Tesco Express

200 North Hanover Street
Glasgow
G4 0PY

Plant Noise Impact Assessment

On behalf of

TESCO

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Executive Summary

Noise Solutions Limited has been appointed to provide a noise impact assessment for plant to be installed for the proposed Tesco Express store located on North Hanover Street, Glasgow.

A new refrigeration pack, an associated gas cooler and one VRF air conditioning unit will be installed within an internal plantroom with louvres sited on the west façade of the building.

The assessment shows that the noise from the proposed plant with the attenuation described within the report will result in no worse than a "neutral" magnitude of effect when assessed using the method described in the Scottish TAN 2011 policy. Additionally the NR required criteria are comfortably met, and the scheme should therefore be acceptable to the local authority.

1.0 Introduction

1.1. Noise Solutions Ltd (NSL) has been commissioned to provide a noise impact assessment for plant serving the proposed Tesco Express store on North Hanover Street, Glasgow.

1.2. An environmental sound survey has been undertaken to establish the prevailing background sound pressure levels at a location representative of the sound levels outside the nearest noise sensitive receptors to the site.

1.3. Noise levels from the plantroom louvres have been predicted at the nearest noise-sensitive receptors and assessed against the local authority's usual requirements and recognised standards.

1.4. A glossary of acoustic terminology is given in **Appendix A**.

2.0 Details of development proposals

2.1. The proposed store is to be located on North Hanover Street, Glasgow. The store will be sited on the ground floor of a student accommodation building. Refrigeration and air conditioning plant is to be located within an internal plantroom with louvres sited on the west façade of the building.

2.2. The proposed plant layout is shown in **Appendix D.** Plant noise data is given in **Appendix E**.

2.3. The air conditioning unit will operate only during the daytime period (07.00 – 22.00 hours) when the proposed store is open. The refrigeration plant may potentially operate at any time of the day or night, although equipment duties will generally be lower at night when demands on the system are reduced.

2.4. A site plan showing the site and surrounding area, the nearest noise sensitive properties and the noise monitoring location used in this assessment is presented in **Appendix B**.

3.0 Nearest noise sensitive receptors

3.1. The area surrounding the site is residential and commercial in nature, where the residential is predominantly student accommodation. The nearest noise sensitive properties to the plant location will be the proposed student flats directly above the plantroom (Receptor R1) where the nearest window is on the western façade and approximately 5m away from the nearest plantroom louvre. The proposed louvres will be sited approximately 3m away from the pathway (Receptor R2).

3.2. **Appendix B** contains an aerial photograph showing the site and surrounding area.

4.0 Existing noise climate

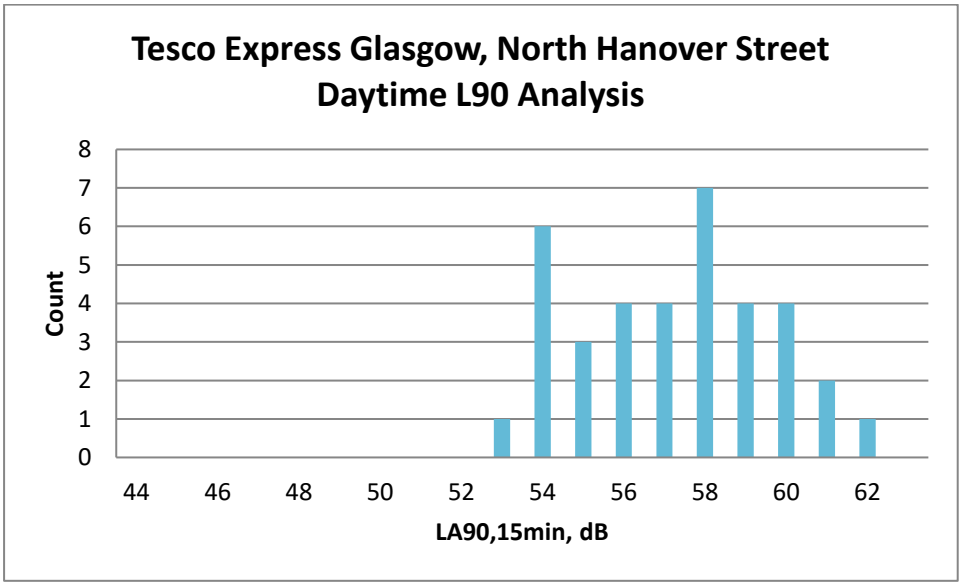
4.1. An environmental noise survey was undertaken to establish the typical background sound levels at a location representative of the noise climate outside the façades of the nearest noise sensitive receptors to the proposed plant area during the quietest times at which the plant will operate.

4.2. The results of the environmental sound survey are summarised in Table 1 below. As noted in the following section, the local authority requires the assessment to use daytime and night-time periods from 07.00 to 22.00 hrs and 22.00 to 07.00 hrs respectively. The full set of measurement results and details of the survey methodology are presented in **Appendix C**.

