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1 FRIAR STREET
READING

NOISE IMPACT ASSESSMENT

Report **15834-NIA-01**

Prepared on 29 May 2020

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Document Revision	Date of Revision	Reasons for Revision	Revision By
0	29/05/2020	First Issue	Kenny Macleod MIOA

1.0 INTRODUCTION

Clement Acoustics has been commissioned to measure existing background noise levels at 1 Friar Street, Reading. Measured noise levels have been used to determine noise emissions criteria for a proposed plant installation in agreement with the planning requirements of Reading Borough Council.

This report presents the results of the environmental survey followed by noise impact calculations and outlines any necessary mitigation measures.

2.0 SITE DESCRIPTION

Current proposals are to install:

- 1 No. Reco-Air Unit
  - To be installed internally with discharge ducting terminating within the rear lightwell
- 1 No. Nuaire Heat Recovery Unit
  - To be installed internally with intake ducting terminating at the front of the building and discharge ducting terminating within the rear lightwell
- 2 No. Toshiba Outdoor Condensers,
  - To be installed at ground floor level within rear lightwell
- 1 No. Nuaire DAVE Toilet Extract Fan
  - To be installed internally with discharge ducting terminating within the rear lightwell
- 1 No. Nuaire DAVE Washup Extract Fan
  - To be installed internally with discharge ducting terminating within the rear lightwell

It is understood that the proposed plant units will be for commercial use, however operational hours are currently unknown. To provide a robust assessment, it will be assumed the plant units could be in operation at any time.

The closest receiver to the external condensers, general ventilation extract and washup & WC extract louvres has been identified as the window on the rear façade of a residential property opposite which is a minimum of 17 m from the proposed plant location, with screening provided by the external building fabric.

The closest receiver to the air intake louvre has been identified as the window on the façade of a residential property above which is a minimum of 3 m from the proposed louvre.

These nearest noise sensitive receivers were identified through observations on-site. If there are any receivers closer to that identified within this report then a further assessment will need to be carried out. Therefore, the closest noise sensitive receiver should be confirmed by the client before the plant is installed or any noise mitigation measures are implemented.

Locations are shown in attached site plans 15834-SP1 & SP2

3.0 ENVIRONMENTAL NOISE SURVEY

3.1 Procedure

Measurements were undertaken at one position as shown on indicative site drawing 15834-SP1. The choice of this position was based both on accessibility and on collecting representative noise data in relation to the site.

The microphone was mounted on a pole at 2nd storey level at the rear of the building. The position was considered to be free-field according to guidance found in BS 4142: 2014, and a correction for reflections has therefore not been applied. Noise levels at the monitoring position were dominated by existing plant units and distant road traffic during the installation and collection of equipment.

Continuous automated monitoring was undertaken for the duration of the survey between 13:15 on 27 February 2020 and 02:00 on 1 March 2020.

Weather conditions were generally dry with light winds, therefore suitable for the measurement of environmental noise.

The measurement procedure generally complied with BS 7445: 1991: '*Description and measurement of environmental noise, Part 2- Acquisition of data pertinent to land use*'.

3.2 Equipment

The equipment calibration was verified before and after use and no abnormalities were observed.

The equipment used was as follows.

- 1 No. Svantek Type 957 Class 1 Sound Level Meter
- Norsonic Type 1251 Class 1 Calibrator

4.0 RESULTS

The $L_{Aeq:\ 5min}$, $L_{Amax:\ 5min}$, $L_{A10:\ 5min}$ and $L_{A90:\ 5min}$ acoustic parameters were measured at the location shown in site drawing 15834-SP1.

Measured noise levels are shown as a time history in Figure 15834-TH1, with average ambient and minimum background noise levels summarised in Table 4.1.

