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# Paul Horsley Acoustics Limited

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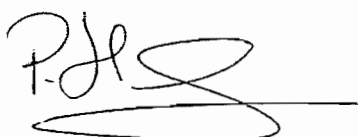
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## Acoustic Report

### Environmental Noise Survey and BS4142:1997 Impact Assessment External Air Conditioning Condenser Units Winterton Medical Practice, Manlake Avenue, DN15 9TA

Our Reference – J1866  
Survey Date – 8<sup>th</sup> April 2011  
Survey and Report by – Paul Horsley MIOA

Date of Report: 15.04.11



DEVELOPMENT CONTROL SECTION	
19 MAY 2011	
Referred To	DATE RECEIVED

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## **1.0 Client**

Winterton Medical Practice,  
Manlake Avenue  
Winterton  
DN15 9TA

## **2.0 Subject**

Operation of external Air Conditioning Condenser Units  
Winterton Medical Practice,  
Manlake Avenue  
Winterton  
DN15 9TA

## **3.0 Aims**

The aim of this report is to determine the baseline background levels, at the nearby noise sensitive residential premises, during a typical daytime period without the specific noise emissions from the operation of the recently installed externally located condenser units.

Monitor and assess the noise output of the specific condenser unit operations installed at the above site, in accordance with the requirements of BS4142: 1997 'Method for Rating Industrial Noise affecting Mixed Residential and Industrial areas'.

Provide an impact assessment on the operations of the plant.

Advise on the validity of complaints arising from local residents, with respect to the above standard, due to unmitigated daytime plant operational conditions.

Provide mitigating noise control recommendations, should they be deemed necessary, in order to allow unrestricted daytime operation of the plant to take place whilst maintaining the existing amenity of the residents.

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### **4.0 Location and Description of Existing Source and Processes**

Winterton Medical Practice is a local doctor's surgery and health centre located within a residential area of Winterton. The site is surrounded on 3 sides with residential premises and the southern boundary is formed by Manlake Avenue.

The area is residential and as such there are no discernible industrial noise sources.

The primary noise sources within the vicinity of the site are due to normal residential activities such as vehicle movements along the local roads, external recreational activity noise and general fauna sources.

The closest noise sensitive residential property, the complainant, is located along Lincoln Drive, with a garden boundary approximately 2m from the specific source with a direct line of sight.

The specific plant under investigation is the 6 No air conditioning condenser units positioned along the northern façade of the main building. The condensers are used on a demand basis to provide cooling for the internally located air conditioning plant and equipment. The subjective noise produced by the condensers is an audible broadband drone from the operation of the fans within the condenser cases. There are 3 No condenser unit positioned at low level and 3 No stacked above. The low level units are obscured from view by a 1.8m high wooden perimeter fencing; however, 60% of the upper units have a direct line of sight to the complainant's premises. The units are positioned 2m from the complainant's boundary fence, with 8m of garden between the fence and the building.

Other noise sources from the site are due primarily to traffic movements along the local road network and birdsong due to the local fauna. There were no other noise sources of note observed at the time of the assessment

The Winterton Medical Practice plant currently operates on a demand basis to serve the operating theatre; however, it is advised that this is no more than 9am to 6 pm Monday to Friday and 9am to 1pm Saturday. No operation on Sunday or public holidays.

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### 5.0 Guidance on the Assessment of Noise Levels

The purpose of any criterion or standard for environmental noise should be to safeguard against unacceptable levels of community response, deemed as a feeling of annoyance during daytime or disturbance at night. WHO defines annoyance as "...a feeling of displeasure evoked by noise."

The main source of information relating to noise and the community response are field studies including noise measurements and social surveys. These studies then attempt to establish a correlation between the two sets of results.

In the absence of any definitive guidance and in order to establish suitable noise criteria, it is necessary to rely on general guidance and assessment methods used for community noise sources. Discussions on the current methods are given below.