Table 1 Summary of survey results

Measurement period	Range of recorded sound pressure levels (dB)			
	$L_{Aeq(15mins)}$	$L_{Amax(15mins)}$	$L_{A10(15mins)}$	$L_{A90(15mins)}$
Daytime (07.00 – 22.00 hours)	64-78	78-103	68-73	53-62
Night-time (22.00 – 07.00 hours)	56-67	73-94	58-71	45-56

Figure 1 Histogram of daytime L_{A90} background sound pressure levels

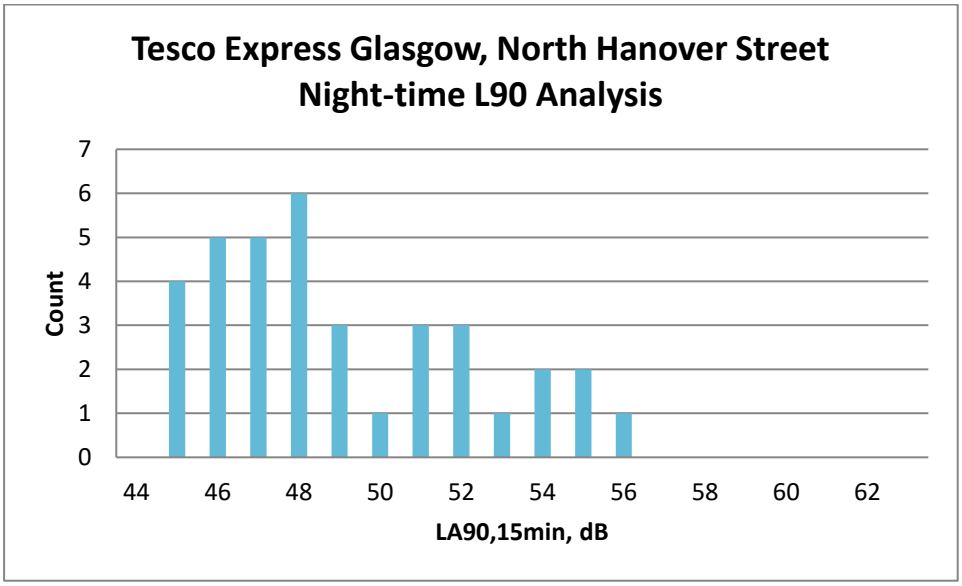


4.3. Additional statistical analysis has been undertaken. As shown in Table 2, the mean, median, and modal values have been calculated:

Table 2 Statistical analysis of $L_{A90,15min}$ levels during the 0700 – 2200 hours period

dB, L_{A90} daytime period	
Mean	57
Mode	58
Median	58

Figure 2 Histogram of night-time L_{A90} background sound pressure levels



4.4. Additional statistical analysis has been undertaken. As shown in Table 3, the mean, median, and modal values have been calculated:

Table 3 Statistical analysis of $L_{A90,15min}$ levels during the 2200 – 0700 hours period

dB, L_{A90} night-time period	
Mean	49
Mode	48
Median	48

4.5. Based on the histogram analyses above, the following values have been considered as representative of the existing background sound pressure levels at nearby noise sensitive premises:

- 54dB L_{A90} during the daytime period; and
- 48dB L_{A90} during the night-time period.

4.6. The above values have been selected to be representative of periods when road traffic was at a minimum and background sound levels are therefore due to more-distant noise sources also affecting the residential property closest to the plant area.

5.0 Plant noise design criteria

Glasgow City Council

5.1. A review of recent planning decisions shows that Glasgow Council typically imposes the following condition:

> *"Noise from or associated with the completed development (the building and fixed plant) shall not give rise to a noise level, assessed with windows open, within any dwelling or noise sensitive building in excess of that equivalent to Noise Rating Curve 35 between 0700 and 2200, and Noise Rating Curve 25 at all other times.*
>
> *Reason: To protect the occupiers of dwellings or noise sensitive buildings from excessive noise."*

Scottish Planning Policy, PAN and TAN

5.2. PAN 1/2011 provides guidance and advice in relation to noise and Scottish planning policy.

5.3. Technical Advice Note – Assessment of noise published by the Scottish Government sets out a methodology of assessing the impact of a new noise source on noise sensitive residential property in the form of stages.

5.4. The first stage directly compares the noise rating level to the prevailing background levels making reference to BS 4142:1997 (which has since been superseded[1]).

> *…the threshold of minor significant impacts is when the difference between the Rating and background noise levels is at least 5dB(A); and commonly do not become sufficiently significant to warrant mitigation until the difference between the Rating and background noise levels is more than 10dB(A).*

The noise sensitivity of a receptor is described in terms of the level of exceedance of the rating level, $L_{Ar,Tr}$ above the background noise level, $L_{A90,T}$, where the sensitivities are defined as follows:

* *Rating Level ($L_{Ar,Tr}$) – Background ($L_{A90,T}$)* ***<5*** *dB(A), the sensitivity is* ***Low***
* *Rating Level ($L_{Ar,Tr}$) – Background ($L_{A90,T}$)* ***≥ 5*** *dB(A), but less than* ***10*** *dB(A), the sensitivity*

[1] BS4142:2014 *'Methods for rating and assessing industrial and commercial sound'*

*is **Medium***

* *Rating Level ($L_{Ar,Tr}$) – Background ($L_{A90,T}$) **≥ 10** dB(A), the sensitivity is **High***

5.5. The second stage is to look at the change in noise level, $L_{Aeq,T}$ before and after the development is analysed, which is assigned a Magnitude according to the following:

Table 4 Assigning Magnitudes of noise impact

Magnitude	Change in noise level, $L_{Aeq,T}$ dB (After – Before)
Major	≥5
Moderate	3 to 4.9
Minor	1 to 2.9
Negligible	0.1 to 0.9
No change	0

5.6. The final stage details the level of *significance of effect* of the noise impacts from industrial developments on the residential property which is determined from the matrix below:

Table 5 Assigning significance of effect of noise impact

Magnitude of Impact (After – Before) $L_{Aeq,T}$ dB	Sensitivity of Receptor based on likelihood of complaint x = (Rating ($L_{Ar,Tr}$) – Background ($L_{A90,T}$)) dB		
	Low (x < 5)	Medium (5 ≤ x < 10)	High (x ≥ 10)
Major (≥5)	Slight/Moderate	Moderate/Large	Large/Very Large
Moderate (3 to 4.9)	Slight	Moderate	Moderate/Large
Minor (1 to 2.9)	Neutral/Slight	Slight	Slight/Moderate
Negligible (0.1 to 0.9)	Neutral/Slight	Neutral/Slight	Slight
No change (0)	Neutral	Neutral	Neutral

Public areas

5.7. It must be noted that the pathway directly adjacent to the proposed louvres have been taken into consideration. Guidance has been sought from BS 8233:2014 in which the standard provides advice in relation to design criteria for external noise. It states that:

> *"for traditional external areas that are used for amenity space, such as gardens and patios, it is desirable that the external noise level does not exceed 50 dB $L_{Aeq,T}$, with an upper guideline value of 55 dB $L_{Aeq,T}$ which would be acceptable in noisier environments. However it is also recognised that these guideline values are not achievable in all circumstances where development might be desirable"*

Proposed criteria

5.8. In order to demonstrate compliance with Glasgow City Council's usual requirements, cumulative plant noise levels inside nearby residential premises should not exceed the following levels at any octave band centre frequency.

Table 6 Glasgow City Council's internal design criteria for noise from fixed plant

Period	Sound pressure level (dB) at octave band centre frequencies (Hz)								NR Level
	63 Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	
Day	63	52	45	39	35	32	30	28	35
Night	55	44	35	29	25	22	20	18	25

5.9. To provide a reasonable noise level at the adjoining pathway to the proposed louvres, it is proposed that the noise level at 3m should not exceed 55dB(A) during the daytime period.

6.0 Plant noise assessment

6.1. Cumulative noise emissions from the proposed plant have been predicted at the nearest residential properties to the plantroom louvre.

6.2. Noise levels have been calculated for the plantroom louvre taking aperture size, directivity of sound propagation, distance attenuation, and acoustic screening into account provided by the building envelope. Predictions are inclusive of the following atmospheric attenuators.

Table 7 Proposed attenuators

Attenuator	Insertion losses dB, at octave band centre frequencies (Hz)							
	63	125	250	500	1k	2k	4k	8k
Plant room intake	6	11	21	34	41	41	38	31
Plant room discharge	6	11	21	34	41	41	38	31

6.3. It should be noted that the proposed plant is not anticipated to exhibit any tonal or impulsive characteristics provided it is well maintained. All proposed plant will be inverter driven and, therefore, will gently ramp up and down depending on the demands on the various systems.

6.4. Tables 8 and 9 summarise the results of the assessment at the most affected residential properties. All other nearby receptors benefit from increased distance/screening to the plant. The full set of calculations can be found in **Appendix F**. The calculations assume plant will operate at maximum duty during the night-time; plant will generally run at a reduced duty at night and, therefore, resulting noise levels will typically be lower.

6.5. Internal noise level predictions are inclusive of a 15dB reduction for a window left partially open for ventilation.

Table 8: Plant noise assessment for R1

Receptor	Period	Internal plant noise level at receptor, NR	Criterion, NR	Difference
R1	Daytime (07.00 – 22.00 hours)	24	35	-9
	Night-time (22.00 – 07.00 hours)	14	25	-11

Table 9: Plant noise assessment for R2

Receptor	Period	Internal plant noise level at pathway, dB	Criterion, dB	Excess, dB
R2	Daytime (07.00 – 22.00 hours)	53	55	-2
	Night-time (22.00 – 07.00 hours)	-	-	-

6.6. The daytime noise levels are determined to result in low sensitivity of receptor with a "no change" magnitude of impact, thus being determined as having a **neutral** significance of effect. The night-time noise levels are determined to have low sensitivity with a "no change" magnitude of impact, thus being determined as having a **neutral** significance of effect.

6.7. The daytime noise levels at the pathway comply with the upper guidance noise level provided by BS 8233:2014 for amenity areas.

6.8. The assessment demonstrates compliance with Glasgow City Council's requirements and, therefore, the proposals should be acceptable to them in terms of noise.

Context and uncertainties

6.9. Where possible uncertainty in the above assessments has been minimised by taking the following steps:

- The meter and calibrator used have a traceable laboratory calibration and the meter was field calibrated before and after the measurements.
- Uncertainty in the calculated impacts has been reduced by the use of a well-established calculation method.
- Care was taken to ensure that the measurement positions were representative of the noise climate outside the nearby residential dwellings and not in positions where higher noise levels were present.

7.0 Summary

7.1. Noise Solutions Ltd (NSL) has been commissioned to provide a noise impact assessment for new plant serving the proposed Tesco Express store at North Hanover Street, Glasgow.