	Average ambient noise level $L_{eq:\ T}$	Minimum background noise level $L_{90:\ 5min}$
Daytime (07:00 - 23:00)	56 dB(A)	45 dB(A)
Night-time (23:00 - 07:00)	55 dB(A)	40 dB(A)

Table 4.1: Average ambient and minimum background noise levels

5.0 NOISE CRITERIA

The Reading Borough Council criteria for noise emissions is as follows:

> *"The predicted specific sound level (LAeq,TR) (with reference to BS:4142) as measured at a point 1 metre external to the nearest noise-sensitive facade shall be at least 10dB below the pre-existing background sound level, LA90,T when all plant/equipment (or any part of it) is in operation."*

It is understood that the proposed plant units will be for commercial use, however operational hours are currently unknown. To provide a robust assessment, it will be assumed the plant units could be in operation at any time. The noise emissions criterion of 30 dB(A), the value 10 dB below

the minimum measured background noise level during the night-time hours, will therefore be used for the purpose of this assessment.

6.0 PLANT NOISE IMPACT ASSESSMENT

6.1 Proposed Installation

The proposed plant installation comprises the following:

- 1 No. Reco-Air Unit
  - To be installed internally with discharge ducting terminating within the rear lightwell
- 1 No. Nuaire Heat Recovery Unit
  - To be installed internally with intake ducting terminating at the front of the building and discharge ducting terminating within the rear lightwell
- 2 No. Toshiba Outdoor Condensers
  - To be installed at ground floor level within rear lightwell
- 1 No. Nuaire DAVE Toilet Extract Fan
  - To be installed internally with discharge ducting terminating within the rear lightwell
- 1 No. Nuaire DAVE Washup Extract Fan
  - To be installed internally with discharge ducting terminating within the rear lightwell

The above plant details and locations have been interpreted using drawing 1968.Reading '*HVAC Plan*'. Where the plant or duct termination locations vary from the above, a reassessment may be necessary and Clement Acoustics should be informed accordingly.

Noise emissions for the proposed plant units, as provided by the manufacturers, are shown in Table 6.1. Loudest modes of operation have been used in order to present a robust worst-case assessment.

Unit	Noise Levels (dB) in each Frequency Band								
	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	dB(A)
Reco-Air Unit Induct Discharge Sound Power Level[1],[2]	101	96	99	86	87	86	81	78	94
Nuaire Heat Recovery Unit Induct Intake Sound Power Level	81	74	75	63	64	61	53	41	70
Nuaire Heat Recovery Unit Induct Discharge Sound Power Level	86	81	84	71	72	71	66	63	79
Toshiba Outdoor Condenser Sound Pressure Level at 1 meter[1],[3]	55	55	53	49	49	45	39	31	53
Nuaire DAVE Toilet Extract Fan Induct Outlet Sound Power Level	78	78	61	57	57	58	54	54	66
Nuaire DAVE Washup Extract Fan Induct Outlet Sound Power Level	82	82	65	60	59	59	54	55	69

Table 6.1: Manufacturer provided noise emissions levels

[1] No spectral data is available for these units, therefore data from a similar sized unit has been used and corrected accordingly.

[2] Induct levels were estimated using the stated breakout level and data from a similar sized unit.

[3] The noise emissions for these units have been taken from information provided by the Client. As model numbers were not provided, it was not possible to obtain noise levels direct from the manufacturer. Drawings show 3 condenser units in the rear plant lightwell, although data is only provided for 2 units, which have been assessed accordingly. If there is a third unit as shown, data should be provided for this so that it can be assessed accordingly.

The proposed plant locations are as described above and are shown on indicative site plans 15834-SP1 & SP2.

6.2 Proposed Mitigation Measures

In order to meet the proposed criteria stated in Section 5.0, it is recommended that in-line attenuators are installed within the ductwork serving the Reo-Air and Nuaire Heat Recovery Units. These should be installed on the atmosphere side of the ductwork, immediately adjacent to the fan in the duct run.

Based on the information provided, attenuators meeting the sound reduction indices as stated in Table 6.2 should be suitable to achieve this.

	Required Attenuation (dB) in each Frequency Band							
Mitigation	**63Hz**	**125Hz**	**250Hz**	**500Hz**	**1kHz**	**2kHz**	**4kHz**	**8kHz**
In-line Attenuator for Reco-Air Unit Discharge	0	1	5	7	8	7	1	0
In-line Attenuator for Nuaire Heat Recovery Unit Intake	2	6	13	23	24	24	14	7

Table 6.2: Required attenuation from mitigation

6.3 Noise Impact Assessment

The closest receiver to the external condensers, general ventilation extract and washup & WC extract louvres has been identified as the window on the rear façade of a residential property opposite which is a minimum of 17 m from the proposed plant location, with screening provided by the external building fabric.

