



71-73 Caversham Road, Reading, RG1 8JA

Planning Noise Assessment

October 2019

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This document has been prepared and checked in accordance with
Waterman Group's IMS (BS EN ISO 9001: 2015, BS EN ISO 14001: 2015 and BS OHSAS 18001:2007)

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Comments

Comments

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- A. Glossary of Acoustic Terminology
- B. Residential Amenity Noise Criteria
- C. Baseline Survey

1. Introduction

Waterman Infrastructure & Environment (WIE) has been appointed to undertake an assessment of the suitability of 71-73 Caversham Road, Reading, RG1 8JA redevelopment, (hereafter referred to as the 'Site'), for residential-led use. Further to this, the potential impact resultant from the Development once operational; namely from any plant that may form part of Development has also been assessed.

The site is within the jurisdiction of Reading Borough Council (RBC) who have provided the following pre-application response to the development.

- Noise impact on the development, to include identification of external noise levels impacting on the proposed site, noise transfer between the commercial uses on the ground floor and the residential properties above and noise transfer between residential apartments; and
- Plant noise assessment.

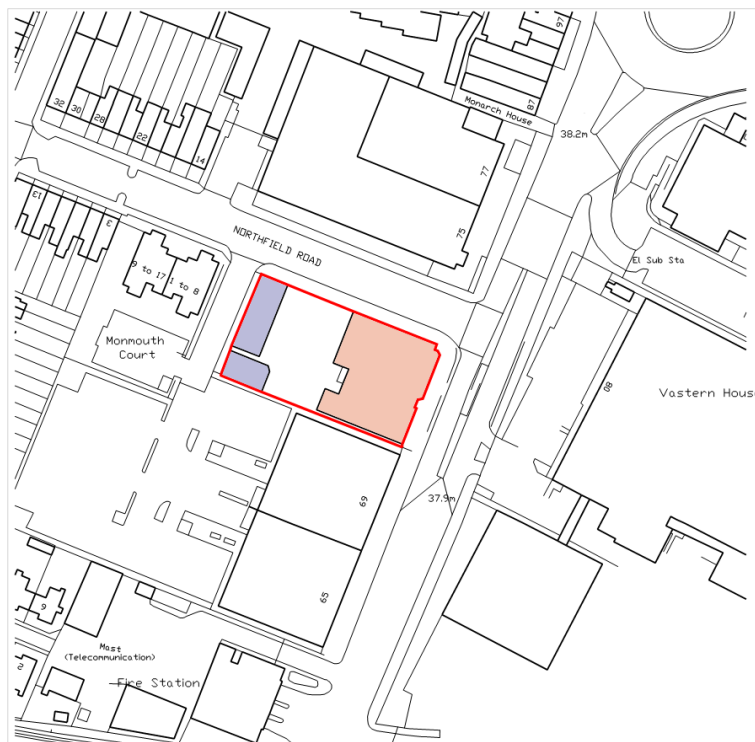
This report also preliminary addresses the pre-application responses by RBC.

1.1 Development

The development consists of the retention of Malthouse and Brewery buildings as offices with demolition of the buildings fronting Caversham Road and erection of a new 7 storey mixed use building comprising 44 residential dwellings, 239 sqm of retail floorspace at ground level and associated cycle parking and landscaping.

Figure 1 presents the location of the Site and planning application boundary. The key noise source incident on the Site is road traffic noise from Caversham Road.

Figure 1: Site Location Plan



Appendix A to this report provides a glossary of acoustic terminology.

2. Residential Amenity Criteria

The most relevant and credited guidance covering desirable levels of environmental noise for indoor and outdoor environments are the World Health Organisation (WHO), 1999 'Guidelines for Community Noise'¹, BS 8233:2014² and ProPG 2017³. Regard has also been given to National Planning Policy Framework (NPPF)⁴, Noise Policy Statement for England⁵, Noise Planning Practice Guidance⁶ although these planning document don't contain specific noise criteria.

With regard to acoustic design and noise control, the NPPF provides a set of overarching aims, broadly reflecting those already contained in the Noise Policy Statement for England (NPSE). They are directed towards the avoidance of significant adverse impacts and reduction of other adverse impacts on health and quality of life; set within the context of the Government's policy on sustainable development. A key element of the NPPF is 'the agent of change principle' set out in Paragraph 182 which states:

"Where the operation of an existing business or community facility could have a significant adverse effect on new development (including changes of use) in its vicinity, the applicant (or 'agent of change') should be required to provide suitable mitigation before the development has been completed."

WHO, BS8233:2014 and ProPG documents set out guideline internal and external noise limits which should be met by all residential developments to ensure the critical effects of noise on sleep, annoyance and speech interference are guarded against. Further to this, ProPG advocates a holistic approach with good acoustic design being a key consideration which is not just reliant on achieving the required guideline noise limits.

A summary of the guideline advice presented within these documents and relevant to the proposed Development is provided in **Table 1** with additional explanatory notes provided in **Appendix B**.

Table 1: Noise Criteria for Assessment of Residential Amenity

Activity	Location	Noise Level dB	
		Day time	Night-time
Resting	Living room	35 dB $L_{Aeq,16h}$	-
Dining	Dining room/area	40 dB $L_{Aeq,16h}$	-
Sleeping (daytime resting)	Bedrooms	35 dB $L_{Aeq,16h}$	30 dB $L_{Aeq,8h}$ 45 dB $L_{Amax,F}$
Enjoyment	Private Garden	50-55dB $L_{Aeq,16h}$	

When considering external amenity spaces such as gardens, balconies and terraces, the guidance provided in BS 8233 and reproduced in ProPG states:

"the acoustic environment of external amenity areas that are an intrinsic part of the overall design should always be assessed and noise levels should ideally not be above the range 50-55 dB $L_{Aeq,16h}$. These guideline values may not be achievable in all circumstances where development might be desirable. In such a situation, development should be designed to achieve the lowest practicable noise levels in these external amenity spaces but should not be prohibited."

¹ World Health Organisation (WHO) (1999); 'Guidelines for Community Noise', WHO, Geneva.

² BSI (2014) BS8233 'Guidance on sound insulation and noise reduction in buildings'. BSI.

³ ANC, IoA, CiEH. (May 2017); Professional Practice Guidance on Planning & Noise. New Residential Development.

⁴ Ministry of housing, Communities and Local Government. (February 2019) National Planning Policy Framework. HMSO.

⁵ Defra. (2010) Noise Policy Statement for England: Crown copyright.

⁶ <https://www.gov.uk/guidance/noise--2> (Accessed 4th July 2019) Note in process of being updated to reflect revised NPPF.

2.1 ProPG Planning & Noise – New Residential Development

The primary goal of ProPG is to assist the delivery of sustainable development by promoting good health and well-being through the effective management of noise. The emphasis of the ProPG is consideration of good acoustic design, thereby creating places that are both comfortable and attractive to live in, where acoustics is considered integral to the living environment. ProPG is only applicable where industrial/commercial noise affecting a site is not dominant, with the emphasis on transportation noise, and is therefore applicable to the Development Site.

The ProPG advocates a systematic proportionate, risk based, 2-stage approach.

