

Changes to Filling Station Services
Shell Filling Station, Cairnie Road, Arbroath,
DD11 3DZ



Noise Impact Assessment

TECHNICAL REPORT

39178-R1

Changes to Filling Station Services

Noise Impact Assessment

Prepared for: Sevan Solutions, The Cart Shed, Amberley Court, Amberley Lane, Milford, Surrey,
GU8 5EB

Site location: Shell Filling Station, Cairnie Road, Arbroath, DD11 3DZ

Table of Contents

1	INTRODUCTION	4
2	NOISE CRITERIA	5
	NOISE RATING (NR) CURVE	5
	WINDOW OPENINGS.....	5
3	NOISE IMPACT ASSESSMENT	7
	PROPOSED PLANT AND PREDICTED SOUND LEVELS.....	7
	ASSESSMENT AT NEAREST NOISE SENSITIVE RECEPTOR (NNSR).....	7
4	CONCLUSIONS	10
	Appendix A: Glossary of Acoustic Terms	I
	Appendix B: Annotated Location Plan.....	II
	Appendix C: Scheme Design	III
	Appendix D: Technical Data Sheets and Calculations.....	VI
	Appendix E: Acousticians Qualifications and Status	IX



Cornwall Suite, Dencora Business Centre, Whitehouse Road, Ipswich IP1 5LT
 Tel: 01473 464 727 | info@sscmail.co.uk | www.soundsolutionconsultants.co.uk
 VAT No. 844 9267 90 | Registration No. 5651834
 Registered Address: 2 Lemons Hill, Tattingstone, Ipswich, Suffolk IP9 2NH

PROJECT NUMBER:	39178	DOCUMENT REFERENCE:	39178-R1
ORIGINATED		CHECKED	
L. Denson BSc. (Hons) MSc MIOA Principal Acoustic Consultant		D. Attwell BEng. (Hons) MIOA Senior Acoustic Consultant	
RELEASE	DATE	CHANGE DESCRIPTION	
1	22/12/2022	First Release	

Sound Solution Consultants Limited (SSC) do not accept any liability in the event of technical reports being used outside of their intended purpose detailed within our terms of engagement or if the report is being relied upon by a third party without direct consent or contract with SSC.

1 INTRODUCTION

1.1 A development has been proposed at Shell Filling Station, Cairnie Road, Arbroath, DD11 3DZ (hereinafter, “The Site”). A plan highlighting the boundary of The Site has been provided in Appendix B with development proposal drawings in Appendix C.

1.2 Planning approval has been granted by Angus Council at an existing fuel service station comprising:

“Erection of Extension to Forecourt Building and Relocation of Storage Container at Filling Station Cairnie Road Arbroath DD11 3DZ” - 22/00459/FULL

1.3 This document has been prepared to discharge Planning Condition 3, which relates specifically to noise, as follows:

“Noise from any fixed plant and equipment associated with the development hereby approved shall not exceed Noise Rating Curve 35 between 07:00 and 22:00 hours and Noise Rating Curve 25 at all other times, as measured within any dwelling or noise sensitive premises with the windows open at least 50 millimetres. “

1.4 The proposals include the relocation of 1no. condenser unit and the provision of another condenser unit and all other equipment (such as jetwashes and pumps) shall operate as existing with no change. This report has therefore been prepared specifically to inform of the impact from the 2no. condenser units on dwellings or noise sensitive premises, accordingly.

1.5 The area surrounding The Site has been noted to be mixed residential and commercial, with Cairnie Road bounding the development site to the northeast, Keptie Road to the west (with a number of commercial units beyond) and residential road Camperdown Drive to the southeast.

1.6 The nearest noise sensitive location to the development proposals has been noted as the residential dwelling - 125 Cairnie Road adjacent The Site, to the northwest.

1.7 The opening hours of the filling station are understood to be 06:00 – 22:00, therefore the proposal has been considered in line with both criteria as stated in Planning Condition 3. Where the more stringent requirements shall be applicable between 06:00 – 07:00.

1.8 A Glossary of Acoustic Terms has been provided in Appendix A that may assist with the terminology used within this report.

2 NOISE CRITERIA

2.1 In accordance with Planning Condition 3, as stated in the previous section, fixed criteria have been given, which are taken as superseding any other national guidance documents or standards.

2.2 The target criteria are given as follows:

- Noise Rating (NR) Curve 35 between 07:00 and 22:00 hours: and
- Noise Rating (NR) Curve 25 between 22:00 and 07:00 hours.