The closest receiver to the air intake louvre has been identified as the window on the façade of a residential property above which is a minimum of 3 m from the proposed louvre.

Taking into account all necessary acoustic corrections, the resulting noise level at the identified residential windows would be as shown in Table 6.3. Detailed calculations are shown in Appendix B.

Receiver	Night-Time Hours Criterion	Noise Level at Receiver (due to proposed plant)
Nearest Residential Property 1	30 dB(A)	30 dB(A)
Nearest Residential Property 2		30 dB(A)

Table 6.3: Noise levels and criterion at noise sensitive receivers

As presented in Table 6.3 and Appendix B, the proposed plant installation with mitigation would be expected to meet the requirements of the proposed criteria.

6.4 British Standard Requirements

Further calculations have been undertaken to assess whether the noise emissions from the proposed plant units would be expected to meet recognised British Standard recommendations, in order to further ensure the amenity of nearby noise sensitive receivers.

British Standard 8233: 2014 '*Guidance on sound insulation and noise reduction for buildings*' gives recommendations for acceptable internal noise levels in residential properties. Assuming worst case conditions, of the closest window being for a bedroom, BS 8233: 2014 recommends 30 dB(A) as being acceptable internal resting/sleeping conditions during night-time.

With loudest external levels of 30 dB(A), acceptable internal conditions would be met without taking the attenuation of the window itself into consideration. According to BS 8233: 2014, a typical building facade with a partially open window offers 15 dB attenuation.

It can therefore be predicted that, in addition to meeting the requirements of the set criteria, the emissions from the proposed plant would be expected to meet the most stringent recommendations of the relevant British Standard, with neighbouring windows partially open. Predicted levels are shown in Table 6.4.

Receiver	Recommended Target – *For resting/sleeping conditions in a bedroom, in BS 8233: 2014*	Noise Level at Receiver (due to plant installation)
Inside Residential Window 1	30 dB(A)	15 dB(A)
Inside Residential Window 2		15 dB(A)

Table 6.4: Noise levels and criteria inside nearest residential spaces

7.0 CONCLUSION

An environmental noise survey has been undertaken at 1 Friar Street, Reading. The results of the survey have enabled criteria to be set for noise emissions from the proposed plant units in accordance with the requirements of Reading Borough Council.

A noise impact assessment has then been undertaken using manufacturer noise data to predict the noise levels, due to the proposed plant, at the nearby noise sensitive receivers.