- **Stage 1:** an initial noise risk assessment of the proposed development site; and
- **Stage 2:** a systematic consideration of four key elements:
 - Element 1 – demonstrating a “Good Acoustic Design Process”;
 - Element 2 – observing internal “Noise Level Guidelines”;
 - Element 3 – undertaking an “External Amenity Area Noise Assessment”; and
 - Element 4 – consideration of “Other Relevant Issues”.

The above approach is underpinned by the preparation and delivery of an Acoustic Design Statement (ADS). The ADS for a site assessed as high risk should be more detailed than a site assessed as low risk. An ADS should not be necessary for a site assessed as negligible risk.

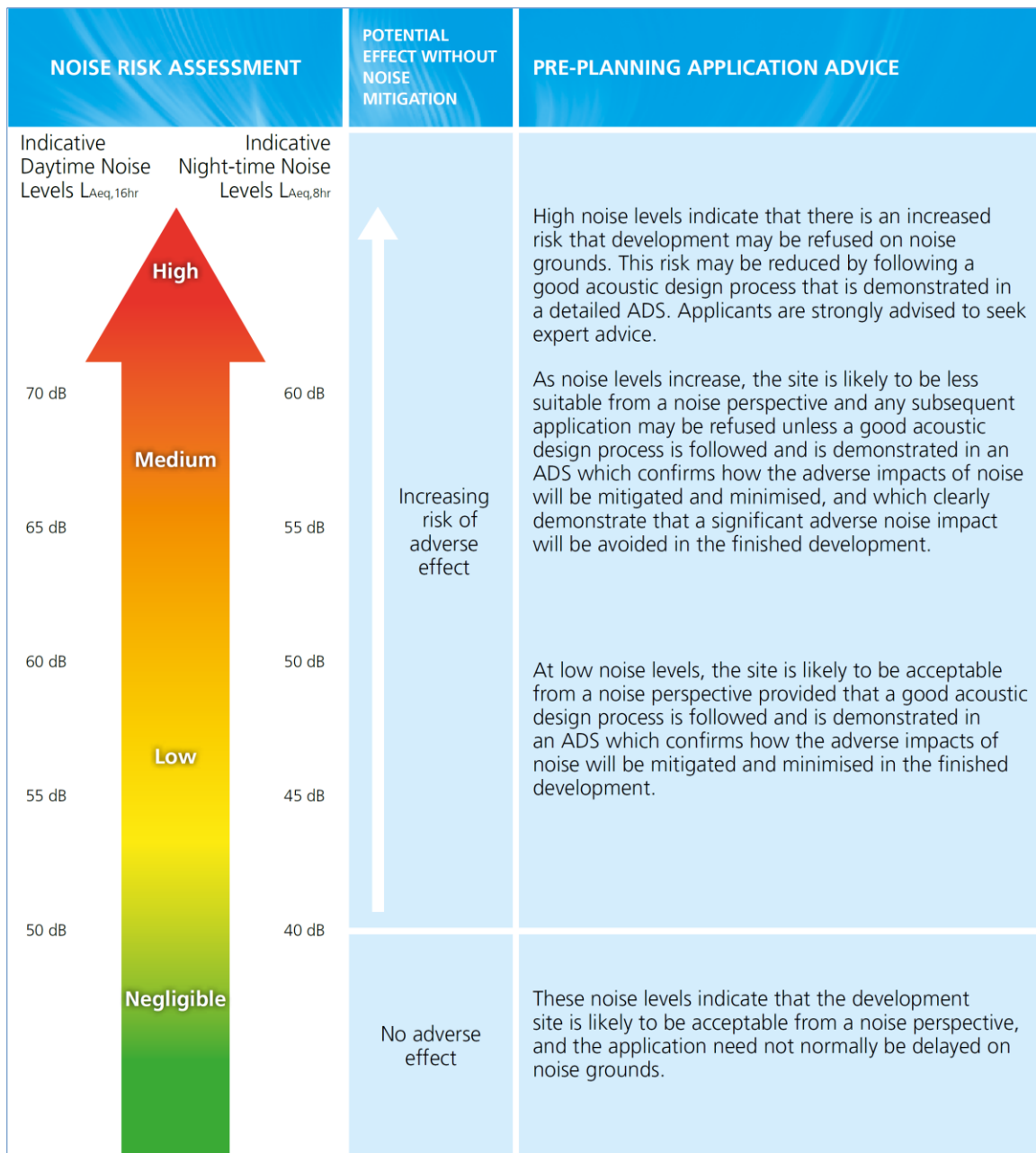
2.1.1 Stage 1: Initial Noise Risk Assessment

The Stage 1 ProPG Initial Noise Risk Assessment is based on the prevailing day (07:00-23:00) and night-time (23:00-07:00) noise levels at the site, established through either measurement or prediction, without any new or additional mitigation. This provides an indication of the likely risk of adverse effects from noise were no subsequent mitigation be included as part of the development proposals. It should indicate whether the Site is considered to pose a negligible, low, medium or high risk from a noise perspective.

Figure 2 from the ProPG has been reproduced illustrating the associated noise risks based on the prevailing noise levels. It is important to note that the assessment of noise risk serves to provide an indication as to the initial suitability of the site for residential development and as to what the acoustic issues are likely to be.

This preliminary noise risk assessment provides prospective developers with a clear indication of where design measures are likely to be required in order to provide suitable residential amenity.

Figure 2: Noise Risk Assessment Reproduced From ProPG



Note:

- Indicative noise levels should be assessed without inclusion of the acoustic effect of any scheme specific noise mitigation measures.
- Indicative noise levels are the combined free-field noise level from all sources of transport noise and may also include industrial/commercial noise where this is present but is "not dominant".
- $L_{Aeq,16h}$ is for daytime 0700-2300, $L_{Aeq,8hr}$ is for night-time 2300-0700.
- An indication that there may be more than 10 noise events at night (2300-0700) with $L_{Amax,F} > 60dB$ means the site should not be regarded as negligible.

2.1.2 Stage 2: Consideration of 4 Key Elements

Element 1- Good Acoustic Design

It is imperative acoustic design is considered at an early stage of the development control process. It is not just compliance with recommended internal and external noise exposure standards but is a multi-faceted and integrated approach to achieve optimal acoustic conditions. This may include strategic design layouts with set-backs, maximisation of screening effects, inclusion of soundscapes (e.g. water features for masking transport noise within communal external amenity areas).

Element 2- Internal Noise Level Guidelines

Guidance is drawn from BS8233:2014 'Guidance on sound insulation and noise reduction for buildings' and is presented in **Table 1**.

Element 3- External Amenity Area Noise Assessment

The ProPG guidance on external amenity area noise assessment reflects and extends the advice contained within BS8233:2014 and the current Government's planning practice guidance-Noise.

3(i) "if external amenity spaces are an intrinsic part of the overall design, the acoustic environment of those spaces should be considered so that they can be enjoyed as intended."

3(ii) "The acoustic environment of external amenity areas that are an intrinsic part of the overall design should always be assessed and noise levels should ideally not be above the range 50-55dB $L_{Aeq,16h}$."

3(iii) "These guideline values may not be achievable in all circumstances where development might be desirable. In such a situation, development should be designed to achieve the lowest practicable noise levels in these external amenity spaces."

