REC
Resource & Environmental Consultants Ltd

Noise Impact Assessment

Proposed Simplified Planning Zone (SPZ)
Hillington Park
Glasgow

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QUALITY ASSURANCE

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EXECUTIVE SUMMARY

Resource and Environmental Consultants (REC) Limited have been commissioned by Terence O'Rourke on behalf of MEPC to undertake a Noise and Vibration Impact Assessment for a proposed Simplified Planning Zone at Hillington Park, Glasgow.

Noise Survey

A Noise Survey has been completed in order to measure the existing ambient and background noise climate at the closest residential receptor to the proposed Simplified Planning Zone.

A series of noise surveys has been completed to consider the potential noise impact of road traffic using the A736 and the M8 motorway and rail traffic noise using the Paisley to Glasgow railway line to the south of the site.

Vibration Survey

A Vibration Survey has been completed in order to measure the potential vibration impact of rail traffic noise using the Paisley to Glasgow railway line to the south of the Site.

Noise & Vibration Impact Assessment

The Noise Impact Assessment has identified that the sensitivity of the receptor is categorised as 'Medium' and the magnitude of impact is categorised as 'No change' if all mitigation measures are adopted. Accordingly the significance of effect is categorised as 'Neutral'. For this significance of effect, the Technical Advice Note offers the following advice:

> *'No effect, not significant, noise need not be considered as a determining factor in the decision making process.'*

The following mitigation measures are recommended:

- While details of individual plant items are not known at this stage, the potential impact of this has been considered. Plant noise emission limits have been set when measured or calculated at the façade of the closest residential receptor. These limits are applicable for either a single plant item or multiple plant items. The limits are shown in Table 4.14. Table 4.14 indicates the noise emission limit for plant with a tonal element intermittently, if there is a constant tonal or distinctive element to the noise then the Noise Emission Limit will be 5dB lower than stated in the table;

- For any commercial units located approximately 25m from the M8 Motorway, i.e. at the northern most boundaries would require higher specification glazing. However, it is assumed that this area will used as a buffer zone with plantings as with the existing buildings located on the northern boundary. If this buffer zone is similar to that that already exists, higher specification glazing would not be required; and,

- Alternative ventilation is required for all office areas that have direct line of sight to either the M8 Motorway or the A736. Details of which are shown in Section 5.1.

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1.0 INTRODUCTION

1.1 Background

Resource and Environmental Consultants (REC) Limited have been commissioned by Terence O'Rourke on behalf of MEPC to undertake a Noise and Vibration Impact Assessment for a proposed Simplified Planning Zone (SPZ) at Hillington Park, Glasgow, to be referred to hereafter as 'the Site'.

This assessment has been undertaken in order to simplify planning control to give greater flexibility to develop new premises, whilst affording an appropriate level of protection for existing noise-sensitive dwellings..

This Noise Impact Assessment has been completed with due regard to the requirements of Planning Advice Note 1/2011 (PAN 1/2011). The scope of the assessment has been agreed with the Environmental Health Departments at both Renfrewshire and Glasgow City Councils.

All acronyms used within this report are defined in the Glossary presented in Appendix II.

1.2 Site Location & Proposed Development

Hillington Park is a business park providing office and industrial units to let. It extends to approximately 2 million sq ft of existing office and industrial accommodation plus a range of other uses. It is located 7 miles west of Glasgow city centre adjacent to junction 26 of the M8 motorway. Hillington Park is uniquely situated in both the Renfrewshire and Glasgow City Council boundaries. A site location plan is shown in Figure 1 of Appendix III.

The SPZ will simplify planning control by removing the need for planning applications for development within defined parameters.

This assessment has been undertaken with due regard to the supplied site location plan as shown on the following planning drawings:

- Site location dated 16th October 2013 contained in Figure 1 of Appendix III.

1.3 Limitations

The limitations of this report are presented in Appendix I.

1.4 Confidentiality

REC has prepared this report solely for the use of the Client and those parties with whom a warranty agreement has been executed, or with whom an assignment has been agreed. Should any third party wish to use or rely upon the contents of the report, written approval must be sought from REC; a charge may be levied against such approval.

2.0 ASSESSMENT CRITERIA

2.1 Local Authority Guidance and Criteria – Renfrewshire and Glasgow City Council's Environmental Health Departments

REC contacted Colin Hunter of Renfrewshire Council by email on 23rd October 2013 in order to specify the methodology for the Noise Survey and subsequent Noise Impact Assessment. Confirmation was received on the 12th November 2013 of agreement with the proposals. Colin Hunter stated that the following criteria is required for the Site:

- For commercial units the daytime noise level shall not exceed the BS8233 'good' criteria for office space which is 40dB $L_{Aeq,16hr}$; and,
- For the BS4142 Assessment of the proposed commercial units upon the existing residential receptors, the $L_{A,r}$ of any M&E fixed plant shall not exceed the existing background noise levels at the receptor.

REC contacted Dom Callaghan of Glasgow City Council by email on 23rd October 2013 in order to specify the methodology for the Noise Survey and subsequent Noise Impact Assessment. No objections were received.

2.2 The Scottish Government, Planning Advice Note 1/2011

Planning Advice Note (PAN) 1/2011 sets out the Scottish Government's advice on the role of the planning system in helping to prevent and limit the adverse effects of noise. The PAN promotes the principles of good acoustic design and a sensitive approach to the location of new development. It promotes the appropriate location of new potentially noisy development, and a pragmatic approach to the location of new development within the vicinity of existing noise generating uses, to ensure that quality of life is not unreasonably affected and that new development continues to support sustainable economic growth.

PAN 1/2011 refers to the Technical Advice Note (TAN) Assessment of Noise which includes Information and advice on noise impact assessment methods. The objective is to evaluate the noise impact of the Noise Generating Development (NGD) on the existing Noise Sensitive Receptors (NSRs).

The TAN offers an assessment split into a series of stages:

- Stage 1: Initial Process. This stage requires an assessment to define the sensitivity of the receptors. The sensitivity is defined as high, medium or low and examples of NSR are given in Table 2.1 of the TAN.
- Stage 2: Quantitative Assessment. For a Noise Generating Development (NGD) a qualitative assessment will be based on comparing an absolute noise level with an appropriate noise target. For internal office rooms (requiring reasonable conditions for study and work requiring concentration) a target noise level of 35 dB $L_{Aeq,t}$ has been selected for daytime periods. This is based on BS 8233 recommendations. Table 2.1 shows the classification of the magnitude of noise impacts based on the difference in noise between the existing noise level and the target noise level.

Table 2.1: Example of Associating Exceedance Noise Levels with Magnitudes of Impacts.

Target Noise Level, x dB	Magnitude of Impact
x ≥ 10	Major adverse
5 ≤ x < 10	Moderate adverse
3 ≤ x < 5	Minor adverse
0 ≤ x < 3	Negligible adverse
x < 0	No change

- Stage 3: Qualitative Assessment. The derivation of the magnitude of impact as described above may not be adequate due to the magnitude of impact being based on change in noise level alone. Other factors which should be taken into account at this stage such as nature of the noise source, in particular, the spectral content of the noise source and its absolute level;

- Stage 4: Level of Significance. The level of significance of the noise impact from the industrial development on the residential NSR is then determined from Table 2.2.