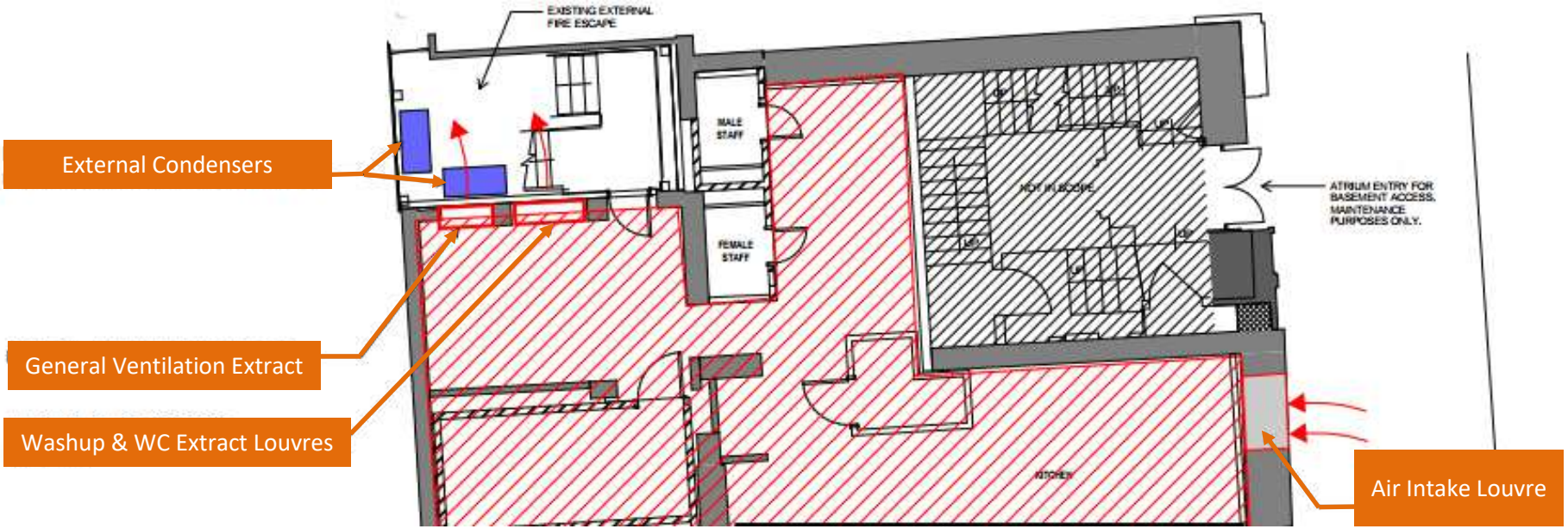
Calculations show that noise emissions from the proposed plant units should meet the requirements of the Reading Borough Council with the recommended mitigation installed as stated herein.

Report by	Approved by
Kenny Macleod MIOA	**Duncan Martin MIOA**

Noise Survey Position

Noise Sensitive Receiver

15834-SP1 Indicative site plan indicating noise monitoring position and nearest noise sensitive receivers **Date:** 29 May 2020



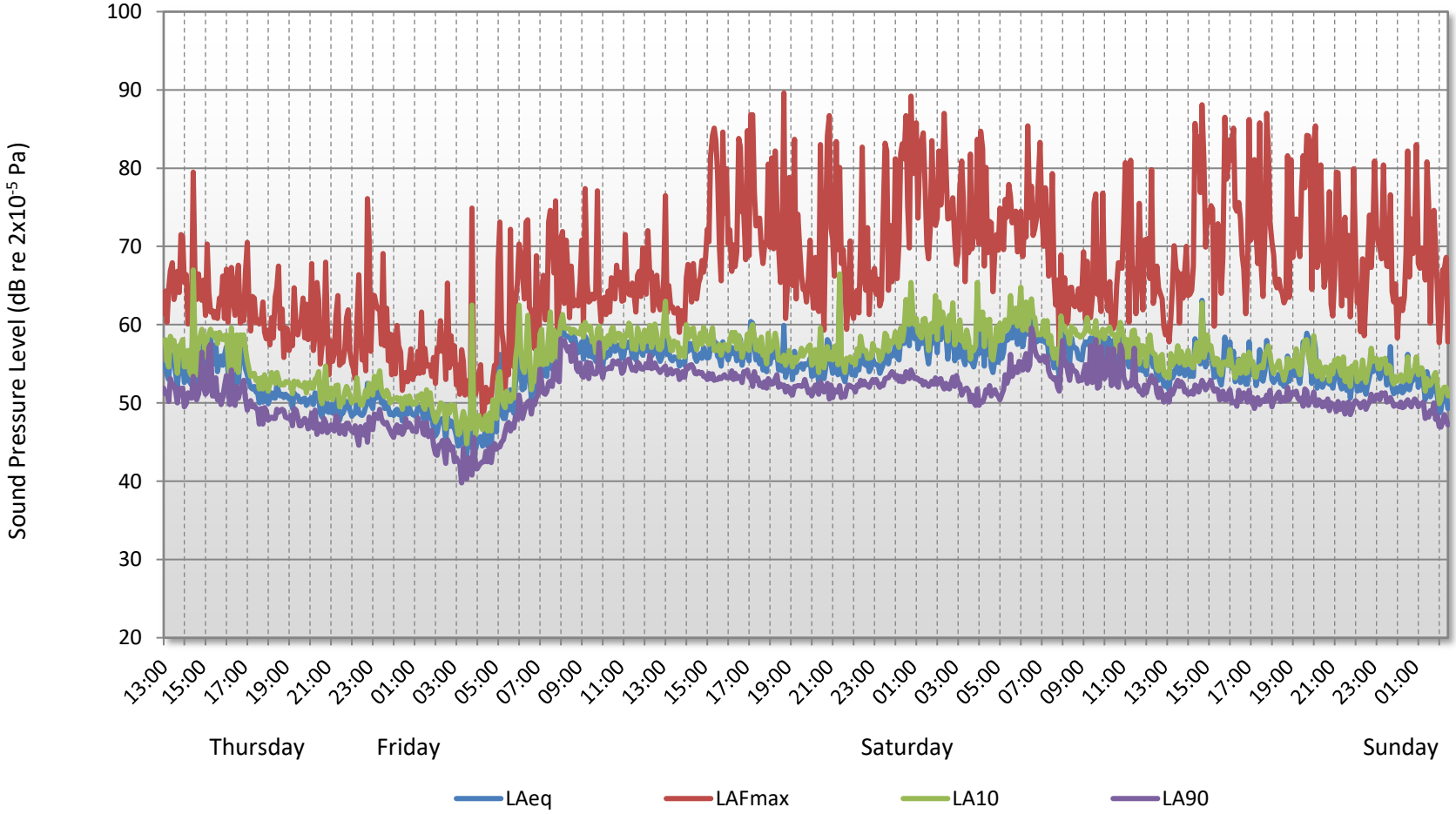
15834-SP2 Indicative site plan indicating proposed location for units