#### 5.1 **BS4142:1997 "Method for Rating Industrial Noise Affecting Mixed Residential and Industrial Areas"**

This standard provides a method by which the impact of noise from factories, industrial premises, fixed installations and noise sources of an industrial nature in commercial premises can be predicted in terms of the likelihood of complaints arising from people residing in nearby dwellings. The standard is intended for use in assessing the measured or calculated noise levels from both existing and new or modified premises.

The likelihood that an individual will complain depends on individual attitudes and perceptions in addition to the noise levels and acoustic features present. The standard however, is only concerned with the rating of a noise based on the margin by which it exceeds a background noise level, with an appropriate allowance for any acoustic characteristics that may be present. In general, a noise is likely to cause complaints when it exceeds the background by a certain margin.

- A difference of around +10 dB or more indicates that complaints are likely
- A difference of around +5 dB is of marginal significance

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- If the rating level is more than -10 dB below the measured background noise level then this is a positive indication that complaints are unlikely.

An important cautionary note is included within the standard:

*"...the user is reminded that this standard is not based on substantive research but rather on accumulated experience"*

It is also states that the method is not suitable for assessing noise measured inside buildings or when the background and rating levels are both very low<sup>1</sup>.

<sup>1</sup> - For the purposes of the standard, background noise levels below 30 dB and rating levels below say 35 dB are considered to be very low.

## 5.2 Subjective Impression of Noise Changes

The following Table provides a semantic scale that may be used to "subjectively" rate changes in sound pressure level.

**Table 1: Subjective effect of changes in sound pressure level**

Change in sound level dB	Change in Power		Change in apparent loudness
	Decrease	Increase	
3	1/2	2	Just perceptible
5	1/3	3	Clearly noticeable
10	1/10	10	Half / Twice as loud
20	1/100	100	Much quieter / louder

After Bies and Hansen

The above table is taken from Professor Colin H Hansen's publication "Fundamentals of Acoustics" page 41, for the Department of Mechanical Engineering, University of Adelaide.

This table also appears in "Engineering Noise Control" by Colin Hansen and David Bies, a comprehensive reference book, amongst others.

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## 6.0 Survey Equipment

Integrating Sound Level Meter, RION NA-27, Type 1, Serial No 431986

RION UC-53A Microphone Serial No 35771

RION NC-74 Calibrator Serial No 530712

Windshield & Tripod

## 7.0 Survey Method

The writer carried out attended noise monitoring of the existing background noise climate at site boundary of the complainant's residential premises both with and without the specific plant in operation. The survey was executed between 10.30 and 12.00 on 8<sup>th</sup> April 2011 in accordance with the requirements of BS4142:1997 'Method for Rating Industrial Noise affecting Mixed Residential and Industrial areas'.

$LA_{eq}$ ,  $LA_{90}$ ,  $LA_{Max}$  and  $LA_{Min}$  indices sound measurements were taken using the sound analyser.

The measurement indices noted above are defined as follows:

$LA_{eq, T}$	the "A" weighted equivalent continuous noise level of sample period T
$LA_{90, T}$	the "A" weighted level exceeded for 90% of sample period T
$LA_{max}$	The "A" weighted maximum level during the sample period T
$LA_{min}$	The "A" weighted minimum level during the sample period T

The sound level meter was calibrated before and after the measurements using the calibrator to ensure accuracy of the results. No variations were noted between calibrations and the results obtained can be deemed to be an accurate representation of the levels recorded.

In order to determine the existing baseline background noise climate, sound recordings were taken over 15-minute periods for each monitoring sessions at the specific assessment positions in accordance with BS4142:1997. Monitoring was made with the specific condenser units isolated to determine the baseline noise climate, then with the units operating at 100% load.

Refer to Appendix A for a marked up locational plan of the site and survey points.

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### **8.0 Prevailing Weather Conditions**

8<sup>th</sup> April 2011 – 20°C, Clear sky, Wind Speed between 0 - 1m/s.

