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Ms Josleen Chug,
London Borough of Camden,
Regeneration and Planning,
2nd Floor,
5 Pancras Square,
London, N1C 4AG.

Your ref	2015/5353/P
Our ref	Reps GOSH
Direct line	0207 852 4583
Pippa.Nisbet@eu.jll.com	

3rd November 2015

Dear Ms Chug,

COMMENTS ON APPLICATION REFERENCE 2015/5353/P
Great Ormond Street Hospital, Great Ormond Street, London, WC1N 3JH

Installation of 4 chiller units at roof level of Variety Club Building (East and West roofs) with associated screening and pipework.

I write to object on behalf of my Client, UCLH NHS Foundation Trust, to the above mentioned application. UCLH has a variety of concerns in relation to this application.

UCLH has a number of medical buildings within its Estate. Its National Hospital for Neurology and Neurosurgery (NHNN) and Royal London Hospital for Integrated Medicine (RLHIM) are located on Queen Square and Great Ormond Street respectively. Both these buildings also have entrances on Powis Place.

UCLH seeks to work in a constructive and pragmatic manner with the owners and occupiers of buildings adjacent to their properties. It understands that GOSH's proposals form an essential part of the Hospital's infrastructure. UCLH clearly supports medical practises and improvements but UCLH must ensure that they fully protect hospital operations and the care of their own patients and staff. UCLH is an essential medical provider in the area.

UCLH's objections to GOSH's application include:

1) **Transport** – Whilst it is understood there is no validation requirement to submit a Transport Assessment, the application provides no detail on construction and maintenance requirements regarding traffic. The Planning Statement states that the chosen location for the new equipment enables a crane to be accessed from Powis Place and that this is a private road. There is no mention of the need for other people using this private road or how it will impact on this.

   Powis Place is used by UCLH and provides essential access for blue light ambulances, patient transport service vehicles, and hospital servicing vehicles. A Construction Management Plan with particular reference to how full access to and over Powis Place will

be maintained with priority assured at all times must be provided. This would need to be drawn up in agreement with UCLH.

2) **Noise** – We include a copy of an Independent Assessment of the Noise Report submitted by BDP. This has been undertaken by Cole Jarman on behalf of UCLH. The Report concludes that higher noise levels may be generated than BDP have identified. The proposed screen on the west roof is not expected to be as effective in reducing noise emissions as allowed for in the BDP assessment, giving a resulting noise some 5dB above the relevant design standard. This would significantly impact on the wards at the NHNN which have openable windows.

3) **Daylight/ Sunlight** – No Daylight/ Sunlight Assessment has been submitted. BRE guidelines specifically mention that other types of buildings in addition to residential should be considered. The guidelines specifically mention hospitals as an example of other types of buildings that might need to be considered. The proposed plant enclosure on the west roof is of a substantial size and we believe it will have a detrimental impact to the levels of daylight/ sunlight received into the wards which are located in the Chandler Wing of the NHNN which faces Powis Place.

4) **Visual impact of the proposed plant on the west roof** – whilst GOSH states they have used materials for the plant enclosure to match other recent installations on their estate, the bulk of the structure will have significant visual impact and create a sense of enclosure down Powis Place. The enclosure will also have a detrimental impact on UCLH's NHNN as a listed building opposite the site and other listed properties to the south on Great Ormond Street.

   This visual impact is emphasised by the views from both the NHNN from Powis Place and views from the south on Great Ormond Street which are highlighted within the D&A as selected areas most likely to be affected.

We therefore respectfully request that UCLH's comments are fully taken into consideration in the determination of this application. Should you have any questions or concerns, please contact Pippa Nisbet of these offices on 0207 852 4583.

Yours sincerely,

JLL

Memorandum

To:	**Carl Standley (CPW)**
From:	**Vernon Cole**
Project:	**UCLH Review of GOSH Rooftop Chiller Application**
Subject:	**Plant Noise Assessment**
Reference:	**25/0650/M1**
Date:	**29 October 2015**

1 Introduction

1.1 Great Ormond Street Hospital (GOSH) have applied to the London Borough of Camden for consent to install new plant on the roof of the Variety Club Building. The plant comprises a number of air cooled chillers, associated pumps and a packaged substation.

