JAMESON ACOUSTICS

Consultants in acoustics, noise and vibration

Technical Note

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Our Client	Bridgestone Construction
Issued To	Client

Didsbury Point, Didsbury
Substation Noise Assessment

1.0 Introduction

A new substation is proposed as part of the new health centre and residential development at Didsbury Point.

Jameson Acoustics has been commissioned to assess noise emissions from the proposed substation to nearby noise sensitive properties (both those structurally connected and detached).

This technical note presents our findings.

2.0 Proposals

2.1 Location

The proposal is to install a new substation building at ground floor to the north-east corner of the building, as illustrated on the Figure below.

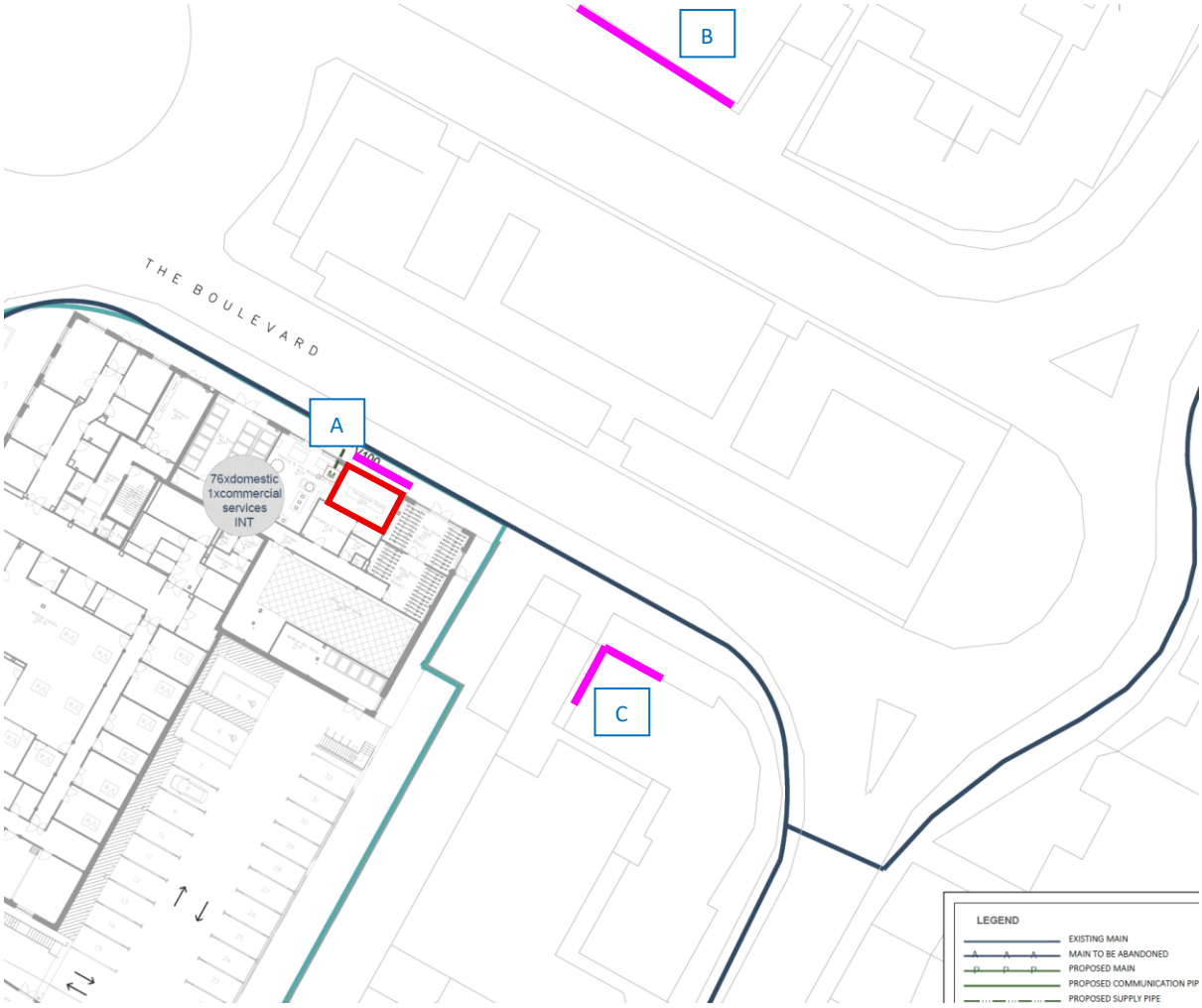
2.2 Nearest Noise Sensitive Receptors

The substation building will be structurally connected to dwellings at Level 1 directly above. The substation will, however, be separated by a double concrete slab arrangement, comprising 140 mm composite deck concrete, a void and a secondary 225 mm solid concrete 'blast' lid.

In terms of external noise breakout, the nearest dwellings are noted to be:

Receptor A: L1 apt windows within the development (directly above substation frontage).
Receptor B: Albert House, to the north over Boulevard, approx. 40 metres away.
Receptor C: Apt building to the east on corner of Clearwater Dr., approx. 20 metres away.

These receptors are indicated on the Figure below.



2.3 Transformer Noise Data

The substation will contain a 500 kVA Dyn11 KNAN transformer, built in accordance with the acoustic standards of NEMA ST-20. In line with this standard, KNAN transformers can be expected to produce an audible sound level (rated at a distance of 0.3 m) of up to 56 dB, as confirmed below.

Table 5. Audible sound levels

Self-cooled, two winding kVA rating	NEMA dB, KNAN	dB, KNAF
500	56	N/A
501–700	57	67
701–1000	58	67
1001–1500	60	67
1501–2000	61	67