Date: 29 May 2020

1 Friar Street, Reading

Environmental Noise Time History

27 February 2020 - 01 March 2020



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APPENDIX A

GLOSSARY OF ACOUSTIC TERMINOLOGY

dB(A)

The human ear is less sensitive to low (below 125Hz) and high (above 16kHz) frequency sounds. A sound level meter duplicates the ear's variable sensitivity to sound of different frequencies. This is achieved by building a filter into the instrument with a similar frequency response to that of the ear. This is called an A-weighting filter. Measurements of sound made with this filter are called A-weighted sound level measurements and the unit is dB(A).

L_{eq}

The sound from noise sources often fluctuates widely during a given period of time. An average value can be measured, the equivalent sound pressure level L_{eq}. The L_{eq} is the equivalent sound level which would deliver the same sound energy as the actual fluctuating sound measured in the same time period.

L_{10}

This is the level exceeded for not more than 10% of the time. This parameter is often used as a "not to exceed" criterion for noise

L_{90}

This is the level exceeded for not more than 90% of the time. This parameter is often used as a descriptor of "background noise" for environmental impact studies.

L_{max}

This is the maximum sound pressure level that has been measured over a period.

Octave Bands

In order to completely determine the composition of a sound it is necessary to determine the sound level at each frequency individually. Usually, values are stated in octave bands. The audible frequency region is divided into 10 such octave bands whose centre frequencies are defined in accordance with international standards.

Addition of noise from several sources

Noise from different sound sources combines to produce a sound level higher than that from any individual source. Two equally intense sound sources operating together produce a sound level which is 3dB higher than one alone and 10 sources produce a 10dB higher sound level.

Attenuation by distance

Sound which propagates from a point source in free air attenuates by 6dB for each doubling of distance from the noise source. Sound energy from line sources (e.g. stream of cars) drops off by 3dB for each doubling of distance.

Subjective impression of noise

Sound intensity is not perceived directly at the ear; rather it is transferred by the complex hearing mechanism to the brain where acoustic sensations can be interpreted as loudness. This makes hearing perception highly individualised. Sensitivity to noise also depends on frequency content, time of occurrence, duration of sound and psychological factors such as emotion and expectations. The following table is a reasonable guide to help explain increases or decreases in sound levels for many acoustic scenarios.