### **9.0 Noise Survey Results**

During the monitoring period 3 separate noise samples were recorded, using 1/1 Octave Centre Band analysis. These monitoring samples were collected from the site boundary next to the complainant's residential premises.

The table of results on the following page indicate the noise levels recorded for the various locations selected during the monitoring period, with a brief description of the noise sources contributing to the individually monitored noise levels recorded.

An overview of monitoring positions is given below:-

1. Location 1 relates to a position at the site boundary approximately 1m from the plant outside to complainant's premises at Lincoln Drive.
2. Location 2 relates to a position along the western site boundary.

Note

The above monitoring locations should be read in conjunction with the site layout appearing in Appendix A of this report.

**10.0 Noise Survey Results Table**

**WINTERTON MEDICAL PRACTICE SURVEY RESULTS**

Map Location	Description of Location	Run ID	LAm <sub>ax</sub> dB	LAm <sub>in</sub> dB	LA <sub>eq</sub> dB	LA <sub>90</sub> dB	Survey Duration	Survey Date	Start Time	Source Description
1	Northern Site Boundary	1	59.4	54.4	55.5	55.1	00:05:00.00	08-04-2011	10:31:02	Plant operational measured at site boundary location. Plant dominant source. Birdsong audible.
1	Northern Site Boundary	2	62.4	33.9	49.6	36.9	00:15:00.00	08-04-2011	10:42:09	Plant isolated. Birdsong dominant. Traffic noise audible but low.
2	Western Site Boundary	3	60.2	34.7	48.8	39.2	00:15:00.00	08-04-2011	11:12:41	Birdsong dominant. Traffic noise audible but low.

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### 11.0 BS 4142:1997 Assessment

The following is an assessment in accordance with BS4142: 1997, which has been based upon the results of the noise assessment recordings for the location 1, at the site boundary with the complainant's premises along Lincoln Drive, with the specific plant noise present and isolated.

Measured Noise Level L1/ID1	$L_{Aeq} (5 \text{ min})$	56 dB
Residual Noise Level L1/ID2	$L_{Aeq} (15 \text{ min})$	50 dB
Background Noise Level L1/ID2	$L_{A90} (15 \text{ min})$	37 dB
Assessment made during daytime period with a reference time period is 15 minutes.		
Correction from Table 1, Corrections to noise level readings, is -1 dB		
Corrected measured level	$(56 - 1)$	= 55 dB
<b>Specified Noise Level</b>		
Acoustic feature (Audible Drone)	$L_{Aeq} (5 \text{ min}) + 5\text{dB}$	= +5 dB
Rating level	$(55 + 5)$	= 60 dB
Background Level	$L_{A90} (15 \text{ min})$	= 37 dB
Excess of Rating over background level	$(60 - 37)$	= <b>+23 dB</b>

The above indicates that there is be a BS4142:1997 rating level at the boundary with the complainant's premises along Lincoln Drive of +23 dB increase in background levels due to the daytime operation of the specific plant.

The above assessment level of **+23 dB**, at this location, is classified as significant with respect to receipt of justifiable complaints relating to the operation of the specific condenser units.

This assessment only relates to noise when assessed at the site boundary and not inside the complainant's garden or residential premises.

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### **12.0 Design Target**

Prior to determining the impact of the plant operation, a design target is required. The design target should be a noise level that allows the plant to operate without causing undue disturbance to the nearby residents during the operational period.

In order to achieve the desired design target, BS4142:1997, recommends a rating level of -5 dB below background level when assessed outside the noise sensitive dwelling, this would require a level at the site boundary of 32 LAeq dB, which is both restrictive and unlikely to be achievable.