Table 2.2: Significance of Effects

Magnitude of Impact $L_{Aeq,t}$ (dB)	Sensitivity of Receptor X = Target Noise Level dB		
	Low (x <5)	Medium (5≤ x <10)	High (x ≥10)
Major (≥5)	Slight / Moderate	Moderate / Large	Large / Very Large
Moderate (3 – 4.9)	Slight	Moderate	Moderate / Large
Minor (1 – 2.9)	Neutral / Slight	Slight	Slight / Moderate
Negligible (0.1 – 0.9)	Neutral / Slight	Neutral / Slight	Slight
No change (0)	Neutral	Neutral	Neutral

- Stage 5: The Decision Process. Depending on the outcome of the assessment, the decision making process would take into account the level of significance of the noise impact on the property according to:

    - Very Large: These effects represent key factors in the decision-making process. They are generally, but not exclusively associated with impacts where mitigation is not practical or would be ineffective;

- Large: These effects are likely to be important considerations but where mitigation may be effectively employed such that resultant adverse effects are likely to have a moderate or slight significance;

- Moderate: These effects, if adverse, while important, are not likely to be key decision-making issues;

- Slight: These effects may be raised but are unlikely to be of importance in the decision making process;

- Neutral: No effect, not significant, noise need not be considered as a determining factor in the decision making process.

The following standards are applicable to the development and are included within the TAN.

2.3 British Standard BS 8233:1999: Sound Insulation and Noise Reduction for Buildings – Code of Practice

The scope of this standard is the provision of recommendations for the control of noise in and around buildings. It suggests appropriate criteria and limits for different situations, which are primarily intended to guide the design of new buildings or refurbished buildings undergoing a change of use, rather than to assess the effect of changes in the external noise climate.

The standard suggests suitable internal noise levels within different types of buildings, including plots, as shown in Table 2.3.

Table 2.3: BS 8233 Recommended Internal Target Noise Levels

Criterion	Typical Situation	Design Range $L_{Aeq,T}$ dB	
		Good	Reasonable
Reasonable conditions for study and work requiring concentration	Cellular Office	40	50

2.4 British Standard BS 4142: 1997: Method for Rating Industrial Noise Affecting Mixed Use Residential and Industrial Areas

This standard is intended to be used to assess whether noise from factories, industrial premises or fixed installations and sources of an industrial nature in commercial premises is likely to give rise to complaints from people residing in nearby dwellings.

The procedure contained in BS 4142 for assessing the likelihood of complaints is to compare the measured or predicted noise level from the source in question, the 'specific noise level' immediately outside the dwelling, with the background noise level. Where the noise contains a 'distinguishable discrete continuous note (whine, hiss, screech, hum etc.) or if there are distinct impulses in the noise (bangs, clicks, clatters or thumps), or if the noise is irregular enough to attract attention' then a correction of +5dB is added to the specific noise level to obtain the 'rating level'.

The likelihood of noise provoking complaints is assessed by subtracting the background noise level from the rating noise level. BS 4142 states:

> *"A difference of around 10dB or higher indicates that complaints are likely. A difference of around 5dB is of marginal significance. A difference of -10dB is a positive indication that complaints are unlikely."*

For the daytime, this assessment is carried out over a 1-hour period, and over a 5 minute period at night. The day and night-time periods are not defined in the Standard but it states that night should cover the times when the general adult population are preparing for sleep or are actually sleeping. For the purposes of this assessment it is assumed that the day and night periods reflect those stated in the TAN i.e. day is 07:00 to 23:00 hours and night 23:00 to 07:00 hours.

BS4142 is not applicable where backgrounds fall below 30dB $L_{A90,1hr}$ or the rating level is calculated to be below 35dB $L_{A,r}$.

2.5 British Standard BS6472: 2008: Evaluation of Human Exposure to Vibration in Buildings (1Hz to 80Hz)

With respect to human exposure to building vibration, BS6472 provides guideline values of the vibration dose value (VDV) above which various degrees of adverse comment may be expected from the occupants of residential buildings. The VDV is defined mathematically as the fourth root of the time integral of the fourth power of the vibration acceleration, after it has been frequency weighted. The guideline values recommended by BS6472 are shown in Table 2.2 below.

Table 2.2: BS6472 Guideline Values

Place	Low Probability of Adverse Comment	Adverse Comment Possible	Adverse Comment Probable
Residential Buildings (16 Hour Day)	0.2 – 0.4	0.4 – 0.8	0.8 – 1.6
Residential Buildings (8 Hour Night)	0.1 – 0.2	0.2 – 0.4	0.4 – 0.8

Where the vibration is intermittent rather than continuous in nature, BS6472 defines procedures for calculating the estimated Vibration Dose Value (eVDV), based on the number and duration of vibration events and the recorded value of the root mean square frequency weighted vibration acceleration. The frequency weighting takes into account the response of the human body to vibrations of different frequency and whether the person is lying down or standing. The eVDV can then be taken as the VDV for use in the assessment of human exposure to vibration in buildings.

The above guidance relates to vibration measured at the point of entry into the human body, which is usually taken to mean the ground surface or at a point mid-span of an upper storey floor, rather than the point of entry into the building (a foundation element).

3.0 NOISE & VIBRATION SURVEYS

REC have conducted a series of Noise and Vibration Surveys to assess the following potential impacts:

- Road traffic noise from vehicles using the A736 and the M8 upon any proposed office space;
- Rail traffic noise from trains using the Paisley to Glasgow railway line to the south of the Site upon any proposed office space;
- Rail traffic vibration from trains using the Paisley to Glasgow railway line to the south of the Site upon any proposed office space; and,
- Noise from any proposed mechanical and electrical plant or commercial operations, which may be included as part of any future development, upon the closest existing noise sensitive residential dwellings.

The measurement positions are shown in Appendix III for reference.

The weather conditions during the Noise Surveys were conducive towards the measurement of environmental noise, being fine and dry with wind speeds of less than 5.0m/s.

3.1 Road Traffic Noise Survey – M8 Motorway

REC has conducted a noise survey at NMP1 during the following period:

- Monday 13th to Tuesday 14th January 2014 starting and ending at 10.37.

The following noise measurement position was chosen for the survey:

- Noise Measurement Position 1 (NMP1): Located in the northern section of Hillington Park approximately 82m from the centre of the M8 motorway. The microphone was located at a height of 1.8m above ground level. It was noted that the dominant noise source at this location was road traffic noise from the M8 motorway.

A summary of the measured sound pressure levels are presented in Table 3.1. The full data set can be seen in Table A1 of Appendix IV.

Table 3.1: Summary of Measured Noise Levels for NMP1

Measurement Position	Period	Measured Sound Pressure Level (dB), freefield			
		$L_{Aeq,T}$	$L_{Amax,fast}$ [1]	$L_{A90,T}$	$L_{A10,T}$
NMP1	Daytime	70.4	76.5	68.3	71.7
	Night-time	68.5		65.9	70.3

[1] 10th highest $L_{Amax,fast}$ from night-time period

3.2 Road Traffic Noise Survey – A736 Hillington Road

REC has conducted a noise survey at NMP2 during the following period:

- Tuesday 14th January 2014 between 10.32 and 13:32.

The following noise measurement position was chosen for the survey:

- Noise Measurement Position 2 (NMP2): Located on the car park of Behar approximately 10.5m from the centre of the A736 Hillington Road. The microphone was located at a height of 1.5m above ground level. It was noted that the dominant noise source at this location was road traffic noise from the A736.