2001–2500	62	67
2501–3000	63	67
3001–4000	64	67
4001–5000	65	67
5001–6000	66	68
6001–7500	67	69
7501–10,000	68	70
10001–12,500	69	71

① Average rise by resistance. Refer to IEEE Std C57.12.00™-2010.

Appendix A contains a sound level measurement test certificate for a typical 800kVA Schneider transformer. There is limited published data on transformers, so this datasheet shall be used to correct to an output level of 56 dB. The data details a sound pressure level of 41 dB(A) and a sound power level of 53 dB(A). A guaranteed sound power level of 55dB(A) has been stated. It is assumed in the production of the report that this data is suitably representative of their 800 kVA transformers in normal operation and can therefore be relied upon.

The following octave band sound power levels from the datasheet shall be used in our assessment.

Item	Linear Sound Power Level (dB) at Octave Band Centre Frequency (Hz)							L_W (dBA)
	63	125	250	500	1k	2k	4k	
800kVA Schneider transformer	51	59	46	42	49	51	37	55
Uplift for 500kVA KNAN unit	*+5*	*+5*	*+5*	*+5*	*+5*	*+5*	*+5*	-
Est. 500kVA transformer	56	64	51	47	54	56	42	60

The above equates to an equivalent linear sound pressure level (free-field) of 56 dB at 0.3 m (46 dBA).

The unit shall be installed on anti-vibration mounts. These mounts shall be 'neoprene in shear' providing a minimum static deflection of 4 mm under load. Compliance with this specification is expected to ensure 95% vibration isolation efficiency, mitigating risks of structure-borne noise transfer to dwellings.

2.4 Substation Building Fabric

The substation will be housed internally within the building, within a cavity masonry external wall construction. However, natural ventilation louvres for air flow will be provided onto the street (facing north). Based on the project drawings, the louvres will be provided via the doors which are sized at approx. 2.0 m x 2.2 m. The total free-area of ventilation has been calculated as 2.0 m^2 (approx. 50% of the total door area).