1.2 The application has been supported by a Noise Impact Assessment undertaken by BDP and reported on 5th August 2015. The assessment derives plant noise emission criteria based on a noise survey at the site and analyses noise transmission to a number of sensitive locations including the façade of the National Hospital for Neurology and Neurosurgery (NHNN) on the opposite side of Powys Place.

1.3 The assessment concludes that through the use of screening, the derived noise standard can be achieved at the highest windows in the NHNN façade facing the GOSH site.

1.4 The highest occupied accommodation is at 4th floor level in the NHNN building and comprises recovery wards with openable windows. The University College London Hospital (UCLH) is particularly concerned that such sensitive accommodation should not be adversely affected by noise from the new plant. As a result Cole Jarman have been commissioned to review the BDP assessment, and to come to a view whether there is a risk of excessive noise being generated.

2 Noise Survey and Assessment Standards

2.1 BDP carried out noise level measurements over a 24 hour period at a location which is considered representative of the nearest overlooking façade of the NHNN building. They determined that the lowest background noise level during the period was 53dB L_{A90}, occurring during the night period 23h00 to 07h00. We have no reason to dispute or doubt this figure.

2.2 Based on the Camden noise policy, BDP propose to design to a level 10dB below this minimum measured noise level based on the presumption that noise emission from the packaged substation is likely to contain tonal elements.

2.3 We concur with this choice of design standard, but believe that noise from the proposed chillers is also likely to be characterised by affected receptors as tonal. This view is based on examination of the quoted octave band noise data contained in Table 4 of the BDP report, which is repeated below:

Table 4 Sound pressure levels of the proposed plant items

Plant Item	Sound Pressure Level at 1m from the unit, dB (ref. 2 x 10^{-5} Pa)									Sound Power dB(A)
	63Hz	125Hz	250Hz	500Hz	1000Hz	2000Hz	4000Hz	8000Hz	dB(A)	
ACC/VCB/ (E) 01 &02	72	69	69	72	67	62	54	47	**72**	**92**
ACC/VCB/ (W) 01 &02	57	59	65	70	72	65	61	52	**74**	**96**
PMP CHW 01 & 02 (1)	60	61	58	57	59	58	58	55	**65**	-
PMP CHW 03 & 04 (1)	48	49	46	45	47	46	46	43	**53**	-
ESS (2)	47	62	62	59	45	37	30	31	**58**	-

Notes

(1) The octave band spectrum is taken from typical pump units and adjusted to match the A-weighted sound pressure level provided by the pump manufacturer.

(2) The electrical substation manufacturer has provided the A-weighted sound pressure level measured at 1m from a similar substation, when the load was low. Noise emissions from electrical substations are typically lower when they are under typical load conditions and therefore a worst case scenario is presented. The octave band spectrum is taken from a typical transformer unit and adjusted to match the A-weighted sound pressure level provided.

2.4 Both air cooled chiller selections incorporate screw compressors which run at high speed and tend to produce a 'whining' noise. This is indicated by the uplift in levels in the 500Hz octave band for the east compound chillers and by the uplift in levels in the 500Hz and 1kHz octave bands for the west compound chillers. If third octave or line spectrum data were available, the tonal character of the noise might be easier to identify, but in the absence of such information, octave band uplifts of the type set out above are characteristic of such features.

2.5 This point is made to emphasize the importance of design to 10dB below the background noise level for all items of plant, and in particular the chillers which are expected to be the dominant noise sources.