However, BS4142:1997 also indicates that background noise levels of about 30-35 dBA are classified as low and care must be taken when using the standard for setting operational values or limitations. If we take guidance from WHO 1999, Guidelines for Community Noise, we find that a daytime noise level of 50 LAeq dB is deemed to be of moderate annoyance due to daytime and evening periods. Therefore combining the requirements of BS4142:1997 for tonality and WHO:1999 for reasonableness of operational levels, we can assume that a noise level of approximately 45 dBA produced by the plant operation, without the tonal element and therefore +5dB forfeit will ensure that there is no undue disturbance from the operation of the plant when considered at the nearby premises. This level of operational noise would be below the existing residual level for the area without the plant operation, which is a clear indicator that noise will not be an issue.

Since we are dealing with an intermittently operated source, it would be advisable to achieve the design target based upon a full frequency range from 63 Hz to 8000 Hz. This will ensure that there is no tonal component to the received noise, thereby eliminating the tonal element of the BS4142:1997 rating assessment, since tonality is not a desirable attribute.

The lowest recorded background level will be utilized for the baseline LA90 dB value from which to determine a design target. Below is the design target limit for the plant noise.

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<b>Freq Hz</b>	<b>63</b>	<b>125</b>	<b>250</b>	<b>500</b>	<b>1000</b>	<b>2000</b>	<b>4000</b>	<b>8000</b>
Recorded Residual level without specific plant, ID2, dB	52	45	38	36	34	37	48	31
BS 4142:1997 -5 dB	-5	-5	-5	-5	-5	-5	-5	-5
<b>Design target , dB</b>	<b>47</b>	<b>40</b>	<b>33</b>	<b>31</b>	<b>29</b>	<b>32</b>	<b>43</b>	<b>26</b>

## 13.0 Impact Assessment of Condenser Plant Noise

The specific noise sources under investigation are the 6 No externally located condenser units. These units are positioned approximately 2m from the complainant's site boundary the north of the site. When operational the subjective noise produced by the condenser units is a constant drone from the movement of air by a driving fan in each unit.

This noise produced is unmitigated and free to travel in the direction of the noise sensitive residential premises, the closest of which is positioned 2m from the plant with a 1.8m high wooden fence on the boundary line and 60% direct line of sight of the upper 3 No condensers.

As has been established above, the plant is currently producing a BS4142:1997 rating level of +23 dB during the operational periods when assessed at the boundary fence position. This level of noise is potentially likely to produce justifiable neighbourhood complaints; as such mitigation will be necessary to allow operation, whilst maintaining the existing amenity of the nearby residential premises.

In order to determine the specific noise reductions required to allow the design target to be achieved an impact assessment of the specific plant noise is necessary.

The following table indicates the directly measured noise level, using the LAeq dB indices, for the operation of the plant when assessed at the site boundary of the complainant's premises and is compared against the design target.

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<b>Freq Hz</b>	<b>63</b>	<b>125</b>	<b>250</b>	<b>500</b>	<b>1000</b>	<b>2000</b>	<b>4000</b>	<b>8000</b>
Measured Plant Operational Level LAeq dB – ID1	58	61	53	55	51	45	40	34
Design Target Level - dB	47	40	33	31	29	32	43	26
Variance, dB	11	21	20	24	22	13	0	8

As can be seen from the results above the specific plant items are producing audible noise that will be required to be attenuated by physical means in order to achieve the design target level specified at the site boundary position.

However, what this direct assessment does not take into account is the topography of the site. The garden fence will be providing a level of attenuation from the recorded direct contribution of the 6 No condenser noise sources, the neighbouring premises land is approximately 0.5m below the level of the path and the recipient will be a certain distance from the fence line.

