9	-13.6	16.2
Unit No.5	23.3	23.1	17.8	12.6	11.5	4.8	-2.9	-13.6	16.2
0	-	-	-	-	-	-	-	-	-
0	-	-	-	-	-	-	-	-	-
0	-	-	-	-	-	-	-	-	-
0	-	-	-	-	-	-	-	-	-
0	-	-	-	-	-	-	-	-	-

SUMMARY	Resultant Lp								dB(A)
	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	
Overall Plant Noise Level (freefield)	30.3	30.1	24.7	19.6	18.5	11.8	4.1	-6.6	23
Plant Noise Level @1m from window	32.8	32.6	27.2	22.1	21.0	14.3	6.6	-4.1	26
Plant Noise Emission Limit Daytime 0700-2300									32

Calculation 18/006/C04

Atmospheric Plant Noise Assessment Calculation to Neighbouring property to south, 113 Frognal (night time 2300-0700)

Item Ref	Operting (Y/N)	Sound pressure level Lp @ 2m								dB(A)
		63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	
										-
Unit No.1	Y	57.9	57.9	53.1	48.6	48.7	43.7	38.2	30.0	52.9
Unit No.2	Y	57.9	57.9	53.1	48.6	48.7	43.7	38.2	30.0	52.9
Unit No.3	Y	57.9	57.9	53.1	48.6	48.7	43.7	38.2	30.0	52.9
Unit No.4	Y	57.9	57.9	53.1	48.6	48.7	43.7	38.2	30.0	52.9
Unit No.5	Y	57.9	57.9	53.1	48.6	48.7	43.7	38.2	30.0	52.9
										-
										-
										-
										-
										-

Distance (Source, Receive,Barrier, Horizontal, Vertical)			
Src-Rec H.	Src-Rec V.	Src-Bar H.	Src-Bar V.
17.5	0.0	0.2	0.10
17.5	0.0	0.2	0.10
17.5	0.0	0.2	0.10
17.5	0.0	0.2	0.10
17.5	0.0	0.2	0.10

Calculation 18/006/C04, continued

Item Ref	Description	Other corrections							
		63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
Unit No.1	Stage 3 duty setback	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0
Unit No.2	Stage 3 duty setback	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0
Unit No.3	Stage 3 duty setback	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0
Unit No.4	Stage 3 duty setback	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0
Unit No.5	Stage 3 duty setback	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0

Frequency		63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
Wavelength @ 344m/s		5.46	2.75	1.38	0.69	0.34	0.17	0.09	0.04

Distance		Barrier Attenuation							
Attenuation		63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
		-	-	-	-	-	-	-	-
		-18.8	-5.0	-5.2	-5.7	-6.4	-7.6	-9.3	-11.5
		-18.8	-5.0	-5.2	-5.7	-6.4	-7.6	-9.3	-11.5
		-18.8	-5.0	-5.2	-5.7	-6.4	-7.6	-9.3	-11.5
		-18.8	-5.0	-5.2	-5.7	-6.4	-7.6	-9.3	-11.5
		-18.8	-5.0	-5.2	-5.7	-6.4	-7.6	-9.3	-11.5
		-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-

Calculation 18/006/C04, continued

Item Ref	Description	Silencer insertion loss							
		63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
Unit No.1									
Unit No.2									
Unit No.3									
Unit No.4									
Unit No.5									

Description	Other Losses							
	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
On time correction 66%	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8
On time correction 66%	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8
On time correction 66%	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8
On time correction 66%	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8
On time correction 66%	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8

Calculation 18/006/C04, continued

Item ref	Resultant Lp								dB(A)
	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	
0	-	-	-	-	-	-	-	-	-
Unit No.1	23.3	23.1	17.8	12.6	11.5	4.8	-2.9	-13.6	16.2
Unit No.2	23.3	23.1	17.8	12.6	11.5	4.8	-2.9	-13.6	16.2
Unit No.3	23.3	23.1	17.8	12.6	11.5	4.8	-2.9	-13.6	16.2
Unit No.4	23.3	23.1	17.8	12.6	11.5	4.8	-2.9	-13.6	16.2
Unit No.5	23.3	23.1	17.8	12.6	11.5	4.8	-2.9	-13.6	16.2
0	-	-	-	-	-	-	-	-	-
0	-	-	-	-	-	-	-	-	-
0	-	-	-	-	-	-	-	-	-
0	-	-	-	-	-	-	-	-	-
0	-	-	-	-	-	-	-	-	-