2.3 Additionally, the criteria should be achieved when windows are open at least 50 mm (e.g., partially open).

NOISE RATING (NR) CURVE

2.4 Noise Rating (NR) curves are often used by building services consultants to predict internal noise levels due to mechanical ventilation systems. In the absence of strong low frequency noise, dB $L_{Aeq, T}$ can be approximated from the NR value using the following formula: dB $L_{Aeq, T} \approx NR + 6$ dB. In the presence of mechanical noise with low frequency content, a difference of 10 dB has been viewed more relevant.

2.5 Based on the above, Table 1 shows the equivalent internal ambient noise levels to be achieved when windows are open by a minimum of 50mm.

Period	IANL Design Requirement dB $L_{Aeq, T}$ re. 20 μ Pa	Mechanical Services Noise Rating Curve*
Daytime (07:00 – 22:00)	≤ 41	$\leq NR 35$
Night-time (22:00 – 07:00)	≤ 31	$\leq NR 25$

* Assumes an absence of strong, low-frequency noise.

Table 1 – Derived internal ambient noise level design requirements

WINDOW OPENINGS

2.6 The sound insulation of open windows depends on the type of window and the degree of opening, where there is often no fixed number for the sound reduction index (SRI) of openings.

2.7 However, the technical document NANR116¹ produced by Napier University considers the SRI of various windows and openings, based on numerous standards and documents, and states the following:

‘Figure 1 provides an overview of the pertinent documents providing either guidance or a research report.

¹ School of the built environmental, Napier University: NANR116: ‘open/closed window research’ Sound insulation through ventilated domestic windows (2007)

The numerical results highlighted by Figure 1 of the assumed / measured insulation rating of an open window are generally in agreement as being approximately 10-15 dBA'.

Information Source	Summary of Findings
PPG 24 (1994) ^[2]	A reduction of 13 dB(A) from the facade level is assumed for an open window
WHO (1999) ^[4]	A reduction of 15 dB from the facade level is assumed for a partially open window. (no reference)
BS 8233 (1999) ^[5]	Windows providing rapid ventilation and summer cooling are assumed to provide 10 - 15 dB attenuation (no specific reference)
BRE Digest 338 (1988) ^[6]	A partly open window has an averaged level difference, $D_{1m,av100-3150}$ of 15 dB
DoE Design Bulletin 26 (1972) ^[7]	A reduction of 5 dB(A) with a window wide open
Nelson - Transportation Noise (1987) ^[8]	Sound insulation of an open single window is 5 – 15 dB. (theoretical)
Mackenzie & Williamson DoE Report (1972–73) ^{[9],[10]}	A vertical sliding sash window open 0.027 m ² (summer night-time ventilation) and 0.36 m ² (daytime summer ventilation) provided a sound level reduction of 16 and 11 dB(A) respectively. (Lab Study)
Kerry and Ford (1973 – 74) ^{[11],[12]}	A horizontal sliding sash window open 25 mm and 200 mm provided averaged sound reduction indices, R_{av} of 14 and 9 dB respectively. (Field Study)
Lawrence and Burgess (1982 – 83) ^{[13],[14]}	A vertical sliding sash open 9% of the total façade provided a sound reduction index R_w 10 dB. (Field study)
Hopkins (2004) ^[15]	Road traffic noise reductions through window openings resulted in reductions of between $D_{2m,n,T}$ 8 and 14 dB. (Field Study)

Figure 1 - Summary of open-window acoustic transmission data

2.8 Based on the above information and previous experience, and in support of a robust assessment, a window that is open by 50 mm (e.g., partially open) shall be assumed to provide a 10 dB reduction.

3 NOISE IMPACT ASSESSMENT

- 3.1 The impact of commercial sound from the proposed development on the surrounding environment would depend on several factors, including (but not limited to) the time of day, frequency of occurrence and nature of sound sources. Development activities would naturally pose a greater risk of impact where they are permissible during noise sensitive periods, where the likelihood of annoyance or sleep disturbance increases. Human response to sounds of a commercial or industrial nature depends on sociological factors, attitudes and perceptions which can be difficult to define and account for any individual case.
- 3.2 The numerical assessment has been provided below for relevant periods of proposed operation, following the definition of plant noise levels.

PROPOSED PLANT AND PREDICTED SOUND LEVELS

- 3.3 It is proposed to retain and relocate 1no. condenser unit (Gree Condenser, 12 kW) and supplement this unit with 1no. additional unit (Gree Condenser, 7 kW) to provide the required duty for the extension to the forecourt building.
- 3.4 The proposed location of the condenser units is presented in Appendix C, Figure C3).
- 3.5 Calculations have been based on information presented in the manufacturer's datasheets (shown in Appendix D) and summarised below.