Taking all the above into account it has been assessed that the actual noise level due to the plant operation at say a realistic position of 2m inside the residential garden, equivalent to 4m from the plant, at head height of the recipient there is a calculated level as follows:

<b>Freq Hz</b>	<b>63</b>	<b>125</b>	<b>250</b>	<b>500</b>	<b>1000</b>	<b>2000</b>	<b>4000</b>	<b>8000</b>
Measured Plant Operational Level LAeq dB – ID1	58	61	53	55	51	45	40	34
Fence Barrier Attenuation - dB	-5	-6	-8	-9	-10	-16	-14	-14
Distance Correction - dB	-6	-6	-6	-6	-6	-6	-6	-6
Existing Plant Noise at 2m inside recipients garden, dB	47	49	39	40	35	23	20	14
Design Target Level - dB	47	40	33	31	29	32	43	26
<b>Attenuation Level Required, dB</b>	<b>0</b>	<b>9</b>	<b>6</b>	<b>9</b>	<b>6</b>	<b>0</b>	<b>0</b>	<b>0</b>

Refer to Appendix C for details of the barrier attenuation calculation.

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### **14.0 Mitigating Noise Control Proposals**

The above impact assessment indicates that mitigating noise control measures will be necessary to allow operation of the specific plant, whilst maintaining the amenity of the nearby noise sensitive residential premises.

The following recommendations provide possible means of acoustic treatment solutions to the plant under consideration to enable the design target noise levels to be met; however, the recommendations are not the finalized solution and may be subject to further discussions.

#### **Option 1 – Relocation of the Plant**

It is recommended that the 6 No condenser units are relocated along the western façade away from direct line of sight of the complainant's premises.

The plant once relocated along the western façade, all at low level, would result in inaudibility at the complainant's premises when accompanied with a 2m high close boarded wooden fence positioned against the corner of the northern facade and the existing shed.

The plant noise would then be directed towards the western site boundary, at a distance of 16m from the plant. The calculated resultant noise due to the plant would be 37 dBA at the boundary and taking the boundary fence attenuation into account would be 27 dBA inside the resident's garden. Based upon a recorded background level of 39 LA90 dB at this position there is no likelihood of justifiable complaints from the western elevation residents due to the relocated plant.

#### **Option 2 – Relocation of the Upper 3 No Plant Items**

As with option 1 above, this proposal is for the relocation of the existing upper 3 No plant items only. The proposal is for the plant to be placed at low level along the western façade.

By removing the upper section of plant from the existing position, the resultant noise level inside the complainant's premises would be 34 dBA, as the lower plant items would be the only

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source aiming in the direction of the existing fence and its barrier effect would be effectively increased due to the variation in path difference.

The 3 No condenser units relocated along the western façade would produce noise at the western boundary of 34 dBA, again below the existing noise levels and not likely to give rise to complaint's.

### **Option 3 - Site Boundary Acoustic Fence**

If all 6 No plant items were to remain in their existing positions, then additional barrier attenuation would be necessary to provide the minimum acoustic performance values as noted above.

In order to achieve the minimum additional acoustic performance the existing fence would need to be acoustically upgraded to a height of 2.5m along the full length of the northern boundary and be of a minimum 20 kg/m<sup>2</sup> superficial mass. The barrier would need to be of a solid panel construction without any gaps between panel joints.

Alternatively the panels could form a 3 sided barrier around the plant, at a minimum 1.5m distance from the plant to allow airflow to suit.

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### **15.0 Report Summary**

An acoustic assessment of the noise levels produced by the operation of the specific condenser units at the Winterton Medical Practice has been undertaken in accordance with BS4142:1997.

The condenser unit operation has been assessed in accordance with the above standard and deemed to be producing noise which is +23 dB above the area background level, when assessed at the site boundary to the closest noise sensitive residential location, along Lincoln Drive.

An impact assessment of the unmitigated condenser unit operation has been made with comparisons of the noise present using the LAeq dB indices against the background LA90 dB indices both with and without the specific noise source.