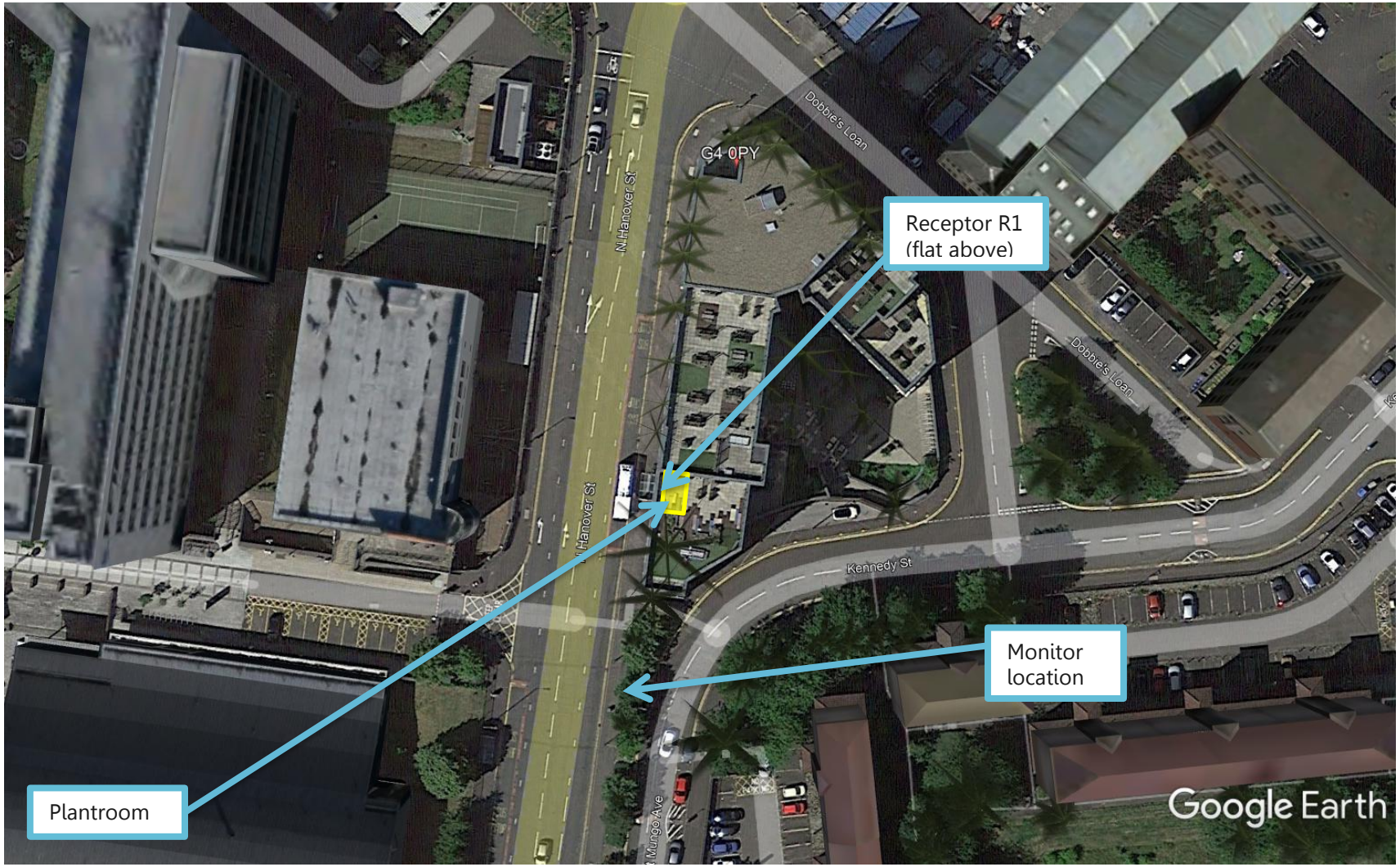
7.2. An environmental noise survey has been undertaken to establish the existing prevailing noise levels at a location representative of the noise climate outside the nearest noise sensitive receptors to the proposed plant area.

7.3. The assessments shows that noise from the proposed plant will comply with recognised Standards and guidance and the local authority's criteria and should therefore be acceptable to them.

Appendix A Acoustic terminology

Parameter	Description
Ambient Noise Level	The totally encompassing sound in a given situation at a given time, usually composed of a sound from many sources both distant and near ($L_{Aeq,T}$).
Decibel (dB)	A scale for comparing the ratios of two quantities, including sound pressure and sound power. The difference in level between two sounds s1 and s2 is given by 20 $\log_{10}$ (s1/s2). The decibel can also be used to measure absolute quantities by specifying a reference value that fixes one point on the scale. For sound pressure, the reference value is 20μPa. The threshold of normal hearing is in the region of 0 dB and 140 dB is the threshold of pain. A change of 1 dB is only perceptible under controlled conditions.
dB(A), L_{Ax}	Decibels measured on a sound level meter incorporating a frequency weighting (A weighting) which differentiates between sounds of different frequency (pitch) in a similar way to the human ear. Measurements in dB(A) broadly agree with people's assessment of loudness. A change of 3 dB(A) is the minimum perceptible under normal conditions, and a change of 10 dB(A) corresponds roughly to halving or doubling the loudness of a sound. The background noise in a living room may be about 30 dB(A); normal conversation about 60 dB(A) at 1 metre; heavy road traffic about 80 dB(A) at 10 metres; the level near a pneumatic drill about 100 dB(A).
Fast Time Weighting	Setting on sound level meter, denoted by a subscript F, that determines the speed at which the instrument responds to changes in the amplitude of any measured signal. The fast time weighting can lead to higher values than the slow time weighting when rapidly changing signals are measured. The average time constant for the fast response setting is 0.125 (1/8) seconds.
Free-field	Sound pressure level measured outside, far away from reflecting surfaces (except the ground), usually taken to mean at least 3.5 metres
Façade	Sound pressure level measured at a distance of 1 metre in front of a large sound reflecting object such as a building façade.
$L_{Aeq,T}$	A noise level index called the equivalent continuous noise level over the time period T. This is the level of a notional steady sound that would contain the same amount of sound energy as the actual, possibly fluctuating, sound that was recorded.
$L_{max,T}$	A noise level index defined as the maximum noise level recorded during a noise event with a period T. L_{max} is sometimes used for the assessment of occasional loud noises, which may have little effect on the overall L_{eq} noise level but will still affect the noise environment. Unless described otherwise, it is measured using the 'fast' sound level meter response.
$L_{10,T}$	A noise level index. The noise level exceeded for 10% of the time over the period T. L_{10} can be considered to be the "average maximum" noise level. Generally used to describe road traffic noise. $L_{A10,18h}$ is the A –weighted arithmetic average of the 18 hourly $L_{A10,1h}$ values from 06:00-24:00.
$L_{90,T}$	A noise level index. The noise level that is exceeded for 90% of the measurement time interval, T. It gives an indication of the lower levels of fluctuating noise. It is often used to describe the background noise level and can be considered to be the "average minimum" noise level and is a term used to describe the level to which non-specific noise falls during quiet spells, when there is lull in passing traffic for example