Plant Item	Sound Power Level, L_w dB
Gree Condenser, 12 kW	71
Gree Condenser, 7 kW	66

Table 2 – Proposed condenser unit, sound power levels.

ASSESSMENT AT NEAREST NOISE SENSITIVE RECEPTOR (NNSR)

- 3.6 The nearest noise sensitive dwelling has been noted as the 125 Cairnie Road, the property is a bungalow with the closest sensitive windows at ground level along the southeast façade, fronting onto the forecourt.
- 3.6.1 The ground floor windows have been considered as both an amenity space primarily used in the daytime (07:00 – 22:00), and the potential to be a bedroom, which would be most sensitive during the night-time period (22:00 – 07:00) when residents may be trying to sleep within their home.
- 3.6.2 The next closest dwelling has been identified along Keptie Road, also a bungalow (as illustrated in Figure B1 in Appendix B). Calculations have also been undertaken to windows of this receptor to inform a robust assessment (as shown in Appendix D).



3.7 The cumulative specific sound levels from the above listed commercial/industrial sources at the NNSRs have been calculated in Appendix D, Table D1 – D4, based on the assumed on-times and derived sound levels; incorporating relevant mitigation measures (both existing and proposed).

3.7.1 The calculations allow for:

- propagation of a point source over distance;
- reflections from surfaces within 1 m of sources; and
- the SRI of a partially open window.

3.8 A summary of internal sound pressure level emissions at the closest residential windows has been provided in the below table.

3.9 It should be noted that the calculation has illustrated a worst-case, in which all proposed plant units operate at 100 % fan speed, running coherently, at the same time, and at maximum duty continuously.

Plant Item/Unit	Sound pressure level (L_p) within nearest room (Equivalent NR Curve)	
	125 Cairnie Road	Keptie Road
Gree Condenser, 12kW	34 dB (NR 28)	26 dB (NR 20)
Gree Condenser, 7kW	29 dB (NR 23)	21 dB (NR 15)
Cumulative sum within dwelling	35 dB (NR 29)	28 dB (NR 22)

Table 3 – Summary of internal NR predictions within the nearest dwellings.

3.10 The worst-case internal noise levels have been summarised in the table above as NR 29 at 125 Cairnie Road and NR 23 at Keptie Road.

3.11 The numerical assessments have highlighted that:

- between the hours of 07:00 - 22:00 internal noise level would lie below the minimum criteria of NR 35, at both 125 Cairnie Road and Keptie Road dwellings; and
- between 06:00 - 07:00 internal noise level would lie above the minimum criteria of NR 25, at 125 Cairnie Road and remain below at Keptie Road.

3.12 Further mitigation is therefore recommended to reduce internal noise levels at 125 Cairnie Road. It is therefore proposed that the development includes the provision of a 2 m solid barrier as presented in Appendix C, Figure C2 and that the condensers are mounted such that the top of each unit is no higher than 2 m above ground level.

3.12.1 The proposed barrier should be of minimum mass 10 kg/m² and be well sealed to the ground with no holes or openings.

3.13 Additional calculations have been undertaken incorporating the proposed new source positions and barrier, the results are presented in Table 4.

Plant Item/Unit	Sound pressure level (L_p) within nearest room (Equivalent NR Curve)	
	125 Cairnie Road	Keptie Road
Gree Condenser, 12kW	27 dB (NR 21)	19 dB (NR 13)
Gree Condenser, 7kW	22 dB (NR 16)	14 dB (NR 8)
Cumulative sum within dwelling	28 dB (NR 22)	21 dB (NR 15)

Note: Full calculation procedures have been shown in Appendix D, Table D1 to D4.

Table 4 - Summary of internal NR predictions within the nearest dwellings, with mitigation.

3.14 The results of the assessment with proposed mitigation have shown that the internal NR rating limits should be achieved at the nearest noise sensitive dwellings, during daytime and night-time periods.

3.15 Therefore, measures have been satisfactorily considered sufficient to discharge Planning Condition 3, subject to the following mitigation methods:

- Placement of condenser units, such that they are no higher than 2 m above ground.
- Provision of a 2 m solid barrier as detailed in the assessment.