A summary of the measured sound pressure levels are presented in Table 3.2.

Table 3.2: Summary of Measured Noise Levels for NMP2

Measurement Position	Period	Measured Sound Pressure Level (dB), freefield			
		$L_{Aeq,T}$	$L_{Amax,fast}$[1]	$L_{A90,T}$	$L_{A10,T}$
NMP2	14/01/2014 10:32 – 11:32	72.5	82.5	61.9	76.5
	14/01/2014 11:32 – 12:32	72.7		62.9	76.4
	14/01/2014 12:32 – 13:32	72.9		63.1	76.7

[1] 10th highest $L_{Amax,fast}$ from 3 hour period.

3.3 Rail Traffic Noise Survey

The railway line lies adjacent to the southern Site boundary. During the Noise Survey it was observed that ScotRail passenger trains were operating on this part of the railway line which connects Glasgow Central to Gourock.

The Railway Traffic Noise Survey was conducted along the southern Site boundary.

Attended rail traffic noise measurements were carried out over the following period:

- Tuesday 26th November 2013 between 09:50 and 10:21.

The following noise measurement position was chosen for this Noise Survey:

- Noise Measurement Position 3 (NMP3): The microphone was located approximately 20m from the centre of the railway line. Noise sources consisted of intermittent train

pass-bys and occasional vehicle pass-bys on Carnegie Road. Train pass-bys were distinguished by use of the coding feature on the sound level meter.

A summary of the measured noise levels for train passes during the Rail Traffic Noise Survey are presented in Table 3.3.

Table 3.3: Summary of Measured Noise Levels

Provider / Type	Direction	Measured Sound Pressure Level $L_{Aeq,t}$ (dB)	Pass-by Measurement Duration (mm:ss)	Measurement Distance to Centre of Line (m)
ScotRail/Passenger	East	66.6	00:15	20
		60.9	00:07	
		62.6	00:10	
		62.6	00:12	
		64.2	00:02	
	West	64.2	00:08	
		55.6	00:02	
		61.1	00:09	
		63.0	00:09	
		58.5	00:15	

3.4 Background Noise Survey - North

A Background Noise Survey has been conducted in order to measure existing background noise levels to the north of the Site which is representative of the existing residential receptors on the opposite side of the M8 motorway located to the north.

NMP1 has been adopted for this survey as it is equidistant from the M8 as the residential receptors. Unattended background noise measurements were carried out between Monday 13th and Tuesday 14th January 2014 starting and ending at 10:37. This survey duration has allowed for measurement of the quietest daytime and night-time periods which are normally 21:30 – 23:00 for the daytime period and 01:00 – 04:00 for the night-time period respectively.

A summary of the lowest measured 1-hour background noise level for the daytime and night-time periods are presented in Table 3.4. The full data set can be seen in Table A2 of Appendix IV.

Table 3.4: Summary of Lowest Measured 1-hour Background Noise Levels for NMP1 (Backgrounds)

Measurement Position	Measured Period	Lowest Measured Background Noise Level $L_{A90,1hr}$ (dB)
NMP1	Daytime	63.2
	Night-time	46.6

3.5 Background Noise Survey - South

A Background Noise Survey has been conducted in order to measure existing background noise levels in the southern area of the Site in a location representative of the existing residential receptors located on the opposite side of the railway line located on Linburn Road to the south during the quietest daytime and night-time periods.

Unattended background noise measurements were carried out between 14:00 on 15:00 on Monday 25th and 09:17 on Tuesday 26th November 2013. This survey duration has allowed for measurement of the quietest daytime and night-time periods which are normally 21:30 – 23:00 for the daytime period and 01:00 – 04:00 for the night-time period respectively.

The following noise measurement position was chosen for the Background Noise Survey:

- Noise Measurement Position 4 (NMP4): Located at 69 Queen Elizabeth Avenue on the northern façade of the building. The microphone was located 1.5m above ground level in a facade position. Noise sources consisted of intermittent road traffic.

A summary of the lowest measured 1-hour background noise level for the daytime and night-time periods are presented in Table 3.5. The full data set can be seen in Table A3 of Appendix IV.

Table 3.5: Summary of Lowest Measured 1-hour Background Noise Levels for NMP4

Measurement Position	Measured Period	Lowest Measured Background Noise Level $L_{A90,1hr}$ (dB)
NMP4	Daytime	44.3*
	Night-time	39.3*

* 3dB has been subtracted from the levels in order to convert the measured levels from a façade measurement to free-field.

The weather conditions during the Noise Surveys were conducive of those required to undertake environmental noise measurements with wind speeds falling below 5m/s and dry conditions.

The Noise Surveys were completed using the following specification noise measurement

equipment shown in Table 3.6.

Table 3.6: Noise Measurement Equipment

Noise Measurement Position	Equipment Description	Manufacturer & Type No.	Serial No.	Calibration Due Date
NMP1 and NMP2	Sound Level Meter	01dB-Metravib Black Solo	65629	19th November 2014
	Pre-amplifier	01dB-Metravib PRE 21 S	166569	
	Microphone	01dB Metravib MCE212	16255	
	Calibrator	01dB-Metravib CAL-21	34924066	25th November 2014
NMP3 and NMP4	Sound Level Meter	01dB-Metravib Black Solo	65211	24th April 2015
	Pre-amplifier	01dB-Metravib PRE 21 S	15766	
	Microphone	01dB Metravib MCE212	142644	
	Calibrator	01dB-Metravib CAL-21	34113643	23rd March 2014

The sound level meters were field-calibrated on Site prior to and after noise measurements were taken. No significant drift was witnessed. Calibration certificates are available upon request.

3.6 Rail Traffic Vibration Survey

REC has conducted a Rail Traffic Vibration Survey in order to measure the level of vibration associated with the different train types which use the Glasgow – Gourock Railway Line. The survey was carried out over the following time period:

- Tuesday 26th November 2013 between 09:50 and 10:21.

The following vibration measurement position was chosen for the Rail Traffic Vibration Survey:

- Vibration Measurement Position 1 (VMP1): The geophone of the Vibration Meter was located on the southern Site boundary, 20m from the centre of the railway line. The geophone was located on soft ground and was secured using the spikes that are screwed into the base of the geophone to prevent movement.

The measured Peak Particle Velocity (PPV) vibration levels have been weighted in accordance with the guidance stated in BS 6472, where the W_b weighting is applied to the vertical axis (z axis) and the W_d weighting is applied to the horizontal axes (x and y axes). A summary of the measured weighted vibration levels from the vibration survey are presented in Table 3.7.

Table 3.7: Measured Peak Particle Velocity Vibration Levels

Time	Provider / Type	Measured Vibration Level, by Axis (mm/s)		
		X Axis	Y Axis	Z Axis
09:55	ScotRail/ Passenger	0.762	0.635	1.27
10:00		0.635	0.508	0.635
10:01		0.381	0.381	0.635
10:04		0.381	0.381	0.508
10:05		0.381	0.508	0.762
10:10		0.635	0.635	0.889
10:13		0.254	0.508	0.635
10:15		0.254	0.254	0.381
10:19		0.254	0.381	0.508

The Rail Traffic Vibration Survey was completed using the specification noise measurement equipment shown in Table 3.8.