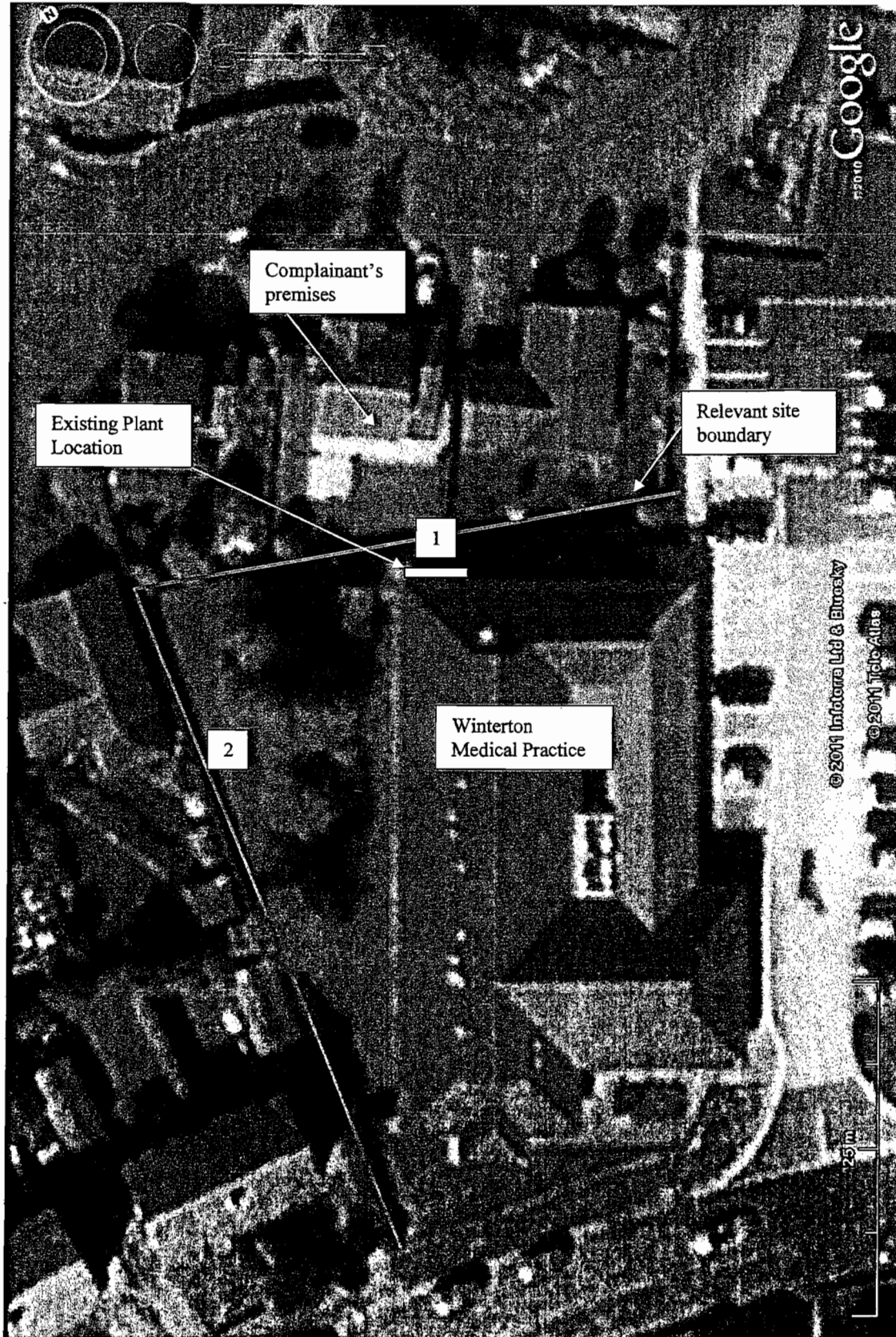
The above assessment has been used to determine the level of mitigation necessary to achieve the design target of -5dB below residual level. The mitigation levels are frequency dependent and their frequency requirements have been determined to suit.

Mitigation measures have been proposed with 3 No options available, offered in preference order of 1-relocation of all 6 No units to the western façade; 2-relocation of the upper 3 No units only to the western façade; or, 3-installation of an acoustic fence along the northern site boundary of 3-sided fence around to plant at a distance of 1.5m.