4 CONCLUSIONS

- 4.1 An assessment of environmental sound levels has been carried out for a proposed development at Shell Filling Station, Cairnie Road, Arbroath, DD11 3DZ.
- 4.2 A noise impact assessment has been carried out to discharge Planning Condition 3 of Planning Approval (ref. 22/00459/FULL). Cumulative noise levels have been predicted within the nearest residential dwellings, based on manufacturer sound data and operations defining the development emission of proposed use.
- 4.3 The numerical assessment in Section 3 has predicted an internal NR level of 3 dB or more below the defined criteria during the day and night, which indicate the likelihood of a low impact within the closest dwellings.
- 4.4 It has been concluded from the findings of this assessment that noise levels should be adequately controlled, to satisfy the requirements of Planning Condition 3. It is therefore recommended that the Condition can be discharged, accordingly.



Appendix A: Glossary of Acoustic Terms

'A' weighting dB(A): Correction applied to the frequency range of a noise in order to approximate the response of the human ear. Noise measurements are often A-weighted using an electronic filter in the sound level meter.

Attenuation: Sound reduction, measured in decibels (dB).

Ambient Sound: The totally encompassing sound in a given situation at a given time usually composed of sound from many sources near and far. Note: The ambient sound comprises the residual sound and the specific sound when present.

Background sound level: A-weighted sound pressure level that is exceeded by the residual sound at the assessment location for 90% of a given time interval, T, measured using time weighting F and quoted to the nearest whole number of decibels.

Calibration: A check of the function of a sound level meter by comparing the meter reading with a known sound pressure level.

Decibel (dB): The unit of sound level and noise exposure measurement. The range of audible sound pressures is approximately 0 dB to 140 dB.

Frequency (Hz): The pitch of the sound, measured in Hertz.

L_{Aeq,T}: The A-weighted equivalent continuous sound pressure level during a period. It is the sound level of a notionally steady sound having the same energy as a fluctuating sound over a specified measurement period, T.

Octave-bands: A division of the frequency range into recognised bands.

Rating level, L_{Ar,T}: The specific sound level plus any adjustment for the character of the sound.

Residual sound: Ambient sound remaining in the absence of the specific sound or that it is suppressed as not to contribute to the ambient sound level.

Residual sound level, L_r or L_{eq,T}: The equivalent continuous A-weighted sound pressure level of the residual sound at the assessment location over a given reference time interval, T.

Sound pressure level (SPL): The basic measure of sound, expressed in decibels, usually measured with an appropriate frequency weighting (e.g. the A-weighted SPL in dB(A)).

Sound power level (L_w): The sound energy radiated per unit time by a sound source measured in watts (W). Sound power can be weighted (e.g. A-weighted) and is not influenced by environmental or physical factors such as weather or distance.

Specific sound: Sound source being assessed.

Specific sound level, L_s or L_{eq,T}: The equivalent continuous A-weighted sound pressure level at the assessment position produced by the specific noise source over a given reference time interval, T.



Appendix B: Annotated Location Plan



Figure B1 – Location Plan, with measurement position and closest receptor annotated.