3(iv) Whether or not external amenity spaces are an intrinsic part of the overall design, consideration of the need to provide access to a quiet or relatively quiet external amenity space forms part of a good acoustic design process."

3(v) Where, despite following a good acoustic design process, significant adverse noise impacts remain on any private external amenity space (e.g. garden or balcony) then that impact may be partially off-set if the residents are provided, through the design of the development or the planning process, with access to:

- a relatively quiet façade (containing openable windows to habitable rooms) or a relatively quiet externally ventilated space (i.e. an enclosed balcony) as part of their dwelling; and/or
- a relatively quiet alternative or additional external amenity space for sole use by a household, (e.g. a garden, roof garden or large open balcony in a different protected, location); and/or
- a relatively quiet, protected, nearby, external amenity space for sole use by a limited group of residents as part of the amenity of their dwellings; and/or
- a relatively quiet, protected, publicly accessible, external amenity space (e.g. a public park or a local green space designated because of its tranquillity) that is nearby (e.g. within a 5 minutes walking distance). The local planning authority could link such provision to the definition and management of Quiet Areas under the Environmental Noise Regulations.

Element 4- Assessment of Other Relevant Issues

This element seeks to build upon relevant national and local planning and noise policies to provide a

systematic list of recommendations for the issues that should be considered before making a judgement about the noise aspects of a particular planning proposal for new residential development.

- 4(i) compliance with relevant national and local policy
- 4(ii) magnitude and extent of compliance with ProPG
- 4(iii) likely occupants of the development
- 4(iv) acoustic design v unintended adverse consequences
- 4(v) acoustic design v wider planning objectives

Not all of the issues listed above will arise in every planning application. Some will be inherent to the good acoustic design.

3. Operational Noise Impact Assessment Criteria

3.1 Fixed External Plant

The primary source of guidance in relation to noise which is industrial in nature, such as fixed building services plant, is provided in BS 4142:2014⁷. BS 4142 states that the potential impact from industrial/commercial sound is based on the level difference between the source, known as the 'specific sound' level ($L_{Aeq,Tr}$), compared with the 'background sound level' ($L_{A90,T}$) that exists in the absence of the source in question. Where the sound contains any acoustic characteristics such as tonality, impulsiveness and intermittency then the specific noise level is adjusted in-line with BS 4142 advice to determine the rating level ($L_{Ar,Tr}$).

Typically, the greater the difference between the rating level and the background sound level the greater the potential of an adverse impact. BS 4142 states:

- A difference of +10dB or more is likely to be an indication of a significant adverse impact, depending on the context;
- A difference of +5dB or more is likely to be an indication of an adverse impact, depending on the context; and
- Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context.

BS4142 further states; '*Adverse impacts include, but are not limited to, annoyance and sleep disturbance. Not all adverse impacts will lead to complaints and not every complaint is proof of an adverse impact.*'

Context is an important consideration of a BS4142 assessment and the impact may require modification due to context, which may include:

- The absolute level of sound;
- The character and level of the residual sound compared to the character and level of the specific sound; and
- Design measures that secure good internal and/or outdoor acoustic conditions, such as; façade insulation treatment, ventilation and/or cooling that will reduce the need to have windows open and acoustic screening.

Should fixed external plant be introduced as part of the Development then noise limits are recommended having regard to the requirements of LBB, guidance within BS4142 and the prevailing background noise levels.

3.2 Servicing & Deliveries

There is no British Standard for the assessment of noise from servicing and deliveries associated with retail use. In this respect, the selected assessment procedure is comparative and based on the change in the prevailing ambient noise level. Where specific detail is known then the significance of potential noise impacts is assessed based upon the significance criteria presented as **Table 2**. Where specific detail is unknown then a qualitative assessment would be undertaken.

⁷ British Standard Institute (BSI) (2019) Methods for rating and assessing industrial and commercial sound. BSI.

Table 2: Significance of Change in Prevailing Noise Levels

Change in prevailing noise level (dB)	Significance
< 3	Negligible
3 to 5	Minor
6 to 10	Moderate
≥ 10	Substantial

3.3 Consultation with Environmental Health of RBC

Environmental Health of RBC were consulted with regard to the baseline strategy and assessment methodology. With regard to noise criteria for fixed external plant, RBC require the specific noise level to be 10 dB below background with rating level not to exceed background level.

4. RBC's Acoustic Design Considerations

As stated in Section 1 of this report, RBC require consideration of the noise transfer between the commercial uses on the ground floor and the residential properties above and noise transfer between residential apartments. At this stage in the planning process specific details on the separating wall and floor constructions is not known, therefore required (and recommended) noise criteria are presented.

4.1 Noise Transfer Residential / Residential

The residential elements of the proposed Development would be required to comply with Approved Document E (ADE) 'Resistance to the passage of sound' of the Building Regulations as a minimum. The relevant performance criteria as set out in ADE are presented as **Table 3**.

Table 3: ADE Performance Criteria For Separating Walls and Floors

Airborne sound insulation requirement from pre-completion testing $D_{nT,w} + C_{tr}$ (minimum values)		Impact Sound Insulation requirement from pre-completion testing $L'_{nT,w}$ (maximum values)
Separating Walls	Separating Floors	Separating Floors
45	45	62

It should be noted that with airborne sound insulation, the greater the value, the better the sound insulation, whereas the opposite is true for impact sound insulation – the lower the impact sound value, the better the impact sound insulation.

There is a statutory requirement to conduct pre-completion sound insulations tests to demonstrate compliance with ADE. Pre-completion testing is not required for robust detail construction as they are high performance separating wall and floor constructions (with associated construction details) that are expected to be sufficiently reliable.

4.2 Noise Transfer Commercial / Residential

ADE recommends that a higher standard of sound insulation may be required between spaces used for normal domestic purposes and non-domestic purposes with the required sound insulation being dependent on the level of noise generated during the non-domestic spaces.

For most use-classes a separating floor affording a sound insulation of $55D_{nT,w} + C_{tr}$ should in most instances afford adequate protection, in particular retail (A1 Use Class) excluding loud music and car parks.

5. Baseline Conditions

5.1 Sensitive Receptors

The nearest sensitive residential receptors to the Site are located on Northfield Road. **Table 4** presents a description of the nearest residential receptors to the Site.

Table 4: Existing Residential Receptors

Ref	Description	Distance From Site Boundary approx. (m)
SR A	Monmouth Court residential apartments (2 and 3 storey residential block)	10 (west) and 35m from residential block
SR B	Northfield Road, 2 storey terrace houses.	30 (north west)

5.2 Environmental Noise Levels

A baseline noise survey was undertaken on Tuesday 10th September. Short-term attended noise measurements were undertaken during the day and night-time period on Caversham and Northfield Road. The findings of the noise survey were used to assess the residential amenity of the Site and assess the potential impact from noise sources introduced as part of the Development.

The noise monitoring locations are described in **Table 5** and illustrated in **Figure 3**.

Table 5: Description of Noise Monitoring Locations

Ref Figure 3	Location	Description
ST1	Caversham Road, approximately 2m from road edge and 1.5m agl.	Dominant noise source was road traffic noise Caversham Road with some contributory intermittent noise from railway line to the south and human activity.
ST2	Northfield Road, approximately 1m from road edge and 1.5m agl.	Dominant noise source was road traffic noise Caversham Road with some contributory intermittent vehicle movement on Northfield Road and human activity.