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## APPENDIX A – Locational Site Plan and Monitoring Positions



**APPENDIX B - Noise Survey Frequency Results Table**

**WINTERTON MEDICAL PRACTICE SURVEY RESULTS**

Map Location	Description of Location	Run ID	LAmax dB	LAmin dB	LAeq dB	Linear Leq dB Sound Pressure Levels in 1/1 Frequency Bands Hz								LA90 dB
						63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	
1	Northern Site Boundary	1	59.4	54.4	55.5	58.0	60.6	52.9	54.6	50.8	44.9	40.2	33.9	55.1
1	Northern Site Boundary	2	62.4	33.9	49.6	51.6	45.4	37.5	35.6	34.3	37.2	47.9	30.5	36.9
2	Western Site Boundary	3	60.2	34.7	48.8	53.8	46.0	38.9	35.7	33.2	36.3	46.9	30.2	39.2

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## Appendix C Barrier Attenuation Calculation

Project: WINTERTON MEDICAL CENTRE - EXISTING FENCE

Freq Hz	63	125	250	500	1k	2k	4k	8k
Sound Pressure Level at 4m	53	55	47	49	45	36	34	28

### POSITIVE SCREEN

Source to Barrier	1.5	
Barrier to Receiver	2	(estimated distance to receiver)
Barrier Height	1.8	
Source Height	1.5	
Receiver Height	1	(direct line of sight assumed between source & receiver)
Path Difference	0.09	

### Attenuation due to Screens

Path Difference	63	125	250	500	1k	2k	4k	8k
-0.30	1	0	0	0	0	0	0	0
-0.20	2	1	0	0	0	0	0	0
-0.10	3	2	1	0	0	0	0	0
-0.05	3	3	2	1	0	0	0	0
-0.01	4	4	4	3	3	2	1	1
0.00	5	5	5	5	5	5	5	5
0.01	5	6	6	6	7	8	8	8
0.05	7	7	8	9	10	12	13	13
0.10	7	8	9	10	11	14	16	16
0.20	8	9	10	11	14	16	19	19
0.30	8	9	10	13	16	18	20	20
0.40	9	10	12	14	17	20	22	22
0.50	9	10	12	15	18	20	23	23
1.00	11	12	14	18	20	23	25	25
2.00	14	15	18	20	24	27	29	29
3.00	15	17	20	22	25	28	30	30
4.00	16	18	20	24	26	30	31	31
5.00	16	18	21	25	27	30	32	32

Screening Effect from above table (B):	7	8	9	10	11	14	16	16
SRI of Screen Panels (C):	10	10	14	16	16	18	18	18
Level at Receiver due to Screening Effect (A - B)=D:	46	47	38	39	34	25	18	12
Level at Receiver due to Direct Transmission (A - C)=E:	43	45	33	33	29	21	16	10
Resultant Level at Receiver (log add'n of D & E):	48	49	39	40	35	26	20	14
NR Level Required:	NR35	NR35	NR45	NR39	NR35	NR32	NR30	NR28
Additional Attenuation Required:	-15	-3	-6	1	0	-6	-10	-14

dBA Correction:	-26	-16	-9	-3	0	1	1	-1
A-Weighted Equivalent:	20	31	29	36	34	26	19	11
dBA Level at Receiver (with no additional attenuation):	40	dBA						
NR65	87	78	72	68	65	62	61	59
NR60	83	74	68	63	60	57	55	54
NR55	79	70	63	58	55	52	50	49
NR50	75	65	59	53	50	47	45	43
NR45	71	61	54	48	45	42	40	38
NR40	67	57	49	44	40	37	35	33
NR35	63	52	45	39	35	32	30	28
NR30	59	48	40	34	30	27	25	23
NR25	55	44	35	29	25	22	20	17

Completed By: Paul Horsley Date: 15.04.10