Change in sound level (dB)	Change in perceived loudness
1	Imperceptible
3	Just barely perceptible
6	Clearly noticeable
10	About twice as loud
20	About 4 times as loud

Barriers

Outdoor barriers can be used to reduce environmental noises, such as traffic noise. The effectiveness of barriers is dependent on factors such as its distance from the noise source and the receiver, its height and its construction.

Reverberation control

When sound falls on the surfaces of a room, part of its energy is absorbed and part is reflected back into the room. The amount of reflected sound defines the reverberation of a room, a characteristic that is critical for spaces of different uses as it can affect the quality of audio signals such as speech or music. Excess reverberation in a room can be controlled by the effective use of sound-absorbing treatment on the surfaces, such as fibrous ceiling boards, curtains and carpets.

APPENDIX B1

15834

1 Friar Street, Reading

EXTERNAL PLANT NOISE EMISSIONS CALCULATION

Receiver: Nearest Residential Receiver 1
Source: Proposed plant installation

	Frequency, Hz								
	63	*125*	*250*	*500*	*1k*	*2k*	*4k*	*8k*	*dB(A)*
Reco-Air Unit Induct Discharge Sound Power Level	101	96	99	86	87	86	81	78	94
Installation effects, dB	3	6	7	8	8	6	5	3	
System losses, dB	-7	-6	-6	-7	-7	-7	-7	-7	
Required attenuation from mitigation (in-line attenuator), dB	0	-1	-5	-7	-8	-7	-1	0	
End reflection, dB	-5	-2	0	0	0	0	0	0	
Sound power at grille, dB	92	93	95	80	80	78	78	74	89
Radiating correction, dB	-8	-8	-8	-8	-8	-8	-8	-8	
Directivity correction, dB	-3	-5	-10	-13	-18	-21	-21	-21	
Correction due to screening from building envelope, dB	-11	-13	-17	-22	-22	-22	-22	-22	
Distance correction to receiver, dB (17 m)	-25	-25	-25	-25	-25	-25	-25	-25	
Sound pressure level from Reco-Air Unit Induct Discharge	**45**	**42**	**35**	**12**	**8**	**2**	**2**	**-2**	**30**
Nuaire Heat Recovery Unit Induct Discharge Sound Power Level	86	81	84	71	72	71	66	63	79
System losses, dB	-5	-4	-3	-3	-4	-4	-4	-4	
End reflection, dB	-9	-5	-2	0	0	0	0	0	
Sound power at grille, dB	72	72	79	68	68	67	62	59	75
Radiating correction, dB	-8	-8	-8	-8	-8	-8	-8	-8	
Directivity correction, dB	-2	-3	-6	-11	-18	-21	-21	-21	
Correction due to screening from building envelope, dB	-11	-13	-17	-22	-22	-22	-22	-22	
Distance correction to receiver, dB (17 m)	-25	-25	-25	-25	-25	-25	-25	-25	
Sound pressure level from Nuaire Heat Recovery Induct Discharge	**27**	**23**	**23**	**3**	**-4**	**-9**	**-14**	**-17**	**16**
Toshiba Outdoor Condenser Sound Pressure Level at 1 meter	55	55	53	49	49	45	39	31	53
Correction due to number of units, dB (2 No.)	3	3	3	3	3	3	3	3	
Combined Sound Pressure Level	58	58	56	52	52	48	42	34	
Correction for reflections, dB	9	9	9	9	9	9	9	9	
Correction due to screening from building envelope, dB	-11	-13	-17	-22	-22	-22	-22	-22	
Distance correction to receiver, dB (17 m)	-25	-25	-25	-25	-25	-25	-25	-25	
Sound pressure level from Toshiba Outdoor Condensers	**32**	**29**	**23**	**15**	**14**	**10**	**4**	**-4**	**20**
Nuaire DAVE Toilet Extract Fan Induct Outlet Sound Power Level	78	78	61	57	57	58	54	54	66
Installation effects, dB	3	6	7	8	8	6	5	3	
System losses, dB	-1	-1	-1	-1	-1	-2	-3	-3	
End reflection, dB	-14	-9	-5	-2	0	0	0	0	
Sound power at grille, dB	66	74	62	62	64	62	56	54	68
Radiating correction, dB	-8	-8	-8	-8	-8	-8	-8	-8	
Directivity correction, dB	-2	-3	-6	-11	-18	-21	-21	-21	
Correction due to screening from building envelope, dB	-11	-13	-17	-22	-22	-22	-22	-22	
Distance correction to receiver, dB (17 m)	-25	-25	-25	-25	-25	-25	-25	-25	
Sound pressure level from Nuaire Toilet Extract Fan Induct Outlet	**21**	**24**	**6**	**-3**	**-9**	**-14**	**-20**	**-22**	**9**
Nuaire DAVE Washup Extract Fan Induct Outlet Sound Power Level	82	82	65	60	59	59	54	55	69
Installation effects, dB	3	6	7	8	8	6	5	3	
System losses, dB	-1	-1	-1	-1	0	0	0	0	
End reflection, dB	-12	-7	-3	-1	0	0	0	0	
Sound power at grille, dB	72	80	68	66	67	65	59	58	72
Radiating correction, dB	-8	-8	-8	-8	-8	-8	-8	-8	
Directivity correction, dB	-2	-3	-6	-11	-18	-21	-21	-21	
Correction due to screening from building envelope, dB	-11	-13	-17	-22	-22	-22	-22	-22	
Distance correction to receiver, dB (17 m)	-25	-25	-25	-25	-25	-25	-25	-25	
Sound pressure level from Nuaire Washup Extract Fan Induct Outlet	**27**	**30**	**12**	**1**	**-6**	**-11**	**-17**	**-18**	**15**
Cumulative sound pressure level at receiver	**46**	**43**	**36**	**17**	**15**	**11**	**6**	**0**	**30**