Appendix C: Scheme Design

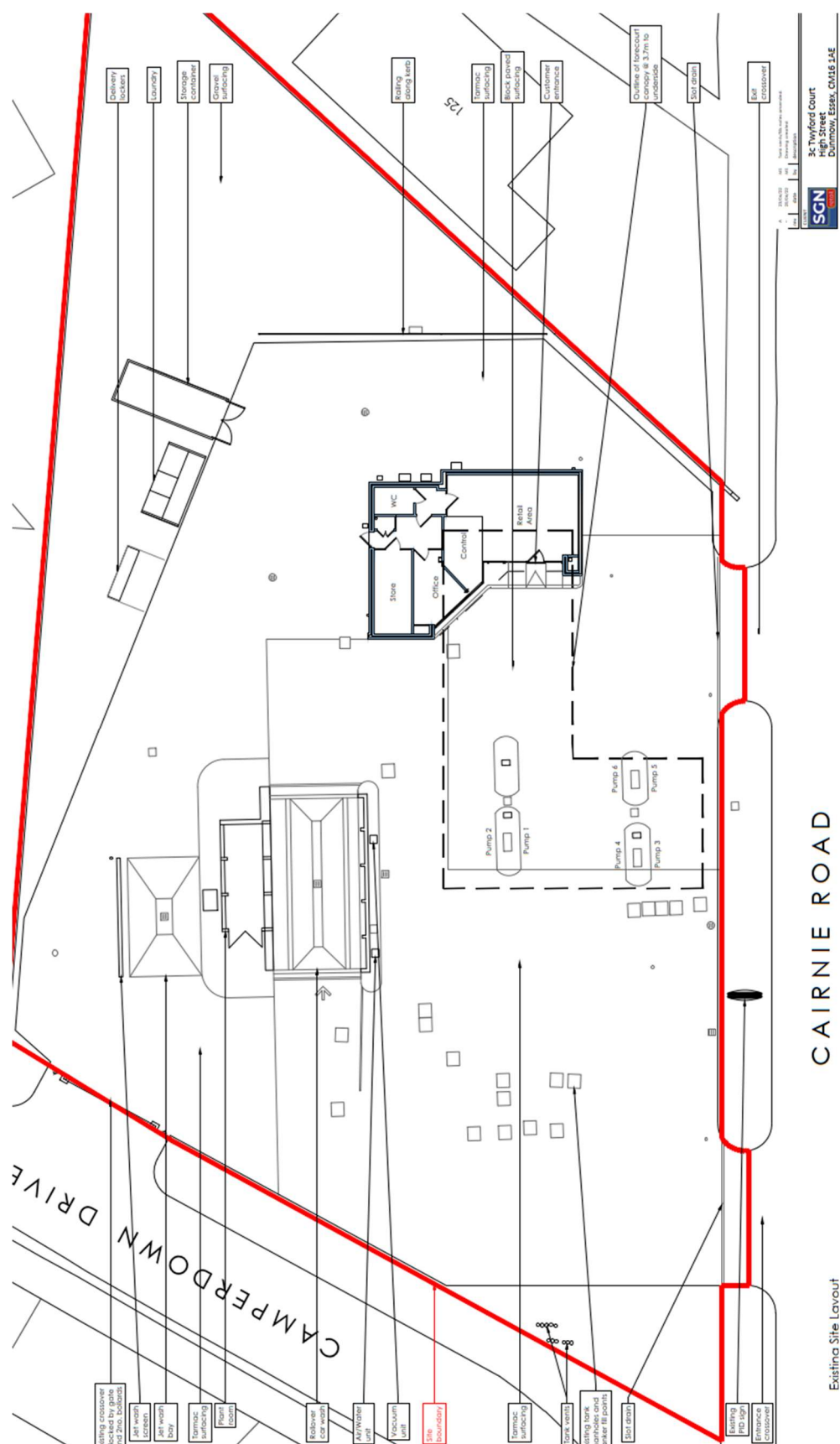
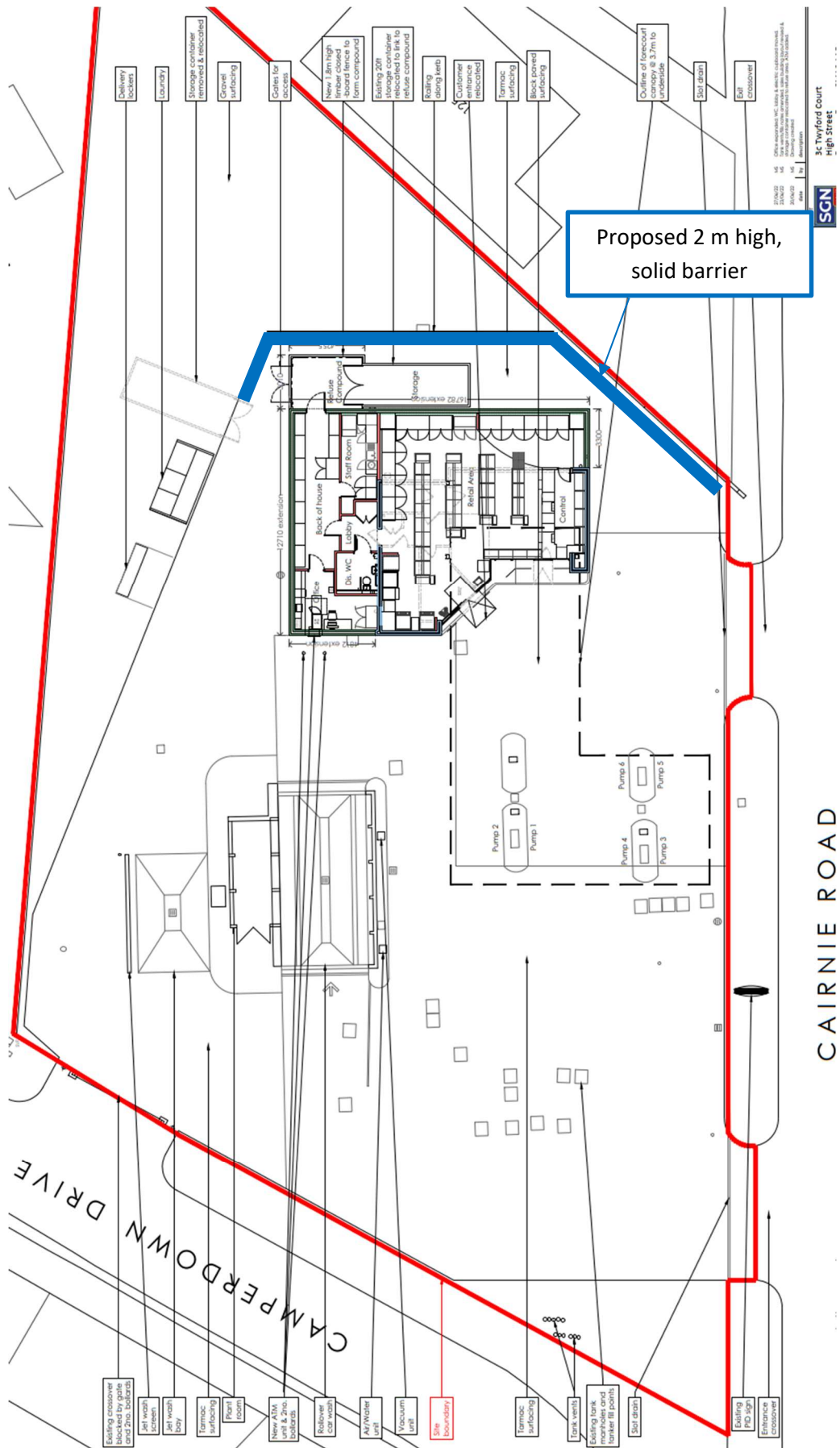