Appendix B Aerial photograph of site showing areas of interest



Appendix C Environmental sound survey

Details of environmental sound survey

C.1 Measurements of the existing background sound levels were undertaken between 16.30 hours on Tuesday the 25th of January and 10.30 hours on Wednesday the 26th of January 2022.

C.2 The sound level meter was programmed to record the A-weighted L_{eq}, L_{90}, L_{10} and L_{max} noise indices for consecutive fifteen-minute sample periods for the duration of the survey.

Measurement position

C.3 The sound level meter was positioned on a lamppost on North Hanover Street south of the proposed store. The approximate location of the microphone is indicated on the aerial photograph in **Appendix B**. In accordance with BS 7445-2:1991 *'Description and measurement of environmental noise – Part 2: Guide to the acquisition of data pertinent to land use'*, the measurements were undertaken under free-field conditions.

C.4 The survey location was chosen such that the lowest background noise levels were similar to those at the nearest residential receptor (R1) but exclude any potential effect of noise from existing plant serving the store.

Equipment

C.5 Details of the equipment used during the survey are provided in the table below. The sound level meter was calibrated before and after the survey; no significant change (+/-0.2 dB) in the calibration level was noted.

Description	Model / serial no.	Calibration date	Calibration certificate no.
Class 1 Sound level meter	Rion NL-52 / 00654035	07/06/2021	1500431
Condenser microphone	Rion UC-59 /08290		
Preamplifier	Rion NH-25 / 54080		
Calibrator	Rion NC-74 /34235932	23/09/2021	1500910-1

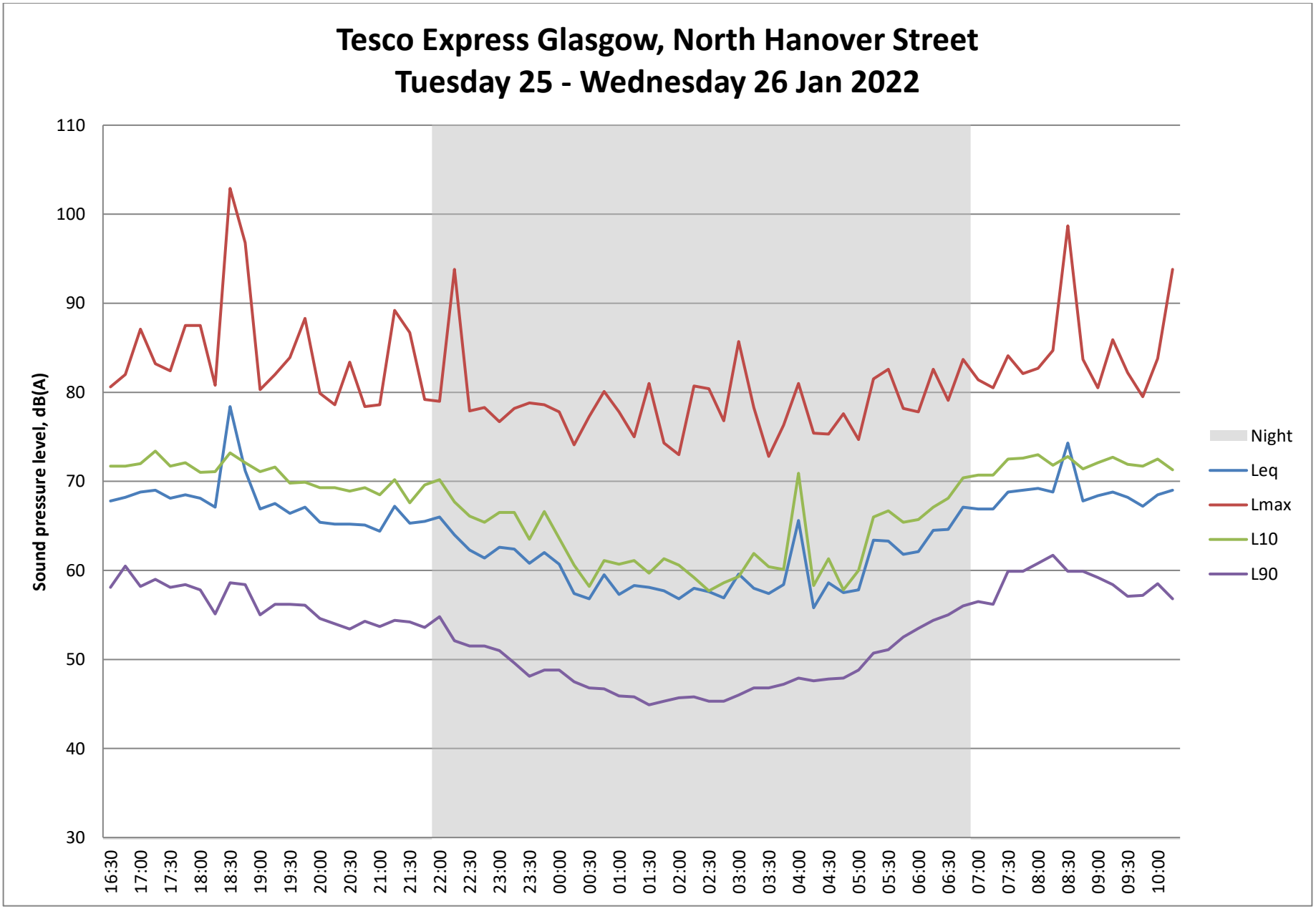
C.6 Weather conditions were determined both at the start and on completion of the survey. It is considered that the meteorological conditions were appropriate for environmental noise