Design Criterion	**30**

BS 8233 ASSESSMENT CALCULATION

Receiver: Inside Nearest Residential Window 1
Source: Proposed plant installation

	Frequency, Hz								
	63	*125*	*250*	*500*	*1k*	*2k*	*4k*	*8k*	*dB(A)*
Sound pressure level outside window	46	43	36	17	15	11	6	0	30
Minimum attenuation from partially open window, dB	-15	-15	-15	-15	-15	-15	-15	-15	
Sound pressure level inside nearest noise sensitive premises	**31**	**28**	**21**	**2**	**0**	**-4**	**-9**	**-15**	**15**

Design Criterion	**30**

APPENDIX B2

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1 Friar Street, Reading

EXTERNAL PLANT NOISE EMISSIONS CALCULATION

Receiver: Nearest Residential Receiver 2
Source: Proposed plant installation

	Frequency, Hz								
	63	*125*	*250*	*500*	*1k*	*2k*	*4k*	*8k*	*dB(A)*
Nuaire Heat Recovery Unit Induct Intake Sound Power Level	81	74	75	63	64	61	53	41	70
System losses, dB	-12	-10	-5	-2	-2	-2	-2	-2	
Required attenuation from mitigation (in-line attenuator), dB	-2	-6	-13	-23	-24	-24	-14	-7	
End reflection, dB	-9	-5	-2	0	0	0	0	0	
Sound power at grille, dB	58	53	55	38	38	35	37	32	48
Radiating correction, dB	-8	-8	-8	-8	-8	-8	-8	-8	
Distance correction to receiver, dB (3 m)	-10	-10	-10	-10	-10	-10	-10	-10	
Sound pressure level at receiver	**40**	**35**	**37**	**20**	**20**	**17**	**19**	**14**	**30**

Design Criterion	**30**

BS 8233 ASSESSMENT CALCULATION

Receiver: Inside Nearest Residential Window 2
Source: Proposed plant installation

	Frequency, Hz								
	63	*125*	*250*	*500*	*1k*	*2k*	*4k*	*8k*	*dB(A)*
Sound pressure level outside window	40	35	37	20	20	17	19	14	30
Minimum attenuation from partially open window, dB	-15	-15	-15	-15	-15	-15	-15	-15	
Sound pressure level inside nearest noise sensitive premises	**25**	**20**	**22**	**5**	**5**	**2**	**4**	**-1**	**15**

Design Criterion	**30**