Figure C1 – Existing site plan.



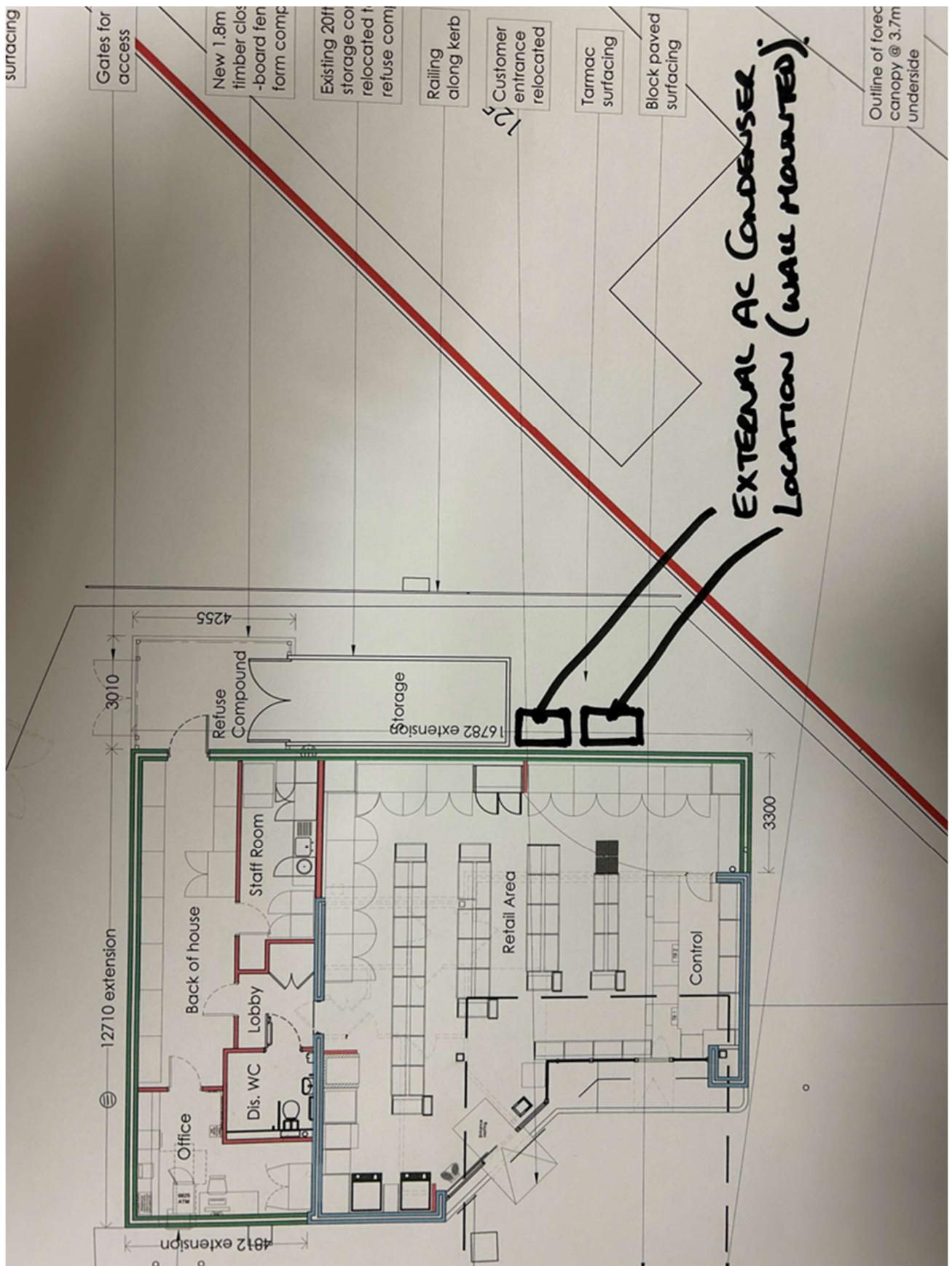


Figure C3 – Proposed condenser unit location

Appendix D: Technical Data Sheets and Calculations

Type			Cassette				
Model		Indoor	GUD50T/B-S	GUD71T/B-S	GUD100T/B-S	GUD125T/B-S	GUD140T/B-S
		Outdoor	GUD50W/Nh B-S	GUD71W/Nh B-S	GUD100W/NhB-S	GUD125W/NhB-S	GUD140W/NhB-S
		Panel	TF06	TF06	TF06	TF06	TF06
Capacity	Cooling	kW	5.30	7.10	10.10	12.50	13.60
	Heating	kW	5.80	8.00	12.00	13.50	16.00
Range	Cooling	kW	2.0~6.0	2.4~8.0	3.2~11	3.6~12.8	6.8~16
	Heating	kW	2.0~6.9	2.2~9.0	3.0~13.5	3.6~14.5	4.5~17
Power input	Cooling	kW	1.30	2.05	3.04	3.85	4.25
	Heating	kW	1.29	2.10	3.40	4.2	4.92
AEER / ACOP		W/W	4.08 / 4.41	3.47 / 3.80	3.32 / 3.54	3.25 / 3.21	3.19 / 3.29
SEER Label Stars	Hot/Ave/Cold	Cool Heat	3.5 / 3.0 / 3.5 4.0 / 3.0 / 2.0	3.0 / 3.0 / 3.0 3.0 / 2.0 / 1.5	3.0 / 3.0 / 3.0 3.0 / 1.5 / 1.0	3.0 / 3.0 / 3.0 3.0 / 2.0 / 1.5	3.0 / 3.0 / 3.0 3.0 / 1.5 / 1.0
Operation temp	Cooling	°C	-15 ~ 52				
	Heating	°C	-15 ~ 24				
System Operation Control		-	Standard, XE71-42G wired controller, Optional, YAPIF6 remote controller				
Air Flow Volume(rated EXP)		l/s	361	389	528	556	583
Sound Pressure Level (L/M/H/SH)		dB (A)	35 / 38 / 41 / 43	39 / 40 / 42 / 43	42 / 46 / 48 / 50	42 / 46 / 49 / 51	TBC