Table 3.8: Vibration Measurement Equipment

Measurement Position	Equipment Description	Manufacturer & Type No.	Serial No.	Calibration Due Date
VMP1	Vibration Meter	Instantel Blastmate III	BA18274	13th April 2015
	Tri-axial Geophone	Instantel Geophone	BG17363	

4.0 NOISE IMPACT ASSESSMENT

The potential noise impact of the following noise sources upon the proposed SPZ development have been considered:

- Road traffic noise from the M8 motorway on proposed offices;
- Road traffic noise from the A736 on proposed offices;
- Rail traffic noise from trains using the Glasgow to Gourock railway line to the south of the Site on proposed offices; and,
- Rail traffic vibration from trains using the Glasgow to Gourock railway line to the south of the Site on proposed offices.

The potential noise impact of the following noise sources from the proposed development upon the closest existing residential receptors have been considered:

- Noise from any proposed mechanical and electrical plant or commercial operations, which may be included as part of any future development, upon the closest noise sensitive receptors.

The Noise Impact Assessment has considered the following stages, as specified in the TAN for each of the above:

- Stage 1: Initial Process. This stage will define the sensitivity of the receptors;
- Stage 2: Quantitative Assessment. Absolute noise levels will be compared with appropriate noise targets for external and internal amenity areas;
- Stage 3: Qualitative Assessment;
- Stage 4: Level of Significance; and,
- Stage 5: The Decision Process.

4.1 PAN 1/2011 Assessment – Road Traffic Noise – M8 Motorway

4.1.1 Stage 1: Initial Process

The proposed NSD comprises commercial and industrial uses. The sensitivity of theses receptors should be considered as ‘medium’ with reference to the examples given in Table 2.1 of the TAN.

4.1.2 Stage 2: Quantitative Assessment

In order to accurately determine the noise level within offices, it has been necessary to calculate the external noise level at the nearest proposed facades.

Table 4.1 details the calculated daytime internal noise levels for the offices, for northern facades with standard thermal double glazing during the daytime period only. Only offices

situated along the northern boundary are shown as these would be exposed to the highest noise levels across the Site and so are a worst case situation.

The now revoked PPG24 suggests that the sound reduction index afforded by such glazing set in a standard brick block wall will reduce external to internal noise levels by approximately 33dB. Standard double glazing is taken as being comprised of 4mm glass for the outer pane, 12mm air space with 4mm glass for the inner pane.

Table 4.1: Calculated Internal Average Noise Levels – Northern Boundary

Distance from Centre of M8 Motorway (m)	Measured Noise Level (dB)	Calculated Noise Level (dB)	Calculated Internal Noise Level with Standard Thermal Double Glazing (dB)	BS 8233 Internal Noise Criteria Level (dB)	Difference +/- (dB)	Magnitude of Impact
25	70.4	75.5	42.5	40	+2.5	Negligible
50	70.4	72.5	39.5	40	-0.5	No Adverse Impact

Table 4.1 shows that the BS 8233 internal noise criteria limit would be breached only if buildings are located within 25m of the centre of the M8 along the northern boundary with standard thermal double glazing in place. However, if buildings are located over 50m from the centre of the M8 there will be no adverse impact from road traffic noise. Therefore, Section 5.0 specifies appropriate mitigation measures.

During summer months it may be necessary to open windows in order to provide a supply of fresh air. BS 8233 suggests that the sound reduction index of a partially open window will attenuate noise by approximately 10-15dB therefore this assessment adopts 12dB. Table 4.2 shows calculated noise levels for commercial units during daytime periods.

Table 4.2: Calculation of Internal Average Noise Levels with Windows Open –Northern Boundary

Distance from Centre of M8 Motorway (m)	Measured Noise Level (dB)	Calculated Noise Level (dB)	Calculated Internal Noise Level with open window (dB)	BS 8233 Internal Noise Criteria Level (dB)	Difference +/- (dB)	Magnitude of Impact
25	70.4	75.5	63.5	40	+23.5	Major Adverse
50	70.4	72.5	60.5	40	+20.5	Major Adverse
75	70.4	70.8	58.8	40	+18.8	Major Adverse

Table 4.2 indicates that the internal target noise level will be exceeded for all facades if windows are opened for any proposed commercial units along the northern boundary and will result in Major Adverse impacts. Accordingly Section 5.0 considers alternative ventilation to opening windows.

4.1.3 Stage 3: Qualitative Assessment

The Quantitative Assessment is deemed to adequately address the noise impacts on the amenity of the commercial units and no further adjustment to the magnitude of impacts is required.

4.1.4 Stage 4: Significance of Effects

With windows closed, Table 4.3 details the significance of effects for any commercial units within 100m of the M8 Motorway with reference to Table 2.2.

Table 4.3: Significance of Effects with Windows Closed – Northern Boundary

Distance from Centre of M8 Motorway (m)	Magnitude of Impact	Sensitivity of Receptor	Significance of Effects
25	Negligible	Medium	Neutral/Slight
50	No Adverse Impact	Medium	Neutral
75	No Adverse Impact	Medium	Neutral

With windows partially open, Table 4.4 details the significance of effects for any commercial units within 100m of the M8 Motorway with reference to Table 2.2.

Table 4.4: Significance of Effects with Windows Partially Open – Northern Boundary

Distance from Centre of M8 Motorway (m)	Magnitude of Impact	Sensitivity of Receptor	Significance of Effects
25	Major Adverse	Medium	Moderate/Large
50	Major Adverse	Medium	Moderate/Large
75	Major Adverse	Medium	Moderate/Large

4.1.5 Stage 5: The Decision Process

When windows are closed the significance of effect has been categorised as 'Neutral/Slight' when approximately 25m from the centre of the M8 Motorway and the TAN offers the following advice:

> *'The effects of noise may be raised but are unlikely to be of importance in the decision making process'.*

When buildings are located over 50m away, TAN offers the following advice:

> *'No effect, not significant, noise need not be considered as a determining factor in the decision making process'.*

With windows partially open the significance of effect has been categorized as 'Moderate/Large' and the TAN offers the following advice:

> *'These effects are likely to be important but where mitigation may be effectively employed such that resultant adverse effects are likely to have a moderate or slight significance'.*

4.2 PAN 1/2011 Assessment – Road Traffic Noise – A736

4.2.1 Stage 1: Initial Process

The proposed NSD comprises commercial and industrial uses. The sensitivity of theses receptors should be considered as 'medium' with reference to the examples given in Table 2.1 of the TAN.

4.2.2 Stage 2: Quantitative Assessment

In order to accurately determine the noise level within offices, it has been necessary to calculate the external noise level at the nearest proposed facades.

Table 4.5 details the calculated daytime internal noise levels for the offices, for the closest facades to the A736 with standard thermal double glazing during the daytime period only.

Table 4.5: Calculated Internal Average Noise Levels

Distance from Centre of A736 (m)	Measured Noise Level (dB)	Calculated Noise Level (dB)	Calculated Internal Noise Level with Standard Thermal Double Glazing (dB)	BS 8233 Internal Noise Criteria Level (dB)	Difference +/- (dB)	Magnitude of Impact
20	73.5	70.7	37.7	40	-2.3	No Adverse Impact
30	73.5	69.0	36.0	40	-4.0	No Adverse Impact

Table 4.5 shows that the BS 8233 internal noise criteria limit will not be exceeded for any commercial units located within 20m of the centre of the A736 with standard thermal double glazing in place and will result in no adverse impact. Therefore, no mitigation measures are required.