3 Noise emission Analysis

3.1 BDP Assessment

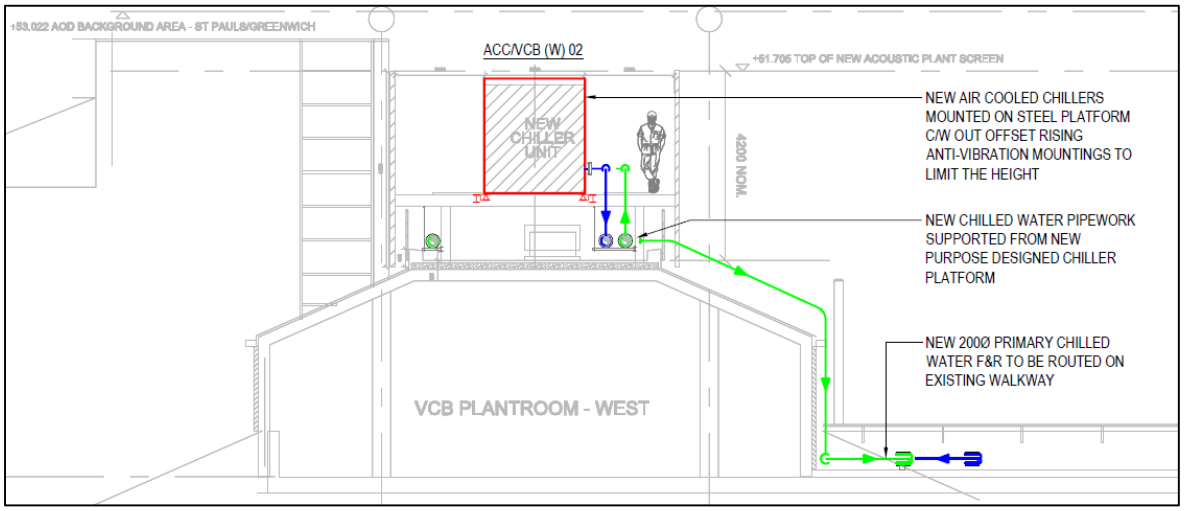
3.1.1 The BDP analysis concludes that at the façade of the NHNN, their assessment position SR1, noise levels generated by the new plant are expected to be 57dB. The noise level is entirely dominated by emission from the chillers in the west compound, and the predicted level exceeds the design standard by 14dB.

3.1.2 This analysis is summarised in BDP Table 6, which is repeated below for convenience.

Table 6 Calculated sound pressure levels at each noise sensitive receptor

Plant Ref.	Location	Resultant Noise Level at each Noise Sensitive Receptor			
		SR1	SR2	SR3	SR4
ACC/VCB (E) 01	VCB east roof	25 dB	47 dB	25 dB	30 dB
ACC/VCB (E) 02	VCB east roof	25 dB	47 dB	25 dB	30 dB
ACC/VCB (W) 01	VCB west roof	55 dB	57 dB	55 dB	55 dB
ACC/VCB (W) 02	VCB west roof	54 dB	60 dB	55 dB	38 dB
PMP CHW 01	VCB west roof	16 dB	13 dB	8 dB	15 dB
PMP CHW 03 & 04	VCB east roof	0 dB	0 dB	0 dB	0 dB
ESS	VCB west roof	28 dB	35 dB	21 dB	26 dB
Total Predicted Noise Level		**57 dB**	**62 dB**	**58 dB**	**55 dB**
Night-time Noise Emission Limits		**43 dB**	**45 dB**	**45 dB**	**45 dB**
Difference		**+14 dB**	**+17 dB**	**+13 dB**	**+10 dB**

3.1.3 In order to mitigate noise emission from the proposed new plant, it is proposed to install an acoustic screen on the west, north and east sides of each plant compound. The screen is specified to be constructed using solid barriers with a mass of not less than 20kg/m^2 and an absorptive surface facing inward toward the plant. The location and size of the screen is indicated in TBA drawing LA5566-M-51-RR-001 Revision R01, which is contained in the BDP report, an excerpt from which is shown below:



For the western plant compound, which is of interest with regard to noise emission to the NHNN, it can be seen that the screen extends in height to the top of the chillers and is located 2m from the sides of the chillers. It should be noted that a significant noise source in the chillers is the fans, which are located on the top panel.