measurements. The table below presents the weather conditions recorded on site at the beginning and end of the survey.

<table>
<tr><th colspan="5">Weather Conditions</th></tr>
<tr><th>Measurement Location</th><th>Time/Date</th><th>Description</th><th>Beginning of Survey</th><th>End of Survey</th></tr>
<tr><td>As indicated on Appendix B</td><td>16.30 25 Jan - 10.30 26 Jan 2022</td><td>Temperature (°C)</td><td>6</td><td>8</td></tr>
<tr><td rowspan="9">Cloud Cover
Symbol Scale in oktas (eighths)
0 Sky completely clear
1
2
3
4 Sky half cloudy
5
6
7
8 Sky completely cloudy
(9) Sky obstructed from view</td><td>Precipitation:</td><td>No</td><td>No</td></tr>
<tr><td>Cloud cover (oktas – see guide)</td><td>8</td><td>8</td></tr>
<tr><td>Presence of fog/snow/ice</td><td>No</td><td>No</td></tr>
<tr><td>Presence of damp roads/wet ground</td><td>No</td><td>Damp</td></tr>
<tr><td>Wind Speed (m/s)</td><td>1.3</td><td>3.1</td></tr>
<tr><td>Wind Direction</td><td>S</td><td>W</td></tr>
<tr><td>Conditions that may cause temperature inversion (i.e. calm nights with no cloud)</td><td>n/a</td><td>n/a</td></tr>
</table>

Results

C.7 The results of the survey are considered to be representative of the background sound pressure levels at the façades of the most affected noise sensitive receptors to the plant area during the quietest times at which the plant will operate. The noise climate at the measurement position was dominated by local road traffic. The results of the survey are presented in a time history graph overleaf.


Tesco Express Glasgow, North Hanover Street
Tuesday 25 - Wednesday 26 Jan 2022
Sound pressure level, dB(A)
110
100
90
80
70
60
50
40
30
16:30
17:00
17:30
18:00
18:30
19:00
19:30
20:00
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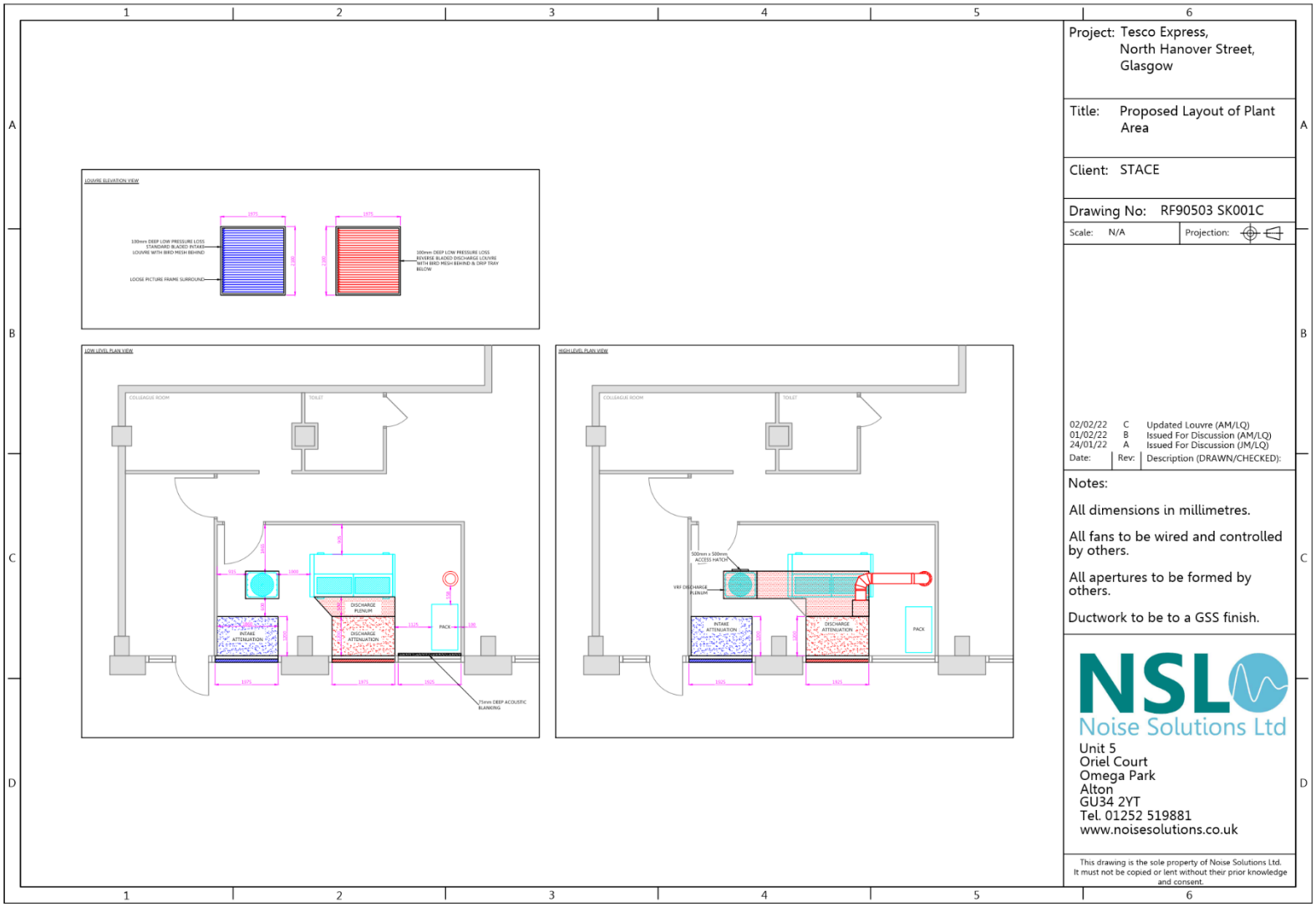
08:00
08:30
09:00
09:30
10:00
Night
Leq
Lmax
L10
L90