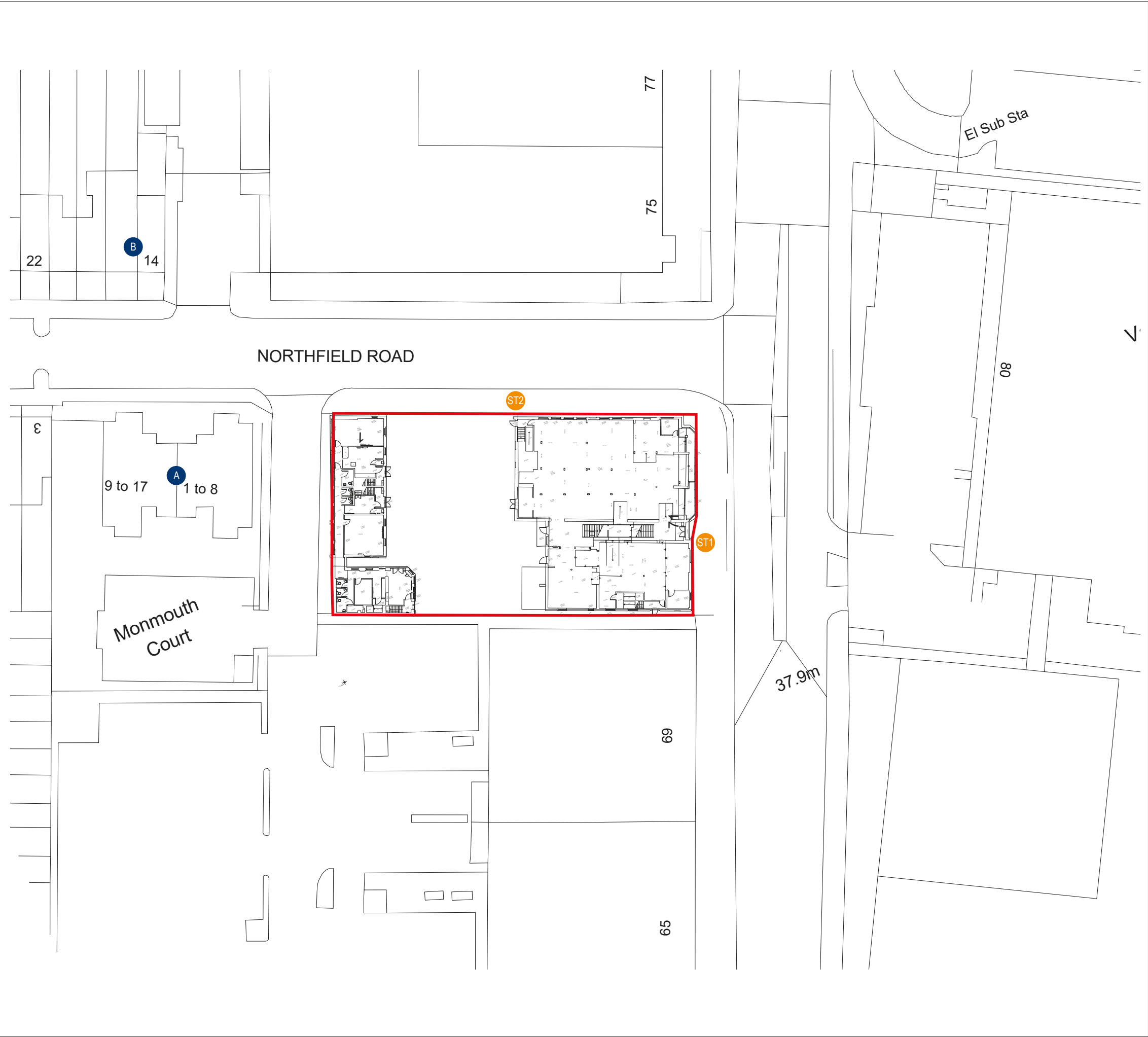
A summary of the measured noise levels is presented as **Table 6** with further survey details within **Appendix C**.

Table 6: Summary of Measured Noise Levels (free-field)

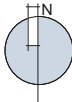
Monitoring (Figure 3)	Location	Period	L _{Aeq,T} dB	L _{A10,T} dB	L _{A90,T} dB	L _{AFmax,5min} dB
			Ave ¹	Ave ²	Ave ³	90th Percentile ⁴
ST1 Caversham Road		Day (1242-1542)	74	77	68	92
		Night (2303-2333)	70	74	55	82
ST2 Northfield Road		Day (11:39-12:39)	61	62	53	81
		Night (2336-0006)	57	61	42	76

Notes: ¹ Logarithmic average; ² Arithmetic average; ³ Modal value (most frequently occurring value) ⁴ The 90th percentile L_{AFmax} value (equivalent to the 10th highest measured L_{AFmax} level) is presented and considered representative of typical L_{AFmax} levels experienced. All figures rounded to nearest whole decibel.

The dominant noise source incident on the Site was road traffic noise from Caversham Road.



- Site Boundary
- Noise Monitoring Locations
- Sensitive Receptors



Project Details	WIE16329-100: Caversham Road
Figure Title	Figure 3: Noise Monitoring & Sensitive Receptor Locations
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6. Assessment of Residential Amenity

A 3-dimensional noise model has been developed using Cadna-A® noise modelling software and calibrated using the results of the baseline noise survey. The Cadna-A® noise model has then been used to generate daytime (0700-2300) and night-time (2300-0700) façade noise levels at the proposed development to inform potential design constraints. Noise levels within proposed external amenity areas are also determined from result of the Cadna-A® noise model to allow comparison with guideline values.

Given the detailed nature of the proposed development, the results of the Cadna-A® noise model has been used to undertake a Stage 2 ProPG noise assessment.

6.1 ProPG Stage 2 Noise Assessment

6.1.1 Element 1 – Good Acoustic Design Process

Due to site constraints, there is limited opportunity to reduce noise levels through set-back from Caversham Road and Northfield Road. The same applies to internal layouts where apartments are single aspect. The proposed massing comprising a taller residential block proximate to Caversham Road compared to that within the western area of the Site, provides screening to the shared podium garden courtyard at level 1 and level 5. The shared podium garden courtyard at level 1 also benefits from screening by the residential block proximate to Northfield Road and existing building to the south.

Balconies on the facades overlooking Caversham Road and Northfield Road are both recessed and enclosed (winter gardens). Inherent design measures should therefore allow suitable noise levels within these areas to be achieved. Protruding balconies are located on internal facing facades and are therefore screened from road traffic noise by the building structure itself.

Plant is located within the building at ground floor level which is set back from the external façade location of level 1. Screening is therefore afforded by the building structure enhanced by the undercroft (cut) location of the plant rooms.

6.1.1 Element 2 – Internal Noise Levels

It is generally accepted that where daytime façade noise levels are $\leq 50\text{dB } L_{Aeq,16h}$ the internal ambient noise level (IANL) with windows open (based on 50% glazing) would be $\leq 35\text{dB } L_{Aeq,16h}$ thereby satisfying the criteria of BS8233:2014. Similarly, night-time façade noise levels of $\leq 45\text{dB } L_{Aeq,8h}$ and $\leq 60\text{dB } L_{Amax}$ would result in IANLs of $\leq 30\text{dB } L_{Aeq,8h}$ and $\leq 45\text{dB } L_{Amax}$ with windows open, again satisfying the criteria of BS8233.