3.1.4 BDP identify the proposed screens as being capable of attenuating noise from chillers by 14dB, thereby reducing the predicted plant noise levels to 43dBA, exactly equivalent to the proposed noise standard. It should be noted that no details are provided in the report of the geometry of

the source/receiver/barrier arrangement so the precise path difference values that have been used in the BDP analysis cannot be determined.

3.2 Cole Jarman Assessment

3.2.1 We do not have the benefit of scaled drawings showing the plan and section of the proposed plant installation in relation to the 4th floor NHNN ward windows. However, based on the drawn information in the BDP report and scaling off heights and distances using Google Earth Pro, the following are considered to be the relevant dimensions for the analysis of plant noise emission and screening effects:

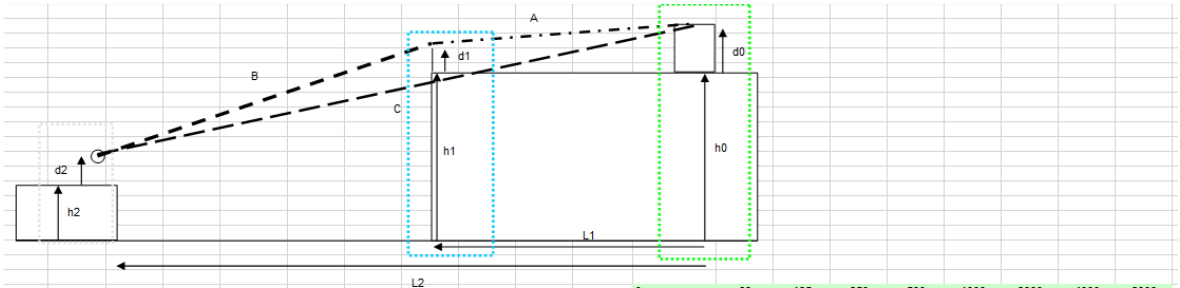
- Horizontal distance NHNN ward windows to chiller plant: 28m
- Vertical distance top of NHNN ward windows to top of chiller plant: 8m
- Vertical distance top screen to top of NHNN ward windows: 8m
- Horizontal distance screen to chiller plant: 2m

3.2.2 For the unscreened condition, calculations of the expected noise levels are set out in attached Calculation sheets CS1 to CS5. It can be seen that taking the plant noise level data as set out in the BDP report, and allowing for some directivity effects for noise radiated by the fans on the top of the chillers, we predict façade incident noise levels at the nearest NHNN windows of 58dBA, 1dB higher than the values determined by BDP. This degree of difference is not considered material.

3.2.3 Considering the summary contained in CS5, it is clear that the noise levels at the receptor are dominated by the air cooled chillers, as indicated in the BDP assessment.

3.2.4 For the unscreened condition, calculations of the expected noise levels are set out in attached Calculation sheets CS6 to CS10. Our calculations indicate that the screen is not expected to be as effective in reducing noise emission as allowed for in the BDP assessment, giving a resulting overall noise level of 48dBA, some 5dB above the relevant design standard.

3.2.5 For clarity, we set out below the dimensions that have been in the assessment of screening.



	h0	d0	L1	h1	d1	L2	h2	d2	DELTA	VIEW	frequency	63	125	250	500	1000	2000	4000	8000
											c = 343 m/s	5.44	2.74	1.37	0.69	0.34	0.17	0.09	0.04
1	16	8	2	16	8	28	16	0	0.083	Shadow		-6.4	-6.8	-7.5	-8.7	-10.6	-13.0	-15.9	-18.9

3.2.6 Effectively, the screening is limited by the fact that the significant noise sources on the chillers, the fans, are located at the same height as the top of the screen. Therefore, while the screening

is effective at removing the line of site from the 4th floor windows in the NHNN building, but it does not provide a deep shadow zone which is required for optimum effectiveness.