Appendix D Plant room layout



Appendix E Plant noise data

Daytime

Unit	Make/model	Measurement unit	dB								dBA
			63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	
Gas Cooler	Kelvion / GE-MA102G4	L_w (per fan), Intake	89	89	85	79	79	77	73	69	85
		L_w (per fan), Discharge	89	89	85	79	79	77	73	69	85
Refrigeration Pack*	Green and Cool / CO2Y	L_w	77	71	73	69	65	62	58	51	71
1No. AC unit	Daikin / REYQ8T	L_w	80	77	78	77	73	67	64	59	78

Night-time

Unit	Make/model	Measurement unit	dB								dBA
			63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	
Gas Cooler	Kelvion / GE-MA102G4	L_w (per fan), Intake	79	79	75	69	69	67	63	59	75
		L_w (per fan), Discharge	79	79	75	69	69	67	63	59	75
Refrigeration Pack*	Green and Cool / CO2Y	L_w	77	71	73	69	65	62	58	51	71

Appendix F Plant noise calculations

Plantroom Louvre – Day

Description	Notes	Sound level (dB) at octave band centre frequency								LAeq (dB)
		63Hz	125Hz	250Hz	500Hz	1000Hz	2000Hz	4000Hz	8000Hz	
Plant room										
Intake										
Reverberant level in plant room	Rev Lp	84	82	76	68	62	59	53	47	72
All plant running										
Opening area (m2)	3.85	6	6	6	6	6	6	6	6	
SRI of opening	I.L	-6	-11	-21	-34	-41	-41	-38	-31	
Inside-outside correction		-6	-6	-6	-6	-6	-6	-6	-6	
Lw of opening	Lw	78	71	55	34	21	17	15	16	57
R1										
Directivity correction	(1925,90deg x 2000,0deg)	0	0	-4	-7	-7	-7	-7	-7	
Distance correction (m)	5	-22	-22	-22	-22	-22	-22	-22	-22	
Screening (δ = /m)	-	0	0	0	0	0	0	0	0	
Surface Directivity		0	0	0	0	0	0	0	0	
BS4142		0	0	0	0	0	0	0	0	
Resultant at receptor R1	Lp @ R1	56	49	29	5	-8	-12	-14	-13	35
R2										
Directivity correction	(1925,0deg x 2000,0deg)	3	4	5	6	6	6	6	6	
Distance correction (m)	3	-18	-18	-18	-18	-18	-18	-18	-18	
Screening (δ = /m)	-	0	0	0	0	0	0	0	0	
Surface Directivity		0	0	0	0	0	0	0	0	
BS4142		0	0	0	0	0	0	0	0	
Resultant at receptor R2	Lp @ R2	64	58	43	23	9	6	3	4	44
Discharge										
Condenser Discharge										

Sound power	Lw	92	92	88	82	82	80	76	72	87
End reflection	2.5025	-1	0	0	0	0	0	0	0	
SRI of opening	I.L	-6	-11	-21	-34	-41	-41	-38	-31	
Lw of opening		85	81	67	48	41	39	38	41	67
R1										
Directivity correction	(1925,90deg x 1300,0deg)	0	-1	-5	-8	-7	-7	-7	-7	
Distance correction (m)	5.5	-23	-23	-23	-23	-23	-23	-23	-23	
Screening (δ = /m)	-	0	0	0	0	0	0	0	0	
Surface Directivity		0	0	0	0	0	0	0	0	
BS4142		0	0	0	0	0	0	0	0	
Resultant at receptor R1	Lp @ R1	62	58	40	18	11	9	8	11	43
R2										
Directivity correction	(1925,0deg x 1300,0deg)	3	4	5	6	6	6	6	6	
Distance correction (m)	3	-18	-18	-18	-18	-18	-18	-18	-18	
Screening (δ = /m)	-	0	0	0	0	0	0	0	0	
Surface Directivity		0	0	0	0	0	0	0	0	
BS4142		0	0	0	0	0	0	0	0	
Resultant at receptor R2	Lp @ R2	70	67	54	36	29	27	26	29	53
VRV Unit Discharge										
Sound power	Lw	80	77	78	77	73	67	64	59	78
End reflection	1.3475	-3	-1	0	0	0	0	0	0	
SRI of opening	I.L	-6	-11	-21	-34	-41	-41	-38	-31	
Lw of opening		71	65	57	43	32	26	26	28	53
R1										
Directivity correction	(1925,90deg x 700,0deg)	-1	-1	-5	-8	-8	-7	-7	-7	
Distance correction (m)	4.5	-21	-21	-21	-21	-21	-21	-21	-21	
Screening (δ = /m)	-	0	0	0	0	0	0	0	0	
Surface Directivity		0	0	0	0	0	0	0	0	
BS4142		0	0	0	0	0	0	0	0	
Resultant at receptor R1	Lp @ R1	49	43	31	14	3	-2	-2	0	29