During summer months it may be necessary to open windows in order to provide a supply of fresh air. BS 8233 suggests that the sound reduction index of a partially open window will attenuate noise by approximately 10-15dB therefore this assessment adopts 12dB. Table 4.6 shows calculated noise levels for the commercial units during daytime periods.

Table 4.6: Calculation of Internal Average Noise Levels with Windows Open

Distance from Centre of A736 (m)	Measured Noise Level (dB)	Calculated Noise Level (dB)	Calculated Internal Noise Level with open window (dB)	BS 8233 Internal Noise Criteria Level (dB)	Difference +/- (dB)	Magnitude of Impact
20	73.5	70.7	58.7	40	+18.7	Major Adverse
30	73.5	69.0	57.0	40	+17.0	Major Adverse
40	73.5	67.7	55.7	40	+15.7	Major Adverse

Table 4.6 indicates that the internal target noise level will be exceeded for all facades that face the A736 if windows are opened for any proposed commercial units will result in Major Adverse impacts. Accordingly Section 5.0 considers alternative ventilation to opening windows.

4.2.3 Stage 3: Qualitative Assessment

The Quantitative Assessment is deemed to adequately address the noise impacts on the amenity of the commercial units and no further adjustment to the magnitude of impacts is required.

4.2.4 Stage 4: Significance of Effects

With windows closed, Table 4.7 details the significance of effects for any commercial units located along the A736 with reference to Table 2.2.

Table 4.7: Significance of Effects with Windows Closed

Distance from Centre of A736 (m)	Magnitude of Impact	Sensitivity of Receptor	Significance of Effects
20	No Adverse Impact	Medium	Neutral
30	No Adverse Impact	Medium	Neutral
40	No Adverse Impact	Medium	Neutral

With windows partially open, Table 4.8 details the significance of effects for any commercial units located along the A736 with reference to Table 2.2.

Table 4.8: Significance of Effects with Windows Partially Open

Distance from Centre of M8 Motorway (m)	Magnitude of Impact	Sensitivity of Receptor	Significance of Effects
20	Major Adverse	Medium	Moderate/Large

30	Major Adverse	Medium	Moderate/Large
40	Major Adverse	Medium	Moderate/Large

4.2.5 Stage 5: The Decision Process

When windows are closed the significance of effect has been categorised as 'Neutral' when commercial units are located along the A736 and the TAN offers the following advice:

> *'No effect, not significant, noise need not be considered as a determining factor in the decision making process'.*

With windows partially open the significance of effect has been categorized as 'Moderate/Large' and the TAN offers the following advice:

> *'These effects are likely to be important but where mitigation may be effectively employed such that resultant adverse effects are likely to have a moderate or slight significance'.*

4.3 PAN 1/2011 Assessment – Rail Traffic Noise – Glasgow to Gourock Railway Line

The measured noise levels for the train pass-bys, for each train type, have been converted to the 16-hour daytime and 8-hour night-time periods by using the following equation formula:

$L_{Aeq,16hr}$ = Average SEL – (10 x log (60 x 60 x 16) + 10 x log N

Where *Average SEL = Average Sound Event Level for Train Type / Provider*
60 x 60 x 16 = No. seconds in a 16-hour daytime / 8-hour night period
N = No. Train pass-bys in a 16 hour daytime/ 8 hour night period

The total number of train pass-bys, have been obtained using internet-based train timetables.

Table 4.9 details the calculated noise levels for ScotRail Passenger Trains.

Table 4.9: Determination of Daytime Noise Levels – ScotRail

Period	Direction	Calculated Average SEL (dB)	Timetable Movements	Calculated Noise Level $L_{Aeq,T}$ (dB)
Daytime	East	63.8	69	45.9 $L_{Aeq,16hr}$
	West	61.5	63	
Night-time	East	63.8	7	39.3 $L_{Aeq,8hr}$
	West	61.5	8	

4.3.1 Stage 1: Initial Process

The proposed NSD comprises commercial and industrial uses. The sensitivity of theses receptors should be considered as 'medium' with reference to the examples given in Table 2.1 of the TAN.

4.3.2 Stage 2: Quantitative Assessment

In order to accurately determine the noise level within offices, it has been necessary to calculate the external noise level at the nearest proposed facades.

Table 4.10 details the calculated daytime internal noise levels for the offices, for southern facades with standard thermal double glazing during the daytime period. Only offices situated along the southern boundary are shown as these would be exposed to the highest noise levels across the Site and so are a worst case situation.

Table 4.10: Calculated Internal Average Noise Levels – Southern Boundary

Distance from Centre of Railway Line (m)	Measured Noise Level (dB)	Calculated Noise Level (dB)	Calculated Internal Noise Level with Standard Thermal Double Glazing (dB)	BS 8233 Internal Noise Criteria Level (dB)	Difference +/- (dB)	Magnitude of Impact
15	45.9	47.2	14.2	40	-25.8	No Adverse Impact
20	45.9	45.9	12.9	40	-27.1	No Adverse Impact
25	45.9	45.0	12.0	40	-28.0	No Adverse Impact

Table 4.10 shows that the BS 8233 internal noise criteria limit will not be exceeded resulting in no adverse impact with standard thermal double glazing in place, therefore, no mitigation measures are required.

During summer months it may be necessary to open windows in order to provide a supply of fresh air. BS 8233 suggests that the sound reduction index of a partially open window will attenuate noise by approximately 10-15dB therefore this assessment adopts 12dB. Table 4.11 shows calculated noise levels for the commercial units during daytime periods.

Table 4.11: Calculation of Internal Average Noise Levels with Windows Open –Western Boundary

Distance from Centre of Railway Line (m)	Measured Noise Level (dB)	Calculated Noise Level (dB)	Calculated Internal Noise Level with open window (dB)	BS 8233 Internal Noise Criteria Level (dB)	Difference +/- (dB)	Magnitude of Impact
15	45.9	47.2	35.2	40	-4.8	No Adverse Impact
20	45.9	45.9	33.9	40	-6.1	No Adverse Impact

25	45.9	45.0	33.0	40	-7.0	No Adverse Impact

Table 4.11 indicates that the internal target noise level will not be exceeded for all facades located along the southern boundary resulting in no adverse impact. Therefore, no mitigation measures are required.

4.3.3 Stage 3: Qualitative Assessment

The Quantitative Assessment is deemed to adequately address the noise impacts on the amenity of the commercial units and no further adjustment to the magnitude of impacts is required.

4.3.4 Stage 4: Significance of Effects

With windows closed, Table 4.12 details the significance of effects for any commercial units located along the southern boundary with reference to Table 2.2.

Table 4.12: Significance of Effects with Windows Closed

Distance from Centre of Railway Line (m)	Magnitude of Impact	Sensitivity of Receptor	Significance of Effects
15	No Adverse Impact	Medium	Neutral
20	No Adverse Impact	Medium	Neutral
25	No Adverse Impact	Medium	Neutral

With windows partially open, Table 4.13 details the significance of effects for any commercial units located along the southern boundary with reference to Table 2.2.