Sound Pressure Level Outdoor		dB (A)	57	52	59	58	55
Sound Power Level Outdoor		dB(A)	67	66	71	69	65
Electrical							
Power Supply		V-Hz-Ph	220-240-50 / 60-1				
Recommended Circuit Breaker		A	16	20	32	40	
Input Current	Cooling	A	6.1	9.6	14.2	18.0	18.5
	Heating	A	6.0	9.8	15.9	19.6	21.4
Dimensions and Weights							
Indoor Dimensions (WxDxH)		mm	840x840x240		840x840x290		
Outdoor Dimensions (WxDxH)		mm	964x340x698		940x460x820		900x340x1350
Panel Dimensions (WxDxH)		mm	950x950x52				
Indoor Net Weight		kg	29	29	33	36	36
Outdoor Net Weight		kg	47	53	83	92	106
Panel Net Weight		kg	6				
Drain Connection		mm	Pump Φ 25mm x 1.5mm				
Condensate Pump Lift & Head		mm	1000				
Installation							
Connection Type		-	Flare				
Outer Diameter	Liquid Pipe	mm (in)	6.35 (1 / 4")		9.52 (3 / 8")		
	Gas Pipe	mm (in)	12.7 (1 / 2")		15.88 (5 / 8")		
Max Pipe Distance	Height	m	20*	25*	30*		
Max Pipe Distance	Length	m	35	50	65	75	
Refrigerant R32	Charge	kg	1.3	1.97	3.02	3.17	4.1
	Pre-charged	m	15	20			
	Additional Gas Charge	g/m	20	25	35		40
Power Supply	Outdoor Unit	mm²	3 x 2.5		3 x 4.0		3 x 6.0
Power Interconnection		mm²	3 x 1.0				
Communication wiring		mm²	2 x 0.75				
Wall Controller wiring		mm²	2 x 0.75				

Figure D1 – Existing (Gree 12 kW) and Proposed (Gree 7 kW) Condenser Units, Technical Data Sheet.