Where the design intent is a natural ventilation strategy through opening of windows then BS8233:2014 considers that IANLs could be increase by 5dB and reasonable internal conditions still provided. This equates to a daytime façade noise level of $\leq 55\text{dB } L_{Aeq,16h}$. This approach is also reflected in ProPG.

Figure 4 presents the daytime predicted façade noise levels and **Figure 5** presents the night-time predicted façade noise levels, both presented as a free-field value (with no reflection). The figures also present the highest predicted noise level on each building façade and therefore worst-case scenario.

Facades illustrated in red would exceed the IANLs with windows open, whereas those illustrated as green or orange in **Figure 4** and green in **Figure 5**, would provide reasonable IANLs with windows partially open. Essentially facades directly overlooking Caversham Road and Northfield Road would exceed guideline IANLs with windows open. Habitable rooms directly adjacent to these facades would require windows of suitable sound insulation specification in combination with a ventilation system to remove the requirement for residents to open windows, such as MVHR. Rear or internal facing habitable rooms, such as those overlooking the shared podium garden courtyard at level 1 are predicted to achieve IANLs with windows

partially open.

Table 7 presents typical glazing and ventilation strategies based on prevailing noise levels.

Table 7: Indicative Glazing & Ventilation Strategy

External Noise Level Not Exceeding		Acoustic Performance Requirement ¹	
Day (dB L _{Aeq})	Night (dB L _{Aeq})	Windows dB R _w +C _{tr}	Ventilators dB D _{n,eW} +C _{tr}
<50	<45	No requirement	
57	52	25	31
60	55	26	32
63	58	29	35
66	61	32	38
69	64	35	41
72	67	38	44
≥72	≥67	Requirements determined on a site-specific basis	

Note: ¹ This may change when account is taken of L_{AFmax} values.

On the façade facing Caversham Road (east elevation) the highest predicted noise levels are at the first level designated for residential use, namely level 1. The predicted daytime façade noise level is 72dB L_{Aeq,16h}, with a predicted night-time noise level of 68dB L_{Aeq,8h} indicating windows affording an acoustic performance of 39dB R_w+C_{tr} in combination with ventilation affording 45dB D_{n,eW}+C_{tr} is likely to be required to achieve guideline IANLs. When account is taken of night-time L_{Amax} value, measured 90th percentile at ST1 of 82dB L_{Amax} (free-field), guideline IANLs of 45dB L_{Amax} should be satisfied within bedrooms based on these acoustic performances for both windows and ventilators.

On the façade facing Northfield Road (north elevation) the highest predicted noise levels are at the first level designated for residential use (level 1) near Caversham Road. The predicted daytime façade noise level is 68dB L_{Aeq,16h}, with a predicted night-time noise level of 63dB L_{Aeq,8h} indicating windows affording an acoustic performance of 34dB R_w+C_{tr} in combination with ventilation affording 40dB D_{n,eW}+C_{tr} is likely to be required. When account is taken of night-time L_{Amax} value, measured 90th percentile at ST2 of 76dB L_{Amax} (free-field), guideline IANLs of 45dB L_{Amax} should be satisfied within bedrooms based on these acoustic performances for both windows and ventilators.

The above is relevant to habitable rooms directly adjacent to these external facades. Where habitable rooms are directly adjacent to winter gardens facing Caversham Road and Northfield Road then standard thermal double glazing should suffice. This statement is based on the windows to winter gardens being in the closed position.

The predicted noise levels on internal facing facades are predicted to predominantly achieve IANLs with windows partially open, and therefore would satisfy IANLs with standard thermal double glazing and trickle ventilators.

The glazing and ventilation strategy together with zoning, which takes account of change in prevailing noise level with height, would be developed once internal layouts are fixed.

6.1.2 Element 3- External Amenity

The development would provide a shared podium garden courtyard at level 1 and level 5. The daytime noise levels within these areas is ≤55dB L_{Aeq,16h} and therefore suitable for residential amenity.

Daytime noise levels on internal facing protruding balconies are predicted to achieve the guideline value of $\leq 55\text{dB L}_{\text{Aeq},16\text{h}}$ and therefore suitable for residential amenity.

Balconies facing Caversham Road and Northfield Road are both recessed, enclosed and part glazed, therefore essentially winter gardens. Noise levels of $\leq 55\text{dB L}_{\text{Aeq},16\text{h}}$ could be achieved with provision of standard acoustic glazing. Open windows to recessed balcony areas would exceed the guideline level of $55\text{dB L}_{\text{Aeq},16\text{h}}$. Residents do have access to an alternative external amenity area where guideline values are predicted to be satisfied. Both ProPG and BS8233:2014 recognise that it is not always possible to satisfy guideline values in external amenity areas stating *“These guideline values may not be achievable in all circumstances where development might be desirable. In such a situation, development should be designed to achieve the lowest practicable noise levels in these external amenity spaces but should not be prohibited.”*

6.1.3 Element 4- Assessment of Other Relevant Issues

With provision of appropriate mitigation and good acoustic design, the proposed development is in-line with relevant national policy and guidance, meeting the criteria of ProPG.

Figure 4: Daytime Façade Noise Levels (dB LAeq,16h (free-field))

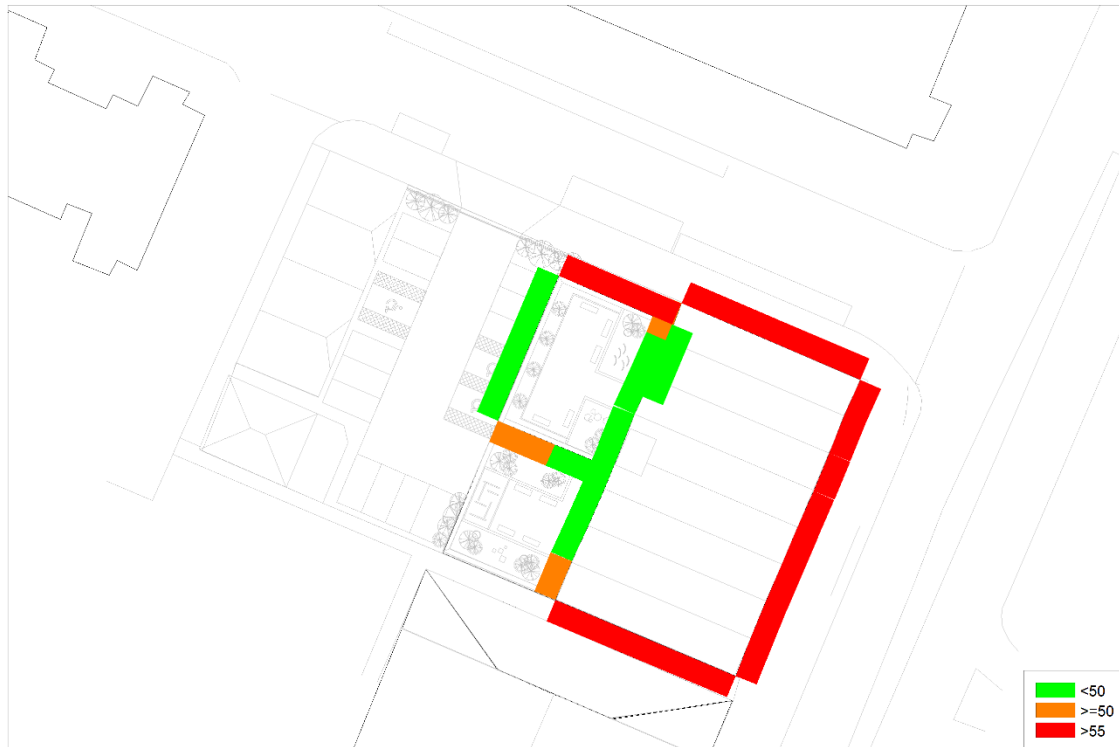


Figure 5: Night-Time Façade Noise Levels (dB LAeq,8h (free-field))