Table 4.13: Significance of Effects with Windows Partially Open

Distance from Centre of Railway Line (m)	Magnitude of Impact	Sensitivity of Receptor	Significance of Effects
15	No Adverse Impact	Medium	Neutral
20	No Adverse Impact	Medium	Neutral
25	No Adverse Impact	Medium	Neutral

4.3.5 Stage 5: The Decision Process

When windows are closed and open the significance of effect has been categorised as 'Neutral' when commercial units are located along the southern boundary and the TAN offers the following advice:

'No effect, not significant, noise need not be considered as a determining factor in the decision making process'.

4.4 Mechanical Plant Noise Emission Limits Assessment – Existing Residential Receptors

It is likely that proposed developments coming forward under the SPZ will incorporate fixed mechanical plant items. While details of individual plant items are not known at this stage, the potential impact of this has been considered. Accordingly it is necessary to set plant noise emission limits in accordance with the criteria set by RC. Table 4.14 shows the plant noise emission limits when measured or calculated at the façade of the closest residential receptor. These limits are applicable for either a single plant item or multiple plant items.

Table 4.14: Calculation of Plant Noise Emission Limits

Location	Period	Lowest Measured 1-hour Background Noise Level $L_{A90,1hr}$ (dB)	RC Criteria (dB)	Calculated Noise Emission Limit $L_{A,r}$ (dB)
Northern	Day-time (07:00 – 23:00)	63.2	$L_{A90} = L_{Ar}$	63.2
	Night-time (23:00 – 07:00)	46.6		46.6
Southern	Day-time (07:00 – 23:00)	44.3	$L_{A90} = L_{Ar}$	44.3
	Night-time (23:00 – 07:00)	39.3		39.3

Table 4.14 indicates the noise emission limit for plant with a tonal element intermittently, if there is a constant tonal or distinctive element to the noise then the Noise Emission Limit will be 5dB lower than stated in the table.

4.5 Rail Traffic Vibration Impact Assessment

The total Vibration Dose Value (VDV) for the daytime period, for passenger commuter trains has been calculated in accordance with the methodology presented in BS 6472: 2008 using the appropriate weightings.

The total number of commuter trains has been obtained from train timetables published on the internet.

Table 4.15 below summarises the results of the vibration assessment.

Table 4.15: Summary of Predicted Vibration Levels

Train Type	Timetabled Train Movements	Predicted Vibration Dose Value ($m/s^{1.75}$)
Passenger	132	0.072

Comparing the predicted VDV levels at the Site boundary, with the railway, and with the guideline values from BS 6472:2008, it can be determined that there is 'less than a low probability of adverse comment likely'.

5.0 MITIGATION

5.1 Commercial Units located along the Northern Boundary

Section 4.1 showed that commercial units located approximately 25m from the M8 Motorway, i.e. at the northern most boundaries would require higher specification glazing. However, it is assumed that this area will used as a buffer zone with plantings as with the existing buildings located on the northern boundary. If this buffer zone is similar to that that already exists, higher specification glazing would not be required.

However, if buildings were to be built within 50m of the M8 then Table 5.1 details the glazing requirements at set distances for office areas with direct line of sight to the M8 Motorway.

Table 5.1: Glazing Requirements for Commercial Units along Northern Boundary

Distance from Centre of M8 Motorway (m)	Measured Noise Level (dB)	Calculated Internal Noise Level with Standard Thermal Double glazing (dB)	BS 8233 Internal Noise Criteria Level (dB)	Difference +/- (dB)	Required Glazing Performance $R_w + C_{tr}$ (dB)	Example Glazing Specification (glass / air space / glass)
25	70.4	42.5	40	+2.5	32	6 / 12 / 10 or 4 / 6 / 6.4A
30	70.4	41.7	40	+1.7	31	4 / 12 / 8 or 4 / 6 / 6.4A
35	70.4	41.1	40	+1.1	31	4 / 12 / 8 or 4 / 6 / 6.4A
40	70.4	40.5	40	+0.5	30	4 / 6 / 6
45	70.4	40.0	40	0.0	29	Standard

A = Acoustic laminate glass

Note: Sound reduction performance of a stand-alone glazing unit is approximately 29dB R_w. The required sound reduction performance, weighted for the road traffic noise spectrum, is obtained by adding the excess to the stand-alone performance value

The previous section indicated that with a partially open window, the internal noise levels for any office areas which face or partially face the direction of the M8 Motorway will exceed the internal target criteria. Accordingly, it is recommended that a through-frame window mounted trickle ventilator is incorporated into the glazing unit of the office areas so that fresh air can enter the room without having to open windows. One such acoustic trickle ventilator is as follows:

- Greenwoods EAR42W Trickle Ventilator, which provides acoustic attenuation of up to 42 dB $D_{n,e,w} + C_{tr}$ in its open position.

The trickle ventilator should be combined with a suitable extraction ventilator such as:

- Mechanical Extract Ventilation (MEV) system;

- Passive Extract Ventilation (PEV) system;
- Mechanical Ventilation Heat Recovery (MVHR) system; or
- Positive Input Ventilation (PIV) system.

Wherever possible office areas should be located away from the noise source with less noise-sensitive rooms facing the noise source.

5.2 Commercial Units located along the A736

The previous section indicated that with a partially open window, the internal noise levels for any office areas which face or partially face the direction of the A736 will exceed the internal target criteria. Accordingly, it is recommended that a through-frame window mounted trickle ventilator is incorporated into the glazing unit of the office areas so that fresh air can enter the room without having to open windows. The ventilation stated in 5.1 can be applied.

Wherever possible office areas should be located away from the noise source with less noise-sensitive rooms facing the noise source.

Recommended Mitigation Measures

For the overall SPZ, the following mitigation measures are recommended:

- While details of individual plant items are not known at this stage, the potential impact of this has been considered. Plant noise emission limits have been set when measured or calculated at the façade of the closest residential receptor. These limits are applicable for either a single plant item or multiple plant items. The limits are shown in Table 4.14. Table 4.14 indicates the noise emission limit for plant with a tonal element intermittently, if there is a constant tonal or distinctive element to the noise then the Noise Emission Limit will be 5dB lower than stated in the table;
- For any commercial units located approximately 25m from the M8 Motorway, i.e. at the northern most boundaries would require higher specification glazing. However, it is assumed that this area will used as a buffer zone with plantings as with the existing buildings located on the northern boundary. If this buffer zone is similar to that that already exists, higher specification glazing would not be required; and,
- Alternative ventilation is required for all office areas that have direct line of sight to either the M8 Motorway or the A736. Details of which are shown in Section 5.1.

6.0 CONCLUSION

REC Limited have been commissioned by Terence O'Rourke on behalf of MEPC to undertake a Noise and Vibration Impact Assessment for a proposed Simplified Planning Zone (SPZ) at Hillington Park, Glasgow

This assessment has been undertaken to determine the potential noise impact upon the NSR due to the proposed SPZ. This Noise Impact Assessment has been completed with due regard to the requirements of PAN 1/2011 and the accompanying TAN.

For commercial units located in the north facing the M8 Motorway the significance of effect has been categorised as 'Neutral/Slight' with windows closed when approximately 25 - 40m from the centre of the M8 Motorway. When buildings are located over 40m away the significance of effect is categorised as Neutral resulting in no effect, not significant, and noise need not be considered as a determining factor in the decision making process.

The A736 results in a major adverse impact with windows open and as such alternative ventilation has been recommended for any office areas that have line of sight to the A736.