4 Conclusions

4.1 Our analysis has indicated that noise emission from the proposed new plant installation at Great Ormond Street Hospital may generate noise levels that exceed the relevant noise standard during night time operation. This is a significant concern for University College London Hospital, as the receptors in question are wards in the National Hospital for Neuroscience and Neurosurgery. The wards have openable windows.

4.2 Our assessment of noise from the plant located on the roof of the Variety Club Building indicates that in the unscreened condition, the levels we predict are very similar to those resulting from the BDP assessment. However, we believe that the proposed screening will be less effective at controlling noise from the dominant noise sources, the fans on the top of each air cooled chiller.

4.3 We accept that our assessment has been based on dimensions and offset distances that are not marked on fully scaled drawings and have not been surveyed. They have been taken from the best available sources for this desk top study. However, even our analysis allows for full screening of noise sources by the proposed acoustic barrier, whereas in practice there will be a reduction in the actual screening loss due to the build-up of sound within the fully screened compounds resulting from reflections off the various internal surfaces.

4.4 By BDPs own assessment, the predicted noise emission in the screened condition exactly matches the recommended noise limit. Given the sensitivity of the calculation to the precise geometric arrangement of plant, screens and receptors, plus the possible imperfect performance of the proposed screens plus the high degree of sensitivity of the receptors, it would be prudent to allow for a degree of tolerance in the design.

4.5 Allowing for that tolerance and/or taking account of the higher noise levels we are predicting compared to the BDP analysis suggests that a re-evaluation is required and a higher degree of noise mitigation should be allowed for.

End of Section

Calculation Sheet 15/0650/CS1

ACC/VOB/ (W) 01 to AP1

		Octave Band Centre Frequency (Hz)								
		63	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**	
Noise Source										
Noise Source - ACC/VOB/ (W) 01										
Sound Pressure Levels @ 1m		**57**	**59**	**65**	**70**	**72**	**65**	**61**	**52**	**74dBA**
Full Conformal Area										
Distance (m)	1									
Type - Semi-anechoic										
dB(A)		**78**	**80**	**86**	**91**	**93**	**86**	**82**	**73**	**95dBA**
		21	*21*	*21*	*21*	*21*	*21*	*21*	*21*	
Stack Directivity Losses										
Octave Band		1	3	3	4	6	7	7	4	
		-1	*-3*	*-3*	*-4*	*-6*	*-7*	*-7*	*-4*	
Point Source Radiation Loss										
Radiation - Hemispherical										
Single Figure Read	8									
		-8	*-8*	*-8*	*-8*	*-8*	*-8*	*-8*	*-8*	
Point Source Distance Loss										
Start Distance (m)	1									
End Distance (m)	28									
		-29	*-29*	*-29*	*-29*	*-29*	*-29*	*-29*	*-29*	
Facade Reflection										
Reflection (dB)	3									
		3	*3*	*3*	*3*	*3*	*3*	*3*	*3*	
External Receiver										
External Receiver - AP1										
Sound Pressure, Lp		**43**	**43**	**49**	**53**	**53**	**45**	**41**	**35**	**56dBA**

Calculation Sheet 15/0650/CS2

ACC/VOB/ (W) 02 to AP1

		Octave Band Centre Frequency (Hz)								
		63	125	250	500	1k	2k	4k	8k	
Noise Source										
Noise Source - ACC/VOB/ (W) 02										
Sound Pressure Levels @ 1m		**57**	**59**	**65**	**70**	**72**	**65**	**61**	**52**	**74dBA**
Full Conformal Area										
Distance (m)	1									
Type - Semi-anechoic										
dB(A)		**78**	**80**	**86**	**91**	**93**	**86**	**82**	**73**	**95dBA**
		21	*21*	*21*	*21*	*21*	*21*	*21*	*21*	
Stack Directivity Losses										
Octave Band		1	3	3	4	6	7	7	4	
		-1	*-3*	*-3*	*-4*	*-6*	*-7*	*-7*	*-4*	
Point Source Radiation Loss										
Radiation - Hemispherical										
Single Figure Read	8									
		-8	*-8*	*-8*	*-8*	*-8*	*-8*	*-8*	*-8*	
Point Source Distance Loss										
Start Distance (m)	1									
End Distance (m)	35									
		-31	*-31*	*-31*	*-31*	*-31*	*-31*	*-31*	*-31*	
Facade Reflection										
Reflection (dB)	3									
		3	*3*	*3*	*3*	*3*	*3*	*3*	*3*	
External Receiver										
External Receiver - AP1										
Sound Pressure, Lp		**41**	**41**	**47**	**51**	**51**	**43**	**39**	**33**	**54dBA**