7. Noise Assessment Fixed External Plant and Building Services

At this stage of the design process, the specific type, configuration of fixed plant and building services are not defined and therefore appropriate plant noise emission limits have been recommended.

Based upon BS4142 guidance and requirements of RBC, it is recommended that noise emissions from fixed mechanical plant and building services, expressed as a specific noise level (dB $L_{Aeq,Tr}$), be limited to 10dB below background at the nearest identified noise receptor, with a maximum daytime value of 45dB $L_{Aeq,Tr}$ where daytime background noise levels exceed 55dB $L_{A90,T}$ and minimum night-time value of 35dB $L_{Aeq,Tr}$ where night-time background noise levels are below 45dB $L_{A90,T}$. The minimum recommended noise limit of 35dB $L_{Aeq,Tr}$ at night-time would not conflict with guideline IANLs, when windows are open, for restorative sleep. As per the requirements of RBC, the rating noise level as defined in BS4142:2019, should not exceed the prevailing background level.

Table 8 presents recommended plant noise limits for existing residential receptors adjacent to the Site.

Table 8: Recommended Plant Noise Limits for Existing Receptors

Sensitive Receptors	Period	Measured Background Noise Level dB L_{A90} ¹	Plant Noise Limit dB $L_{Aeq,Tr}$ ²
Northfield Road	Day	53	43
	Night	42	35

Note: ¹ Based on modal measured background noise level. ² Specific noise level as defined in BS4142:2019.

With regard to future residents within the Development, it is recommended that plant noise levels do not exceed 40dB $L_{Aeq,Tr}$ at 1m from the façade (expressed as a free-field value). This would result in an IANL of 25-30dB L_{Aeq} , thereby satisfying the BS8233 night-time criteria with windows open.

Plant specification would be sufficiently flexible to ensure that suitably quiet, non-tonal plant can be procured and / or mitigation options such as screening (e.g. acoustic louvres) could be installed as necessary to ensure that the plant noise criteria is met. Further to this, it should be noted that plant is located within the building at ground floor level which undercuts the floors above and is therefore afforded screening from the building structure itself.

8. Delivery and Servicing

Specific detail on the retail end users, servicing locations and operational times of the Development are not known. The number of delivery vehicles associated with the retail use would be largely dependent upon the final occupants which has not yet been determined. It is considered that standard controls, secured through planning conditions relating to hours of delivery would be inherent in the scheme design and therefore, noise effects associated with servicing and deliveries on existing and future sensitive receptors could be adequately controlled and therefore negligible.

With regard to waste collection, the storage and access is located at ground floor within the western area of the development and therefore screened by the building itself. Intermittent collection of waste is likely to be comparable to existing and therefore the potential impact is regarded as negligible.

9. Conclusions

The minimum required sound insulation performance of separating walls and floors between residential uses and separating floor between commercial and residential uses are presented. The acoustic performance presented is in-line with the requirements of The Building Regulations Approved Document E (ADE) 'Resistance to the passage of sound' and should therefore adequately protect residents from the transfer of noise.

The initial site noise risk assessment, informed through results of the baseline noise survey and subsequent CadnaA® noise modelling, indicates that a good acoustic design process needs to be followed to provide suitable residential amenity.

The results of the Stage 2 ProPG noise assessment are summarised as follows:

- **Element 1:** There is limited opportunity due to site constraints to maximise setbacks to the build line from Caversham Road and Northfield Road. The proposed design layout incorporates elements of good acoustic design, such as strategic massing to protect external amenity areas from road traffic noise, location of plant at ground floor level within the building thereby maximising screening, incorporation of fully enclosed recessed balconies facing the surrounding road network.
- **Element 2:** Facades facing Caversham Road and Northfield Road would require provision of suitable glazing and ventilation in order to provide appropriate internal residential amenity. Habitable rooms on the internal facing elevations are predicted to have reasonable IANLs with windows partially open, due to shielding from the building structure.
- **Element 3:** Predicted noise levels within external amenity spaces are predicted to be $\leq 55\text{dB L}_{\text{Aeq},16\text{h}}$ and are therefore suitable for residential amenity.
- **Element 4:** With the inclusion of appropriate design measures, the proposed development satisfies national policy and guidance. Any fixed external plant or building services associated with the Development, would be designed to satisfy BS4142 guidance and requirements of RBC and therefore should not impact on residents or adjacent land uses.

As specific details of the end users of the non-residential elements of the Development are not known, it is considered that through the implementation of standard controls, such as a delivery and serving management plan, noise effects associated with servicing and deliveries on existing and future sensitive receptors would be negligible.

In summary, the noise assessment indicates that through incorporation of good acoustic design and selection of appropriate glazing and ventilation, together with compliance with building regulation requirements, suitable residential amenity would be provided.

Potential impacts associated with the operation of the development can be controlled to a level of negligible significance provided careful attention is paid to the building design, plant selection, installation and noise attenuation and therefore it is considered compatible with surrounding land uses and would not adversely impact on the existing residential amenity.