CU1 - Gree 12kW calculation of sound level at Cairnie Road				
#	Procedure	Data	Overall level (dB)	Units
1	A-Weighted Sound Power level	L_{WA}	71	dB(A)
2	Sound Pressure level at 1 m from source (assuming hard ground measurement)	L_{pA}	63	dB(A)
3	Additional reflections from wall (Q)	2	3	dB
4	Distance (m)	13	-22	dB
5	Barrier Loss (m)	2	-7	dB
6	Loss via open window	-	-10	dB
7	On-time correction (%)	100	0	dB
8	Number of items (N)	1	0	dB
9	Façade correction	n/a	0	dB
10	Sound Pressure level inside nearest dwelling	L_{pA}	27	dB(A)

Table D1 – Calculation Procedure, Gree 12 kW (Cairnie Road).

CU2 - Gree 7kW calculation of sound level at Cairnie Road				
#	Procedure	Data	Overall level (dB)	Units
1	A-Weighted Sound Power level ("Silent Mode"), dB(A)	L_{WA}	66	dB(A)
2	Sound Pressure level at 1 m from source (assuming hard ground measurement)	L_{pA}	58	dB(A)
3	Additional reflections from wall (Q)	2	3	dB
4	Distance (m)	13	-22	dB
5	Barrier Loss (m)	2	-7	dB
6	Loss via open window		-10	dB
7	On-time correction (%)	100	0	dB
8	Number of items (N)	1	0	dB
9	Façade correction	n/a	0	dB
10	Sound Pressure level inside nearest dwelling	L_{pA}	22	dB(A)

Table D2 – Calculation Procedure, Gree 7 kW (Cairnie Road).

CU1 - Gree 12kW calculation of sound level at Keptie Road				
#	Procedure	Data	Overall level (dB)	Units
1	A-Weighted Sound Power level	LWA	71	dB(A)
2	Sound Pressure level at 1 m from source (assuming hard ground measurement)	LpA	63	dB(A)
3	Additional reflections from wall (Q)	2	3	dB
4	Distance (m)	30	-30	dB
5	Barrier Loss (m)	2	-7	dB
6	Loss via open window	-	-10	dB
7	On-time correction (%)	100	0	dB
8	Number of items (N)	1	0	dB
9	Façade correction	n/a	0	dB
10	Sound Pressure level inside nearest dwelling	LpA	19	dB(A)

Table D3 – Calculation Procedure, Gree 12 kW (Keptie Road).

CU2 - Gree 7kW calculation of sound level at Keptie Road				
#	Procedure	Data	Overall level (dB)	Units
1	A-Weighted Sound Power level ("Silent Mode"), dB(A)	LWA	66	dB(A)
2	Sound Pressure level at 1 m from source (assuming hard ground measurement)	LpA	58	dB(A)
3	Additional reflections from wall (Q)	2	3	dB
4	Distance (m)	30	-30	dB
5	Barrier Loss (m)	2	-7	dB
6	Loss via open window		-10	dB
7	On-time correction (%)	100	0	dB
8	Number of items (N)	1	0	dB
9	Façade correction	n/a	0	dB
10	Sound Pressure level inside nearest dwelling	LpA	14	dB(A)

Table D4 – Calculation Procedure, Gree 7 kW (Keptie Road).

Appendix E: Acousticians Qualifications and Status

Lee Denson BSc. (Hons) MSc. MIOA

Position Held: Principal Acoustic Consultant.

Qualifications: BSc. (Hons) Music Technology.
MSc. Music Technology.
Institute of Acoustics Diploma in Acoustics and Noise Control.

Affiliations: Member of the Institute of Acoustics.

Acoustics Experience: 9 years.

Dominic Attwell BEng. (Hons) MIOA

Position Held: Senior Acoustic Consultant.

Qualifications: BEng. (Hons) Audio Acoustics.

Affiliations: Member of the Institute of Acoustics.

Acoustics Experience: 6 years.