SUMMARY	Resultant Lp								dB(A)
	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	
Overall Plant Noise Level (freefield)	30.3	30.1	24.7	19.6	18.5	11.8	4.1	-6.6	23
Plant Noise Level @1m from window	32.8	32.6	27.2	22.1	21.0	14.3	6.6	-4.1	26
Plant Noise Emission Limit Night Time 0700-2300									27

Calculation 18/006/C05

Atmospheric Plant Noise Assessment Calculation to Neighbouring property to west, north facing window in garage roof at 1 Oak Hill Way (daytime 0700-2300)

Item Ref	Operting (Y/N)	Sound pressure level Lp @ 2m								dB(A)
		63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	
										-
Unit No.1	Y	57.9	57.9	53.1	48.6	48.7	43.7	38.2	30.0	52.9
Unit No.2	Y	57.9	57.9	53.1	48.6	48.7	43.7	38.2	30.0	52.9
Unit No.3	Y	57.9	57.9	53.1	48.6	48.7	43.7	38.2	30.0	52.9
Unit No.4	Y	57.9	57.9	53.1	48.6	48.7	43.7	38.2	30.0	52.9
Unit No.5	Y	57.9	57.9	53.1	48.6	48.7	43.7	38.2	30.0	52.9
										-
										-
										-
										-
										-

Distance (Source, Receive,Barrier, Horizontal, Vertical)			
Src-Rec H.	Src-Rec V.	Src-Bar H.	Src-Bar V.
15	1.0	10.0	1.00
14	1.0	9.0	1.00
13	1.0	8.0	1.00
12	1.0	7.0	1.00
11	1.0	6.0	1.0

Calculation 18/006/C05, continued

Item Ref	Description	Other corrections							
		63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
Unit No.1	Stage 3 duty setback	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0
Unit No.2	Stage 3 duty setback	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0
Unit No.3	Stage 3 duty setback	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0
Unit No.4	Stage 3 duty setback	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0
Unit No.5	Stage 3 duty setback	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0

Frequency		63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
Wavelength @ 344m/s		5.46	2.75	1.38	0.69	0.34	0.17	0.09	0.04

Distance	
Attenuation	
	-
	-17.5
	-16.9
	-16.3
	-15.6
	-14.8
	-
	-
	-
	-
	-

Barrier Attenuation							
63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
-	-	-	-	-	-	-	-
-4.9	-5.1	-5.4	-6.0	-6.9	-8.4	-10.3	-12.7
-5.0	-5.2	-5.5	-6.2	-7.2	-8.8	-10.9	-13.3
-5.0	-5.2	-5.7	-6.4	-7.6	-9.3	-11.5	-14.0
-5.1	-5.4	-5.9	-6.7	-8.1	-9.9	-12.2	-14.8
-5.2	-5.5	-6.1	-7.1	-8.7	-10.7	-13.1	-15.8
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-

Calculation 18/006/C05, continued

Item Ref	Description	Silencer insertion loss							
		63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
Unit No.1									
Unit No.2									
Unit No.3									
Unit No.4									
Unit No.5									

Description	Other Losses							
	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
On time correction 66%	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8
On time correction 66%	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8
On time correction 66%	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8
On time correction 66%	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8
On time correction 66%	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8

Calculation 18/006/C05, continued

Item ref	Resultant Lp								dB(A)
	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	
0	-	-	-	-	-	-	-	-	-
Unit No.1	24.7	24.5	19.4	14.3	13.5	7.0	-0.4	-11.0	18.0
Unit No.2	25.2	25.0	19.9	14.7	13.8	7.2	-0.4	-11.0	18.3
Unit No.3	25.8	25.6	20.3	15.1	14.0	7.3	-0.4	-11.1	18.7
Unit No.4	26.4	26.1	20.8	15.5	14.2	7.4	-0.4	-11.2	19.0
Unit No.5	27.1	26.8	21.4	15.9	14.4	7.4	-0.5	-11.4	19.4
0	-	-	-	-	-	-	-	-	-
0	-	-	-	-	-	-	-	-	-
0	-	-	-	-	-	-	-	-	-
0	-	-	-	-	-	-	-	-	-
0	-	-	-	-	-	-	-	-	-

SUMMARY	Resultant Lp								dB(A)
	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	
Overall Plant Noise Level (freefield)	32.9	32.7	27.4	22.2	21.0	14.3	6.6	-4.1	26
No facade correction as 90 degree incidence angle									
Plant Noise Emission Limit Daytime 0700-2300									33

Calculation 18/006/C06

Atmospheric Plant Noise Assessment Calculation to Neighbouring property to west, north facing window in garage roof at 1 Oak Hill Way (daytime 0700-2300)