The railway line results in no adverse impact with regards to noise or vibration and as such no mitigation measures are required.

This Noise Impact Assessment has set plant noise emission limits for the proposed commercial units so that the existing background noise levels at the existing residential receptors is not exceeded.

The following mitigation measures are recommended:

- While details of individual plant items are not known at this stage, the potential impact of this has been considered. Plant noise emission limits have been set when measured or calculated at the façade of the closest residential receptor. These limits are applicable for either a single plant item or multiple plant items. The limits are shown in Table 4.14. Table 4.14 indicates the noise emission limit for plant with a tonal element intermittently, if there is a constant tonal or distinctive element to the noise then the Noise Emission Limit will be 5dB lower than stated in the table;

- For any commercial units located approximately 25m from the M8 Motorway, i.e. at the northern most boundaries would require higher specification glazing. However, it is assumed that this area will used as a buffer zone with plantings as with the existing buildings located on the northern boundary. If this buffer zone is similar to that that already exists, higher specification glazing would not be required; and,

- Alternative ventilation is required for all office areas that have direct line of sight to either the M8 Motorway or the A736. Details of which are shown in Section 5.1.

If all mitigation measures are implemented, the significance of effect of any noise source upon the proposed commercial areas will be 'Neutral' and the TAN offers the following advice:

> *'No effect, not significant, noise need not be considered as a determining factor in the decision making process'.*

APPENDIX I LIMITATIONS

1. This report and its findings should be considered in relation to the terms of reference and objectives agreed between REC Limited and the Client as indicated in Section 1.2.

2. The executive summary, conclusions and recommendations sections of the report provide an overview and guidance only and should not be specifically relied upon without considering the context of the report in full.

3. REC cannot be held responsible for any use of the report or its contents for any purpose other than that for which it was prepared. The copyright in this report and other plans and documents prepared by REC is owned by them and no such plans or documents may be reproduced, published or adapted without written consent. Complete copies of this may, however, be made and distributed by the client as is expected in dealing with matters related to its commission. Should the client pass copies of the report to other parties for information, the whole report should be copied, but no professional liability or warranties shall be extended to other parties by REC in this connection without their explicit written agreement there to by REC.

APPENDIX II GLOSSARY OF ACOUSTICAL TERMINOLOGY

Noise

Noise is defined as unwanted sound. Human ears are able to respond to sound in the frequency range 20 Hz (deep bass) to 20,000 Hz (high treble) and over the audible range of 0 dB (the threshold of perception) to 140 dB (the threshold of pain). The ear does not respond equally to different frequencies of the same magnitude, but is more responsive to mid-frequencies than to lower or higher frequencies. To quantify noise in a manner that approximates the response of the human ear, a weighting mechanism is used. This reduces the importance of lower and higher frequencies, in a similar manner to the human ear.

Furthermore, the perception of noise may be determined by a number of other factors, which may not necessarily be acoustic. In general, the impact of noise depends upon its level, the margin by which it exceeds the background level, its character and its variation over a given period of time. In some cases, the time of day and other acoustic features such as tonality or impulsiveness may be important, as may the disposition of the affected individual. Any assessment of noise should give due consideration to all of these factors when assessing the significance of a noise source.

The most widely used weighting mechanism that best corresponds to the response of the human ear is the 'A'-weighting scale. This is widely used for environmental noise measurement, and the levels are denoted as dB(A) or L_{Aeq}, L_{A90} etc, according to the parameter being measured.

The decibel scale is logarithmic rather than linear, and hence a 3 dB increase in sound level represents a doubling of the sound energy present. Judgement of sound is subjective, but as a general guide a 10 dB(A) increase can be taken to represent a doubling of loudness, whilst an increase in the order of 3 dB(A) is generally regarded as the minimum difference needed to perceive a change under normal listening conditions.

An indication of the range of sound levels commonly found in the environment is given in the following table.

Table A1: Typical Sound Pressure Levels

Sound Pressure Level dB(A)	Location
0	Threshold of hearing
20 - 30	Quiet bedroom at night
30 - 40	Living room during the day
40 - 50	Typical office
50 - 60	Inside a car
60 - 70	Typical high street
70 - 90	Inside factory
100 - 110	Burglar alarm at 1m away
110 - 130	Jet aircraft on take off
140	Threshold of pain

Acoustic Terminology

Table A2: Terminology

Descriptor	Explanation
dB (decibel)	The scale on which sound pressure level is expressed. It is defined as 20 times the logarithm of the ratio between the root-mean-square pressure of the sound field and a reference pressure (2x10-5Pa).
dB(A)	A-weighted decibel. This is a measure of the overall level of sound across the audible spectrum with a frequency weighting (i.e. 'A' weighting) to compensate for the varying sensitivity of the human ear to sound at different frequencies.
$L_{Aeq, T}$	L_{Aeq} is defined as the notional steady sound level which, over a stated period of time (T), would contain the same amount of acoustical energy as the A - weighted fluctuating sound measured over that period.
L_{Amax}	L_{Amax} is the maximum A - weighted sound pressure level recorded over the period stated. L_{Amax} is sometimes used in assessing environmental noise where occasional loud noises occur, which may have little effect on the overall Leq noise level but will still affect the noise environment. Unless described otherwise, it is measured using the 'fast' sound level meter response.
L_{10} & L_{90}	If a non-steady noise is to be described it is necessary to know both its level and the degree of fluctuation. The Ln indices are used for this purpose, and the term refers to the level exceeded for n% of the time. Hence L_{10} is the level exceeded for 10% of the time and as such can be regarded as the 'average maximum level'. Similarly, L_{90} is the 'average minimum level' and is often used to describe the background noise. It is common practice to use the L_{10} index to describe traffic noise.
Free-field Level	A sound field determined at a point away from reflective surfaces other than the ground with no significant contributions due to sound from other reflective surfaces. Generally as measured outside and away from buildings.
Fast	A time weighting used in the root mean square section of a sound level meter with a 125millisecond time constant.
Slow	A time weighting used in the root mean square section of a sound level meter with a 1000millisecond time constant.
W_b and W_d	Frequency weighting that relates to the vertical motion (W_b) and the horizontal motion (W_d) of the vibration. The weightings demonstrate maximum sensitivity to vertical acceleration in the frequency range 4Hz to 12.5Hz and to horizontal acceleration in the range 1Hz to 2Hz.