In terms of tonality, the spectral data suggests the unit may exhibit tonal noise characteristics at 125 Hz. Provided the resultant noise rating level falls below the background noise level, this tonality would only be 'just perceptible' meaning a +2 dB 'acoustic feature' correction shall be applied in accordance with BS 4142.

The construction elements are:

External wall: Cavity masonry, brick/cavity/block, with m2 of solid metal panel cladding
Soffit: 225mm solid concrete 'blast' lid, cavity, 140mm composite deck slab.
Louvred doors: Solid metal double doors (ca. 2.2m x 2.2m) with 50% free-area louvres.

The sound reduction performance of these elements used in our assessment are presented below. These values are taken from published data, where available, and Insul prediction software with sensible flanking limitations applied.

Element	Sound Reduction, *R* (dB) at Octave Band Centre Frequency (Hz)							R_W (dB)
	63	125	250	500	1k	2k	4k	
External wall	23	28	30	35	38	43	47	-
Soffit	40	46	54	58	63	65	65	-
Louvred doors	4	4	4	5	5	6	7	-

Based on the above, the composite sound reduction performance of the front wall and door has been calculated to be as follows. Note, the lowest octave band value, -10 dB, shall be taken for our broadband calculations.

Element	Sound Reduction, *R* (dB) at Octave Band Centre Frequency (Hz)							R_W (dB)
	63	125	250	500	1k	2k	4k	
Front wall	10	11	11	12	12	13	14	-

3.0 Plant Noise Limits

The project's external plant noise emission limits were outlined in the Hann Tucker Associates Noise Impact Assessment Report 28562/NIA1/R6, as summarised below.

Desc.	Daytime (07:00-23:00)	Night-time (23:00-07:00)
Plant Noise Rating Limit, dB $L_{Ar,Tr}$	37	30

Consideration shall be given to the night-time operation of the substation. There is no other notable plant emitting noise from the north elevation of the building to consider.

For internal noise transfer, plant noise transfer to structurally-connected dwellings shall be designed to a level at least 5 dB below anticipated background L_{90} noise levels in habitable rooms. With ventilation systems operating at normal trickle duty, it is reasonable to assume background noise levels will be within 5 dB of the BS 8233 design limit of 30 dB $L_{Aeq,8hr}$ in bedrooms at night, i.e. 25 dB L_{Aeq} (approx. NR 20). Hence, a target of NR 15 L_{eq} shall be applied.

4.0 External Noise Assessment

Our assessment considers external noise breakout from the substation plantroom in accordance with the following equation, with additional corrections for sound reflections and directionality applied as appropriate.

$$SPL_{out} = SPL_{in} - SRI + 10\log_{10}\left(\frac{S}{r^2}\right) - 14$$

Where: SRI = sound reduction of building element, R (dB), r = distance to receiver (m), S = approximate area of separating element (m²)

The following table presents our BS 4142 calculations to each receptor.

Description	Receptor		
	A	B	C
Sound Power Level, L_{Aw} (dB)	60	60	60
Resultant Lp in substation room (dB)	54	54	54
Composite SRI of front elevation	*-10*	*-10*	*-10*
Distance (m)	*5*	*40*	*20*
+10lg(S/r2)-14 [S=18m2)	*-15*	*-33*	*-27*
Directionality	*90deg off axis*	*on axis*	*90deg off axis*
Directionality correction	-4	0	-4
Specific Noise Level at Window, L_{Aeq} (dB)	25	11	13
Acoustic Feature Correction, re. BS 4142 (dB)	2	2	2
Noise Rating Level at Window, $L_{Ar,Tr}$ (dB)	**27**	**13**	**15**
Plant Noise Limit (night-time), $L_{Ar,Tr}$ (dB)	*30*	*30*	*30*
Compliance/exceedance	-3	-17	-15

The results demonstrate compliance with the project's external plant noise limits.