Calculation Sheet 15/0650/CS3

PMP CHW 01 to AP1

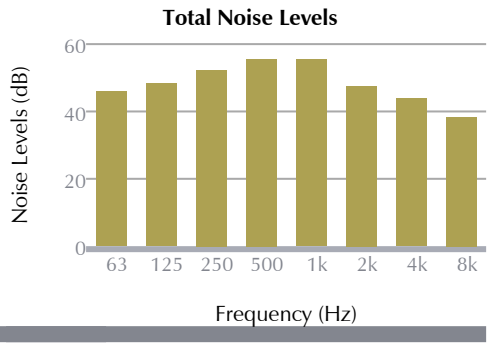
		Octave Band Centre Frequency (Hz)								
		63	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**	
Noise Source										
Noise Source - PMP CHW 01										
Sound Pressure Levels @ 1m		**60**	**61**	**58**	**57**	**59**	**58**	**58**	**55**	**65dBA**
Full Conformal Area										
Distance (m)	1									
Type - Semi-anechoic										
dB(A)		**70**	**71**	**68**	**67**	**69**	**68**	**68**	**65**	**75dBA**
		10	*10*	*10*	*10*	*10*	*10*	*10*	*10*	
Point Source Radiation Loss										
Radiation - Hemispherical										
Single Figure Read	8									
		-8	*-8*	*-8*	*-8*	*-8*	*-8*	*-8*	*-8*	
Point Source Distance Loss										
Start Distance (m)	1									
End Distance (m)	28									
		-29	*-29*	*-29*	*-29*	*-29*	*-29*	*-29*	*-29*	
Facade Reflection										
Reflection (dB)	3									
		3	*3*	*3*	*3*	*3*	*3*	*3*	*3*	
External Receiver										
External Receiver - AP1										
Sound Pressure, Lp		**36**	**37**	**34**	**33**	**35**	**34**	**34**	**31**	**41dBA**

Calculation Sheet 15/0650/CS4

ESS to AP1

		Octave Band Centre Frequency (Hz)								
		63	125	250	500	1k	2k	4k	8k	
Noise Source										
Noise Source - ESS										
Sound Pressure Levels @ 1m		**47**	**62**	**62**	**59**	**45**	**37**	**30**	**31**	**58dBA**
Full Conformal Area										
Distance (m)	1									
Type - Semi-anechoic										
dB(A)		**63**	**78**	**78**	**75**	**61**	**53**	**46**	**47**	**75dBA**
		16	*16*	*16*	*16*	*16*	*16*	*16*	*16*	
Point Source Radiation Loss										
Radiation - Hemispherical										
Single Figure Read	8									
		-8	*-8*	*-8*	*-8*	*-8*	*-8*	*-8*	*-8*	
Point Source Distance Loss										
Start Distance (m)	1									
End Distance (m)	28									
		-29	*-29*	*-29*	*-29*	*-29*	*-29*	*-29*	*-29*	
Facade Reflection										
Reflection (dB)	3									
		3	*3*	*3*	*3*	*3*	*3*	*3*	*3*	
External Receiver										
External Receiver - AP1										
Sound Pressure, Lp		**30**	**45**	**45**	**42**	**28**	**20**	**13**	**14**	**41dBA**

Project Name	UCLH
Project Reference	15/0650
Receiver Reference	AP1
Description	Hospital
Noise Limit	43
dBA	58