R2										
Directivity correction	(1925,0deg x 700,0deg)	2	3	4	5	6	6	6	6	
Distance correction (m)	3	-18	-18	-18	-18	-18	-18	-18	-18	
Screening (δ = /m)	-	0	0	0	0	0	0	0	0	
Surface Directivity		0	0	0	0	0	0	0	0	
BS4142		0	0	0	0	0	0	0	0	
Resultant at receptor R2	Lp @ R2	55	50	43	30	20	14	14	16	39

SUMMARY

SUMMARY	**63Hz**	**125Hz**	**250Hz**	**500Hz**	**1000Hz**	**2000Hz**	**4000Hz**	**8000Hz**	
Receptor R1									
Intake	56	49	29	5	-8	-12	-14	-13	35
Condenser Discharge	62	58	40	18	11	9	8	11	43
VRV Discharge	49	43	31	14	3	-2	-2	0	29
Cumulative	**63**	**58**	**41**	**19**	**12**	**10**	**9**	**12**	**44**
Receptor R2									
Intake	64	58	43	23	9	6	3	4	44
Condenser Discharge	70	67	54	36	29	27	26	29	53
VRV Discharge	55	50	43	30	20	14	14	16	39
Cumulative	**71**	**68**	**55**	**37**	**30**	**28**	**27**	**30**	**53**

Plantroom Louvre – Night

Description	Notes	Sound level (dB) at octave band centre frequency								LAeq (dB)
		63Hz	125Hz	250Hz	500Hz	1000Hz	2000Hz	4000Hz	8000Hz	
Plant room										
Intake										
Reverberant level in plant room	Rev Lp	75	73	67	59	52	49	43	37	63
All plant running										
Opening area (m2)	3.9	6	6	6	6	6	6	6	6	
SRI of opening	I.L	-6	-11	-21	-34	-41	-41	-38	-31	
Inside-outside correction		-6	-6	-6	-6	-6	-6	-6	-6	
Lw of opening	Lw	69	61	46	25	11	8	5	6	48
R1										
Directivity correction	(1925,90deg x 2000,0deg)	0	0	-4	-7	-7	-7	-7	-7	
Distance correction (m)	5.0	-22	-22	-22	-22	-22	-22	-22	-22	
Screening (δ = /m)	-	0	0	0	0	0	0	0	0	
Surface Directivity		0	0	0	0	0	0	0	0	
BS4142		0	0	0	0	0	0	0	0	
Resultant at receptor R1	Lp @ R1	47	39	20	-4	-18	-21	-24	-23	26
R2										
Directivity correction	(1925,0deg x 2000,0deg)	3	4	5	6	6	6	6	6	
Distance correction (m)	3.0	-18	-18	-18	-18	-18	-18	-18	-18	
Screening (δ = /m)	-	0	0	0	0	0	0	0	0	
Surface Directivity		0	0	0	0	0	0	0	0	
BS4142		0	0	0	0	0	0	0	0	
Resultant at receptor R2	Lp @ R2	54	48	33	13	0	-4	-6	-6	34
Discharge										
Condenser Discharge										
Sound power	Lw	82	82	78	72	72	70	66	62	77
End reflection	2.5	-1	0	0	0	0	0	0	0	
SRI of opening	I.L	-6	-11	-21	-34	-41	-41	-38	-31	
Lw of opening		75	71	57	38	31	29	28	31	57
R1										

Directivity correction	(1925,90deg x 1300,0deg)	0	-1	-5	-8	-7	-7	-7	-7	
Distance correction (m)	5.5	-23	-23	-23	-23	-23	-23	-23	-23	
Screening (δ = /m)	-	0	0	0	0	0	0	0	0	
Surface Directivity		0	0	0	0	0	0	0	0	
BS4142		0	0	0	0	0	0	0	0	
Resultant at receptor R1	Lp @ R1	52	48	30	8	1	-1	-2	1	33
R2										
Directivity correction	(1925,0deg x 1300,0deg)	3	4	5	6	6	6	6	6	
Distance correction (m)	3.0	-18	-18	-18	-18	-18	-18	-18	-18	
Screening (δ = /m)	-	0	0	0	0	0	0	0	0	
Surface Directivity		0	0	0	0	0	0	0	0	
BS4142		0	0	0	0	0	0	0	0	
Resultant at receptor R2	Lp @ R2	60	57	44	26	19	17	16	19	43

SUMMARY

SUMMARY	**63Hz**	**125Hz**	**250Hz**	**500Hz**	**1000Hz**	**2000Hz**	**4000Hz**	**8000Hz**	
Receptor R1									
Intake	47	39	20	-4	-18	-21	-24	-23	26
Condenser Discharge	52	48	30	8	1	-1	-2	1	33
Cumulative	**53**	**48**	**30**	**8**	**1**	**-1**	**-2**	**1**	**34**
Receptor R2									
Intake	54	48	33	13	0	-4	-6	-6	34
Condenser Discharge	60	57	44	26	19	17	16	19	43
Cumulative	**61**	**57**	**44**	**26**	**20**	**18**	**16**	**19**	**43**