APPENDICES

A. Glossary of Acoustic Terminology

Ambient sound	The totally encompassing sound in a given situation at a given time, usually composed of sound from all sources near and far.																		
Assessment period	The period in a day over which assessments are made.																		
A-weighting	A frequency weighting applied to measured or predicted sounds levels in order to compensate for the non-linearity of human hearing.																		
Background noise	Background noise is the term used to describe the noise measured in the absence of the noise under investigation. It is described as the average of the minimum noise levels measured on a sound level meter and is measured statistically as the A-weighted noise level exceeded for ninety percent of a sample period. This is represented as the L_{90} noise level (see below).																		
Broadband	Containing the full range of frequencies.																		
Decibel [dB]	The level of noise is measured objectively using a Sound Level Meter. This instrument has been specifically developed to mimic the operation of the human ear. The human ear responds to minute pressure variations in the air. These pressure variations can be likened to the ripples on the surface of water but of course cannot be seen. The pressure variations in the air cause the eardrum to vibrate and this is heard as sound in the brain. The stronger the pressure variations, the louder the sound that is heard. The range of pressure variations associated with everyday living may span over a range of a million to one. On the top range may be the sound of a jet engine and on the bottom of the range may be the sound of a pin dropping. Instead of expressing pressure in units ranging from a million to one, it is found convenient to condense this range to a scale 0 to 120 and give it the units of decibels. The following are examples of the decibel readings of every day sounds: <table> <tr> <td>Four engine jet aircraft at 100m</td><td>120 dB</td></tr> <tr> <td>Riveting of steel plate at 10m</td><td>105 dB</td></tr> <tr> <td>Pneumatic drill at 10m</td><td>90 dB</td></tr> <tr> <td>Circular wood saw at 10m</td><td>80 dB</td></tr> <tr> <td>Heavy road traffic at 10m</td><td>75 dB</td></tr> <tr> <td>Telephone bell at 10m</td><td>65 dB</td></tr> <tr> <td>Male speech, average at 10m</td><td>50 dB</td></tr> <tr> <td>Whisper at 10m</td><td>25 dB</td></tr> <tr> <td>Threshold of hearing, 1000 Hz</td><td>0 dB</td></tr> </table>	Four engine jet aircraft at 100m	120 dB	Riveting of steel plate at 10m	105 dB	Pneumatic drill at 10m	90 dB	Circular wood saw at 10m	80 dB	Heavy road traffic at 10m	75 dB	Telephone bell at 10m	65 dB	Male speech, average at 10m	50 dB	Whisper at 10m	25 dB	Threshold of hearing, 1000 Hz	0 dB
Four engine jet aircraft at 100m	120 dB																		
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Male speech, average at 10m	50 dB																		
Whisper at 10m	25 dB																		
Threshold of hearing, 1000 Hz	0 dB																		
dB(A): A-weighted decibels	The ear is not as effective in hearing low frequency sounds as it is hearing high frequency sounds. That is, low frequency sounds of the same dB level are not heard as loud as high frequency sounds. The sound level meter replicates the human response of the ear by using an electronic filter which is called the 'A' filter. A sound level measured with this filter switched on is denoted as dB(A). Practically all noise is measured using the A filter. The sound pressure level in dB(A) gives a close indication of the subjective loudness of the noise.																		
Façade Noise Level	A noise level measured or predicted at the façade of a building, typically at a distance of 1m, containing a contribution made up of reflections from the façade itself (+3 dB).																		
Free-Field	Free field is a measurement area not subject to significant reflection of acoustical energy. A free field measurement is typically not closer than 3.5 metres to any large flat object (other than the ground) such as a fence or wall..																		
L_{Amax} noise level	This is the maximum noise level recorded over the measurement period.																		
L_{Amin} noise level	This is the lowest level during the measurement period.																		
$L_{Aeq,T}$ noise level	This is the 'equivalent continuous A-weighted sound pressure level, in decibels' and is defined in British Standard 7445 as the 'value of the A-weighted sound pressure level of a continuous, steady sound that, within a specified time interval, T, has the same mean square sound pressure as a sound under consideration whose level varies with time'.																		

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	It is a unit commonly used to describe construction noise, noise from industrial premises and is the most suitable unit for the description of other forms of environmental noise.
L_{A90} noise level	This is the noise level that is exceeded for 90% of the measurement period and gives an indication of the noise level during quieter periods. It is often referred to as the background noise level and is used in the assessment of disturbance from industrial noise.
L_{A10} noise level	This is the noise level which is achieved for 10% of the monitoring period and is often used to describe road traffic noise.
Rating Level dB L_{A,r,Tr}	Specific sound level plus any adjustment for the characteristic features of the sound.
Residual Sound	Ambient sound remaining at the assessment location when the specific sound source is suppressed to such a degree that it does not contribute to the ambient sound.
Sound Reduction Index (R)	The sound reduction index is a single-number rating of the sound reduction through a wall or other building element. Since the sound reduction may be different at different frequencies, test measurements are subjected to a standard procedure which yields a single number that is about equal to the average sound reduction in the middle of the human hearing range.
Specific Sound Level dB L_{Aeq,Tr}	Equivalent continuous A-weighted sound pressure level produced by the specific sound source at the assessment location over a given reference time interval, Tr.
Weighted Sound Reduction Index (R_w)	Single number rating used to describe the laboratory airborne sound insulation properties of a material or building element over a range of frequencies, typically 100-3150Hz.
C_{TR}	An adjustment to the R _w scale to take account of the lower performance against a typical spectrum of road traffic noise dominated by low frequencies.
D_{ne,W}	Weighted element normalised level difference.

Appendices

B. Residential Amenity Noise Criteria

Table B1 provides a summary of the noise criteria used for the assessment of residential amenity which have been derived from advice provided within ProPG.

Table B1: Noise Criteria For Assessment of Residential Amenity

Activity	Location	Noise Level	
		Day time	Night-time
Resting	Living room	35 dB $L_{Aeq,16h}$	-
Dining	Dining room/area	40 dB $L_{Aeq,16h}$	-
Sleeping (daytime resting)	Bedrooms	35 dB $L_{Aeq,16h}$	30 dB $L_{Aeq,8h}$ 45 dB $L_{Amax,F}$ (note 4)
Enjoyment and relaxing	Garden	50-55dB $L_{Aeq,16h}$	

Note 1: The Table provides recommended internal L_{Aeq} target levels for overall noise in the design of a building. These are the sum total of structure-borne and airborne noise sources. Ground-borne noise is assessed separately and is not included as part of these targets, as human response to ground-borne noise varies with many factors such as level, character, timing, occupant expectation and sensitivity.

Note 2: The internal L_{Aeq} target levels shown in the Table are based on the existing guidelines issued by the WHO and assume normal diurnal fluctuations in external noise. In cases where local conditions do not follow a typical diurnal pattern, for example on a road serving a port with high levels of traffic at certain times of the night, an appropriate alternative period, eg 1 hour, may be used, but the level should be selected to ensure consistency with the internal L_{Aeq} target levels in the Table.

Note 3: These internal L_{Aeq} target levels are based on annual average data and do not have to be achieved in all circumstances. For example, it is normal to exclude occasional events, such as fireworks night or New Year's Eve.

Note 4: Regular individual noise events (for example, scheduled aircraft or passing trains) can cause sleep disturbance. A guideline value may be set in terms of SEL or $L_{Amax,F}$, depending on the character and number of events per night. Sporadic noise events could require separate values. In most circumstances in noise sensitive rooms at night (e.g. bedrooms) good acoustic design can be used so that individual noise events do not normally exceed 45dB $L_{Amax,F}$ more than 10 times a night. However, where it is not reasonably practicable to achieve this guideline then the judgement of acceptability will depend not only on the maximum noise levels but also on factors such as the source, number, distribution, predictability and regularity of noise events.

Note 5: Designing the site layout and the dwellings so that the internal target levels can be achieved with open windows in as many properties as possible demonstrates good acoustic. Where it is not possible to meet internal target levels with windows open, internal noise levels can be assessed with windows closed, however any façade openings used to provide whole dwelling ventilation (e.g. trickle ventilators) should be assessed in the 'open' position and, in this scenario, the internal L_{Aeq} target levels should not normally be exceeded, subject to the further advice in Note 7.

Note 6: Attention is drawn to the requirements of the Building Regulations.