Reference	Noise Levels (dB)							
	63	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**
ACC/VOB/ (W) 01	43	43	49	53	53	45	41	35
ACC/VOB/ (W) 02	41	41	47	51	51	43	39	33
PMP CHW 01	36	37	34	33	35	34	34	31
ESS	30	45	45	42	28	20	13	14

Calculation Sheet 15/0650/CS6

ACC/VOB/ (W) 01 to AP1

		Octave Band Centre Frequency (Hz)								
		63	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**	
Noise Source										
Noise Source - ACC/VOB/ (W) 01										
Sound Pressure Levels @ 1m		**57**	**59**	**65**	**70**	**72**	**65**	**61**	**52**	**74dBA**
Full Conformal Area										
Distance (m)	1									
Type - Semi-anechoic										
dB(A)		**78**	**80**	**86**	**91**	**93**	**86**	**82**	**73**	**95dBA**
		21	*21*	*21*	*21*	*21*	*21*	*21*	*21*	
Stack Directivity Losses										
Octave Band		1	3	3	4	6	7	7	4	
		-1	*-3*	*-3*	*-4*	*-6*	*-7*	*-7*	*-4*	
Point Source Radiation Loss										
Radiation - Hemispherical										
Single Figure Read	8									
		-8	*-8*	*-8*	*-8*	*-8*	*-8*	*-8*	*-8*	
Maekawa Screening Loss										
Path Difference (m)	0.083									
		-6	*-6*	*-7*	*-9*	*-11*	*-13*	*-16*	*-19*	
Point Source Distance Loss										
Start Distance (m)	1									
End Distance (m)	28									
		-29	*-29*	*-29*	*-29*	*-29*	*-29*	*-29*	*-29*	
Facade Reflection										
Reflection (dB)	3									
		3	*3*	*3*	*3*	*3*	*3*	*3*	*3*	

	Octave Band Centre Frequency (Hz)								
	63	125	250	500	1k	2k	4k	8k	
External Receiver									
External Receiver - AP1									
Sound Pressure, Lp	**38**	**37**	**42**	**44**	**42**	**32**	**25**	**16**	**45dBA**

ACC/VOB/ (W) 02 to AP1

		Octave Band Centre Frequency (Hz)								
		63	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**	
Noise Source										
Noise Source - ACC/VOB/ (W) 02										
Sound Pressure Levels @ 1m		**57**	**59**	**65**	**70**	**72**	**65**	**61**	**52**	**74dBA**
Full Conformal Area										
Distance (m)	1									
Type - Semi-anechoic										
dB(A)		**78**	**80**	**86**	**91**	**93**	**86**	**82**	**73**	**95dBA**
		21	*21*	*21*	*21*	*21*	*21*	*21*	*21*	
Stack Directivity Losses										
Octave Band		1	3	3	4	6	7	7	4	
		-1	*-3*	*-3*	*-4*	*-6*	*-7*	*-7*	*-4*	
Point Source Radiation Loss										
Radiation - Hemispherical										
Single Figure Read	8									
		-8	*-8*	*-8*	*-8*	*-8*	*-8*	*-8*	*-8*	
Maekawa Screening Loss										
Path Difference (m)	0.083									
		-6	*-6*	*-7*	*-9*	*-11*	*-13*	*-16*	*-19*	
Point Source Distance Loss										
Start Distance (m)	1									
End Distance (m)	35									
		-31	*-31*	*-31*	*-31*	*-31*	*-31*	*-31*	*-31*	
Facade Reflection										
Reflection (dB)	3									
		3	*3*	*3*	*3*	*3*	*3*	*3*	*3*	

	Octave Band Centre Frequency (Hz)								
	63	125	250	500	1k	2k	4k	8k	
External Receiver									
External Receiver - AP1									
Sound Pressure, Lp	**36**	**35**	**40**	**42**	**40**	**30**	**23**	**14**	**43dBA**