APPENDIX III FIGURES

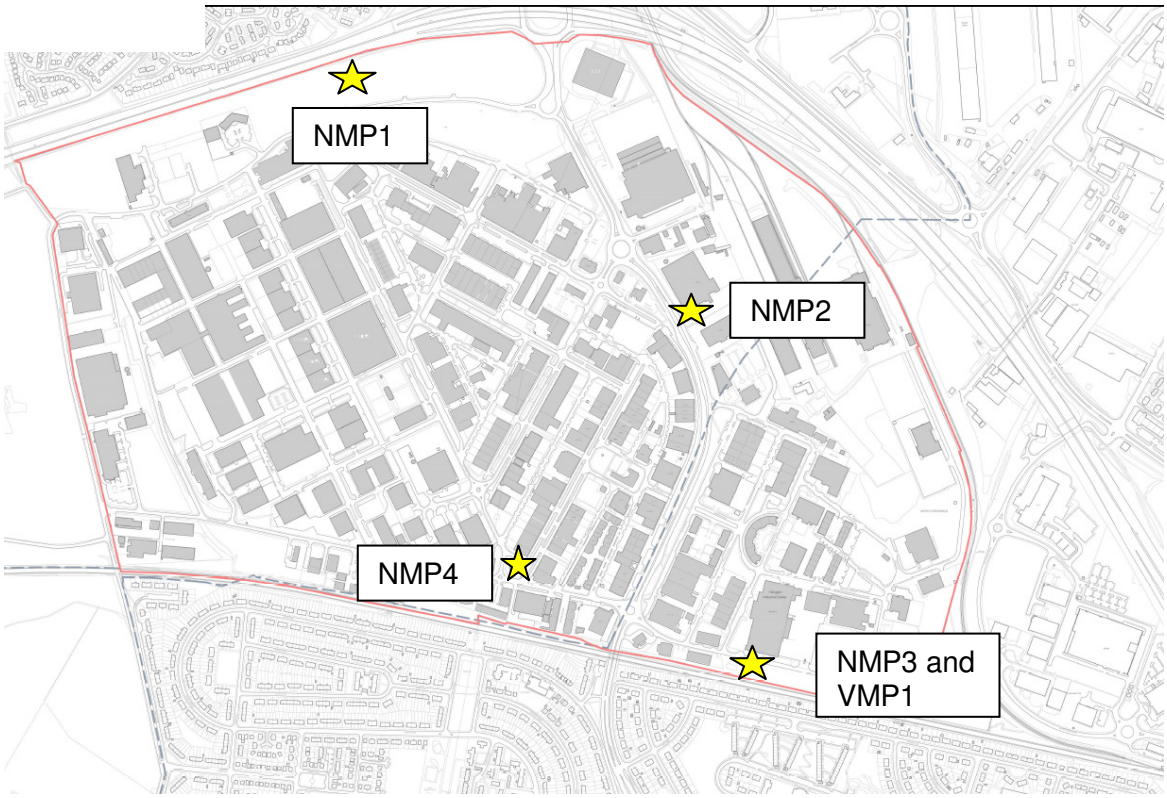

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Figure 1

Site Location Plan and Noise and Vibration Measurement Positions

APPENDIX IV SOUND PRESSURE LEVEL DATA

Table A1: Measured Noise Levels for NMP1

Measurement Start	Measured Sound Pressure Level (dB), freefield			
	$L_{Aeq,T}$	$L_{Amax,fast}$	$L_{A90,T}$	$L_{A10,T}$
13/01/2014 10:37	70.7	74.7	69.0	71.8
13/01/2014 11:37	71.4	85.0	69.5	72.6
13/01/2014 12:37	71.1	75.3	69.2	72.3
13/01/2014 13:37	70.5	76.0	68.8	71.6
13/01/2014 14:37	71.7	75.7	69.9	72.9
13/01/2014 15:37	71.3	74.0	69.0	72.8
13/01/2014 16:37	65.3	73.6	63.2	66.4
13/01/2014 17:37	66.5	74.0	64.2	69.1
13/01/2014 18:37	70.6	74.8	68.6	71.9
13/01/2014 19:37	69.9	74.1	67.6	71.4
13/01/2014 20:37	68.3	73.6	65.2	70.2
13/01/2014 21:37	68.1	73.4	65.2	69.8
13/01/2014 22:37	65.8	72.9	60.7	68.3
13/01/2014 23:37	63.8	70.3	57.0	66.6
14/01/2014 00:37	61.5	73.9	52.6	65.0
14/01/2014 01:37	60.4	70.3	45.0	64.4
14/01/2014 02:37	61.7	72.1	48.9	65.3
14/01/2014 03:37	64.0	72.9	56.5	67.0
14/01/2014 04:37	67.7	75.6	62.1	70.4
14/01/2014 05:37	72.2	78.4	70.0	73.8
14/01/2014 06:37	74.1	89.7	72.6	75.0
14/01/2014 07:37	72.2	76.6	70.7	73.2
14/01/2014 08:37	72.5	77.6	70.7	73.6
14/01/2014 09:37	72.0	80.3	69.8	73.3

Table A2: Measured Noise Levels for NMP4

Measurement Start	Measured Sound Pressure Level (dB), Facade		
	$L_{Aeq,T}$	$L_{A90,T}$	$L_{A10,T}$
25/11/2013 14:00	62.9	54.6	67.6
25/11/2013 15:00	60.7	53.9	64.4
25/11/2013 16:00	61.8	54.6	65.5
25/11/2013 17:00	61.3	53.4	65.3
25/11/2013 18:00	57.9	51.3	62.0
25/11/2013 19:00	55.7	48.5	58.0
25/11/2013 20:00	52.5	48.4	52.8
25/11/2013 21:00	53.6	49.7	53.3
25/11/2013 22:00	54.3	47.3	55.8
25/11/2013 23:00	50.5	45.9	51.6
26/11/2013 00:00	49.2	45.4	51
26/11/2013 01:00	48.1	44.7	48.5
26/11/2013 02:00	44.2	42.3	45.3
26/11/2013 03:00	44.8	42.3	45.4
26/11/2013 04:00	47.1	43.9	48.9
26/11/2013 05:00	51.1	47.2	51.2
26/11/2013 06:00	55.5	48.5	58.6
26/11/2013 07:00	60.3	55.1	62.9

REC are a multi-disciplinary health, safety, environmental and energy consultancy. Our national coverage enables our local experts to provide cost effective and pragmatic consultancy services in an efficient and sustainable manner.

REC Environmental Management

- Environmental Management
- Divestment Services
- Environmental Management Systems
- CDM Co-Ordination
- Environment Permit Application

REC Renewable Energy

- Feasibility Studies
- Ground Source Heat Pumps Installation
- Air Source Heat Pump Installation
- System Design and Maintenance
- Solar Photovoltaic (PV) Systems
- Combined Heat and Power Systems

REC Acoustics

- Sound Insulation Testing
- Noise at Work Assessment
- Development Related Noise
- Environmental Noise

REC Geoenvironmental

- Geotechnical Investigation & Assessment
- Contaminated Land Investigation & Assessment
- Waste Management
- Groundwater Testing
- Environmental Impact Assessment

REC Asbestos & Legionella

- Asbestos Management Surveys
- Demolition/Refurbishment Surveys
- Analysis of Asbestos in Soils and Bulk Samples
- Air Testing for Clearances and Reassurance
- Legionella Risk Assessment

REC Air Quality

- Air Quality Impact
- Odour Assessment
- Dispersion Modelling
- Stack Emission Testing
- Pollution Monitoring

REC Ecology

- Phase 1 Habitat Surveys
- Invasive Species
- Legally Protected Species Surveys
- Mitigation Schemes
- Ecological Impact Assessment (EcIA)
- BREEAM & Code 4 Sustainable Homes
- Habitat Management Plans
- Management planning and targeted Biodiversity Action Plan survey
- Environmental Impact Assessment

REC Flood Risk

- Flood Risk & Consequence Assessment
- Strategic Flood Risk Assessment (SFRA)
- EIA Technical Chapters
- Assessment of Flood Levels
- Hydrology & Hydrogeology
- Flood Defence Structures
- Drainage Systems (SUDS) Design
- Mitigation Measures
- Soakaway Tests