Item Ref	Operting (Y/N)	Sound pressure level Lp @ 2m								dB(A)
		63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	
										-
Unit No.1	Y	57.9	57.9	53.1	48.6	48.7	43.7	38.2	30.0	52.9
Unit No.2	Y	57.9	57.9	53.1	48.6	48.7	43.7	38.2	30.0	52.9
Unit No.3	Y	57.9	57.9	53.1	48.6	48.7	43.7	38.2	30.0	52.9
Unit No.4	Y	57.9	57.9	53.1	48.6	48.7	43.7	38.2	30.0	52.9
Unit No.5	Y	57.9	57.9	53.1	48.6	48.7	43.7	38.2	30.0	52.9
										-
										-
										-
										-
										-

Distance (Source, Receive,Barrier, Horizontal, Vertical)			
Src-Rec H.	Src-Rec V.	Src-Bar H.	Src-Bar V.
15	1.0	10.0	1.00
14	1.0	9.0	1.00
13	1.0	8.0	1.00
12	1.0	7.0	1.00
11	1.0	6.0	1.0

Calculation 18/006/C06, continued

Item Ref	Description	Other corrections							
		63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
Unit No.1	Stage 3 duty setback	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0
Unit No.2	Stage 3 duty setback	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0
Unit No.3	Stage 3 duty setback	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0
Unit No.4	Stage 3 duty setback	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0
Unit No.5	Stage 3 duty setback	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0	-9.0

Frequency		63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
Wavelength @ 344m/s		5.46	2.75	1.38	0.69	0.34	0.17	0.09	0.04

Distance	
Attenuation	
	-
	-17.5
	-16.9
	-16.3
	-15.6
	-14.8
	-
	-
	-
	-
	-
	-

Barrier Attenuation							
63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
-	-	-	-	-	-	-	-
-4.9	-5.1	-5.4	-6.0	-6.9	-8.4	-10.3	-12.7
-5.0	-5.2	-5.5	-6.2	-7.2	-8.8	-10.9	-13.3
-5.0	-5.2	-5.7	-6.4	-7.6	-9.3	-11.5	-14.0
-5.1	-5.4	-5.9	-6.7	-8.1	-9.9	-12.2	-14.8
-5.2	-5.5	-6.1	-7.1	-8.7	-10.7	-13.1	-15.8
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-

Calculation 18/006/C06, continued

Item Ref	Description	Silencer insertion loss							
		63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
Unit No.1									
Unit No.2									
Unit No.3									
Unit No.4									
Unit No.5									

Description	Other Losses							
	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
On time correction 66%	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8
On time correction 66%	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8
On time correction 66%	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8
On time correction 66%	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8
On time correction 66%	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8

Calculation 18/006/C06, continued

Item ref	Resultant Lp								dB(A)
	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	
0	-	-	-	-	-	-	-	-	-
Unit No.1	24.7	24.5	19.4	14.3	13.5	7.0	-0.4	-11.0	18.0
Unit No.2	25.2	25.0	19.9	14.7	13.8	7.2	-0.4	-11.0	18.3
Unit No.3	25.8	25.6	20.3	15.1	14.0	7.3	-0.4	-11.1	18.7
Unit No.4	26.4	26.1	20.8	15.5	14.2	7.4	-0.4	-11.2	19.0
Unit No.5	27.1	26.8	21.4	15.9	14.4	7.4	-0.5	-11.4	19.4
0	-	-	-	-	-	-	-	-	-
0	-	-	-	-	-	-	-	-	-
0	-	-	-	-	-	-	-	-	-
0	-	-	-	-	-	-	-	-	-
0	-	-	-	-	-	-	-	-	-

SUMMARY	Resultant Lp								dB(A)
	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	
Overall Plant Noise Level (freefield)	32.9	32.7	27.4	22.2	21.0	14.3	6.6	-4.1	26
No facade correction as 90 degree incidence angle									
Plant Noise Emission Limit Night Time 2300-0700									28



Cole Jarman Limited Reg. in England and Wales No. 7102436
An RSK Company
Registered Office Spring Lodge, 172 Chester Road, Helsby WA6 0AR
www.colejarman.com info@colejarman.com

Head Office +44 (0)1932 829007
John Cree House, 24b High Street, Addlestone, Surrey, United Kingdom KT15 1TN
Manchester 0161 470 8888 | Fourways House, 57 Hilton Street, Manchester M1 2EJ
Bristol 0117 287 2633 | The Old School, Stillhouse Lane, Bristol BS3 4EB