PMP CHW 01 to AP1

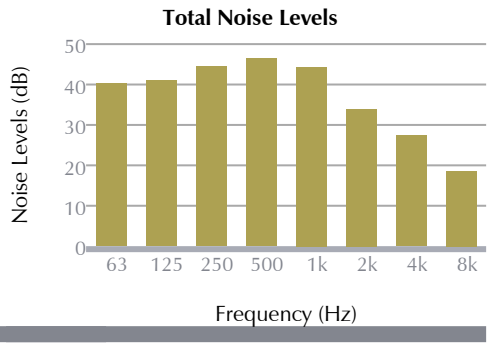
		Octave Band Centre Frequency (Hz)								
		63	125	250	500	1k	2k	4k	8k	
Noise Source										
Noise Source - PMP CHW 01										
Sound Pressure Levels @ 1m		**60**	**61**	**58**	**57**	**59**	**58**	**58**	**55**	**65dBA**
Full Conformal Area										
Distance (m)	1									
Type - Semi-anechoic										
dB(A)		**70**	**71**	**68**	**67**	**69**	**68**	**68**	**65**	**75dBA**
		10	*10*	*10*	*10*	*10*	*10*	*10*	*10*	
Point Source Radiation Loss										
Radiation - Hemispherical										
Single Figure Read	8									
		-8	*-8*	*-8*	*-8*	*-8*	*-8*	*-8*	*-8*	
Maekawa Screening Loss										
Path Difference (m)	0.300									
		-7	*-9*	*-11*	*-13*	*-16*	*-19*	*-22*	*-25*	
Point Source Distance Loss										
Start Distance (m)	1									
End Distance (m)	28									
		-29	*-29*	*-29*	*-29*	*-29*	*-29*	*-29*	*-29*	
Facade Reflection										
Reflection (dB)	3									
		3	*3*	*3*	*3*	*3*	*3*	*3*	*3*	
External Receiver										
External Receiver - AP1										
Sound Pressure, Lp		**29**	**29**	**24**	**20**	**19**	**16**	**13**	**7**	**24dBA**

Calculation Sheet 15/0650/CS9

ESS to AP1

		Octave Band Centre Frequency (Hz)								
		63	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**	
Noise Source										
Noise Source - ESS										
Sound Pressure Levels @ 1m		**47**	**62**	**62**	**59**	**45**	**37**	**30**	**31**	**58dBA**
Full Conformal Area										
Distance (m)	1									
Type - Semi-anechoic										
dB(A)		**63**	**78**	**78**	**75**	**61**	**53**	**46**	**47**	**75dBA**
		16	*16*	*16*	*16*	*16*	*16*	*16*	*16*	
Point Source Radiation Loss										
Radiation - Hemispherical										
Single Figure Read	8									
		-8	*-8*	*-8*	*-8*	*-8*	*-8*	*-8*	*-8*	
Maekawa Screening Loss										
Path Difference (m)	0.300									
		-7	*-9*	*-11*	*-13*	*-16*	*-19*	*-22*	*-25*	
Point Source Distance Loss										
Start Distance (m)	1									
End Distance (m)	28									
		-29	*-29*	*-29*	*-29*	*-29*	*-29*	*-29*	*-29*	
Facade Reflection										
Reflection (dB)	3									
		3	*3*	*3*	*3*	*3*	*3*	*3*	*3*	
External Receiver										
External Receiver - AP1										
Sound Pressure, Lp		**22**	**36**	**34**	**28**	**12**	**1**	**-9**	**-11**	**29dBA**

Project Name	UCHL
Project Reference	15/0650
Receiver Reference	AP1
Description	Hospital
Noise Limit	43
dBA	48



Reference	Noise Levels (dB)							
	63	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**
ACC/VOB/ (W) 01	38	37	42	44	42	32	25	16
ACC/VOB/ (W) 02	36	35	40	42	40	30	23	14
PMP CHW 01	29	29	24	20	19	16	13	7
ESS	22	36	34	28	12	1	-9	-11