5.0 Internal Noise Assessment

The following table presents our assessment of internal noise transfer from the substation up to a Level 1 bedroom through the double concrete floor slab. The calculation determines the maximum operational noise levels permissible in the plantroom to satisfy the internal noise limits in the receiver room. A comparison is drawn between these maximum limits and the predicted reverberant noise levels in the substation room.

Substation to Bedroom (NR15) - Floor

	L		W		H					
Receive room dimensions:	3.5	m	3	m	2.5	m		*SPL2 = SPL1 + 10log(S/A) - SRI*		
	L		W							
Interface dimensions:	3.5	m	3	m						
Frequency	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**dBA**	**NR (Full)**	**NR (250-4k)**
Receive Room Criteria	47	35	26	19	15	12	9	26	15	15
Receive Room RT	0.7	0.6	0.5	0.5	0.5	0.5	0.5			
Wall/Floor SRI	40	46	54	58	63	65	65	*< Floor: Double concrete*		
Flanking: Amp. Music (N/A)	0	0	0	0	0	0	0			
Limiting Source Room Lp	**85**	**79**	**79**	**76**	**77**	**76**	**73**	**82**		
Predicted Lp in Substation	**47**	**57**	**45**	**41**	**49**	**50**	**35**	**54**		
Predicted Lp in Substation	**-38**	**-22**	**-34**	**-35**	**-28**	**-26**	**-38**	**-**		

The results demonstrate compliance with the project's internal noise limits.

In summary, our noise assessment demonstrates compliance with the project's acoustic design criteria without the need for additional noise mitigation measures. It is important to ensure anti-vibration mounts (as specified herein) are installed beneath the transformer to mitigate structure-borne noise and vibration transfer risks. We would highlight that the project design information indicates the inclusion of these mounts, but it would be prudent to verify their specification.

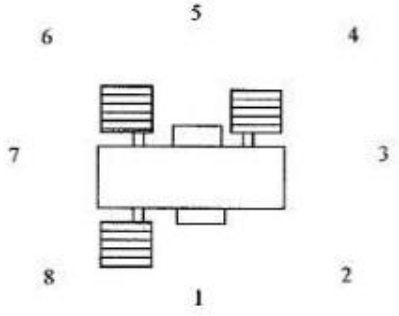
For and on behalf of
Jameson Acoustics Limited

Appendix A – Project Data

Transformer Noise Data

Sound Level Measurement

Transformer Rating 800kVA	Serial No 100204736
Transformer Type GM	Location IN THE TEST AREA
Drawing Number LK50295A0	
EDF Spec ES 4-6001	Date of Test 25/05/07
HV Voltage 11000	Tested in Accordance with BS EN 60076-10:2001 / IEC 60076-10:2001
LV Voltage 433	
Tap position 3	
Witness	Customer EDF Energy
Measurement in dB(A)	
	With Breather Cap

Microphone Position	Ambient Before	Measured Level	Ambient After	Octave filter Frequency Hz	Measured value at point 1 **(trf energised)**
1	40.7	42.2	41.9	31.5	57.5
2	40.9	42.2	41.6	62.5	50.5
3	41.8	44.2	41.1	125	59.3
4	41.9	44.7	42.3	250	45.6
5	40.2	44.3	41.0	500	42.4
6	41.9	42.9	41.9	1000	48.6
7	41.6	44.0	41.0	2000	51.4
8	40.6	44.9	40.5	4000	37.2
				8000	31.7
				16000	30.4
Average	41	44	41	A	55.3
Difference		3			
Correction		3			
Corrected	Lpa	41			
height	1.6m	Contour Lm	7.3m	S=1.25hLm = 14.6 m²	
				Lwa = Lpa+10logS	
				= 41 + 12 = 53	
Sound pressure	41 dB(A)	Sound power Level	53 dB(A)	Guaranteed value 55dB(A)	
Tested by [redacted]					

See Drawing LK50295A0 For Plan View