Note 7: Where development is considered necessary or desirable, despite external noise levels above WHO guideline, the internal L_{Aeq} target levels may be relaxed by up to 5dB and reasonable internal conditions still achieved. The more often internal L_{Aeq} levels start to exceed the internal L_{Aeq} target levels by more than 5dB, the more that most people are likely to regard them as "unreasonable". Where such exceedances are predicted, applicants should be required to show how the relevant number of rooms affected has been kept to a minimum. Once internal L_{Aeq} levels exceed the target levels by more than 10dB, they are highly likely to be regarded as "unacceptable" by most people, particularly if such levels occur more than occasionally. Every effort should be made to avoid relevant rooms experiencing "unacceptable" noise levels at all and where such levels are likely to occur frequently, the development should be prevented in its proposed form.

C. Baseline Survey

Table C1 presents equipment detail used for the baseline survey. The sound level meters were field calibrated before and on completion with no significant drift detected. All equipment used holds a valid calibration certificate which are available on request.

Table C1: Noise Monitoring Equipment Details

Measurement Location	Equipment	Model	Serial No.
ST1, ST2	Sound Level Meter (Type 1)	Norsonics 140 Type 1 Sound Level Meter	1406408
	Microphone	1209 - Pre-amplifier	43591
	Pre-amplifier	1225 Microphone	10129
All	Calibrator	Rion NC-74	35173533

All equipment was field calibrated before and on completion of the baseline survey. Weather conditions were noted as being dry with wind speed less than 5 m/s and therefore suitable for noise survey.

Tables C2 and C3 present the measured noise levels at ST1 Caversham Road and ST2 Northfield Road.

Table C2: Measured Noise Levels ST1 Caversham Road

Address	Start Time	L _{Aeq}	L _{Amax}	L _{A10}	L _{A90}
1	(2019/09/10 12:42:33.00)	73.8	85.5	76.4	65.7
2	(2019/09/10 12:47:34.00)	75.3	98.3	76.8	67.0
3	(2019/09/10 12:54:48.00)	73.5	83.7	76.5	64.7
4	(2019/09/10 12:59:50.00)	73.5	81.1	76.4	67.3
5	(2019/09/10 13:04:52.00)	74.2	86.8	77.1	67.4
6	(2019/09/10 13:09:54.00)	74.5	84.6	77.2	67.9
7	(2019/09/10 13:14:56.00)	73.0	82.4	75.7	66.8
8	(2019/09/10 13:19:58.00)	73.6	83.7	76.3	65.4
9	(2019/09/10 13:25:00.00)	74.2	81.7	76.9	67.5
10	(2019/09/10 13:30:02.00)	75.1	89.7	78.1	67.1
11	(2019/09/10 13:35:05.00)	73.5	81.5	76.1	68.1
12	(2019/09/10 13:40:07.00)	75.1	88.8	77.2	67.1
13	(2019/09/10 13:45:09.00)	74.2	90.6	76.4	67.2
14	(2019/09/10 13:50:11.00)	74.0	84.4	76.4	66.9
15	(2019/09/10 13:55:13.00)	74.7	84.4	77.1	69.5
16	(2019/09/10 14:00:15.00)	74.0	84.6	76.4	68.1
17	(2019/09/10 14:05:17.00)	73.4	82.4	76.5	65.9
18	(2019/09/10 14:10:19.00)	74.2	86.2	76.6	66.4
19	(2019/09/10 14:15:21.00)	73.4	84.9	75.8	68.0
20	(2019/09/10 14:20:24.00)	73.7	81.9	76.6	67.7
21	(2019/09/10 14:25:26.00)	74.8	88.6	77.5	68.1
22	(2019/09/10 14:30:28.00)	75.2	86.6	77.8	70.1
23	(2019/09/10 14:35:30.00)	74.0	83.9	76.6	67.7
24	(2019/09/10 14:40:32.00)	73.2	80.8	76.6	65.8
25	(2019/09/10 14:45:34.00)	73.7	81.3	77.0	66.7
26	(2019/09/10 14:50:36.00)	74.5	89.0	76.0	68.1
27	(2019/09/10 14:55:38.00)	73.7	85.4	76.4	65.3
28	(2019/09/10 15:00:40.00)	74.3	84.4	77.0	67.4
29	(2019/09/10 15:05:43.00)	75.4	99.5	77.5	66.0
30	(2019/09/10 15:10:45.00)	74.0	84.8	77.0	67.0
31	(2019/09/10 15:15:47.00)	73.2	81.0	76.2	67.1
32	(2019/09/10 15:20:49.00)	73.5	92.6	76.7	64.6
33	(2019/09/10 15:25:51.00)	73.7	87.9	76.7	64.7
34	(2019/09/10 15:30:54.00)	73.9	82.8	76.8	67.8
35	(2019/09/10 15:35:56.00)	74.3	87.3	76.7	66.7
36	(2019/09/10 15:40:58.00)	76.5	92.9	79.3	67.3

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Address	Start Time	L _{Aeq}	L _{Amax}	L _{A10}	L _{A90}
1	(2019/09/10 23:03:01.00)	70.4	81.0	74.4	53.9
2	(2019/09/10 23:08:03.00)	69.9	82.2	73.7	54.5
3	(2019/09/10 23:13:05.00)	69.0	81.2	74.0	51.7
4	(2019/09/10 23:18:07.00)	70.0	81.0	74.4	54.5
5	(2019/09/10 23:23:09.00)	69.7	80.2	73.9	54.5
6	(2019/09/10 23:28:12.00)	68.0	80.5	72.3	53.6

Table C3: Measured Noise Levels ST2 Northfield Road

Address	Start Time	L _{Aeq}	L _{Amax}	L _{A10}	L _{A90}
1	(2019/09/10 11:38:47.00)	63.2	80.1	64.7	60.8
2	(2019/09/10 11:43:49.00)	64.0	74.5	66.6	53.1
3	(2019/09/10 11:48:51.00)	56.7	71.3	59.8	48.1
4	(2019/09/10 11:53:53.00)	58.2	73.4	60.9	52.9
5	(2019/09/10 11:58:54.00)	59.8	74.4	63.6	52.2
6	(2019/09/10 12:03:56.00)	63.1	81.6	64.7	51.4
7	(2019/09/10 12:08:58.00)	60.1	75.5	62.5	51.9
8	(2019/09/10 12:14:00.00)	57.0	79.8	58.5	48.8
9	(2019/09/10 12:19:02.00)	58.3	81.0	60.2	49.9
10	(2019/09/10 12:24:04.00)	60.0	76.2	62.4	53.1
11	(2019/09/10 12:29:06.00)	58.1	69.7	60.9	52.6
12	(2019/09/10 12:34:08.00)	59.5	75.7	62.7	50.5
Address	Start Time	L _{Aeq}	L _{Amax}	L _{A10}	L _{A90}
1	(2019/09/10 23:36:12.00)	57.5	70.2	61.9	44.5
2	(2019/09/10 23:41:14.00)	58.6	81.2	60.7	44.2
3	(2019/09/10 23:46:16.00)	56.5	71.1	60.6	42.3
4	(2019/09/10 23:51:18.00)	57.2	70.7	62.0	42.8
5	(2019/09/10 23:56:21.00)	55.2	67.6	59.4	42.1
6	(2019/09/11 00:01:23.00)	56.6	68.9	60.6	42.4

Appendices

UK and Ireland Office Locations

