MACH ACOUSTICS

LECKWITH QUAY

Environmental Noise Assessment Report

Gareth Davies Project Services

04 March 2022

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Revision	Description	Author	Checked by	Issued by	Issue Date
00	First Issue	ZE	JC	JC	15/08/2019
01	Revised site plan	JC	JC	JC	06/12/2019
02	Revised site plan	AB	JC	JC	08/10/2021
03	Revised site plan, update to dwelling review	AB	JC	JC	24/02/2022
04	-	JC	JC	JC	04/03/2022

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EXECUTIVE SUMMARY

An Environmental Noise Assessment has been undertaken by Mach Acoustics to assess the external noise environment at the proposed Leckwith Quay site.

The results of the noise survey indicate that the noise levels across the development site fall within TAN 11 Noise Exposure Category B, which states '*Noise should be taken into account when determining planning applications and, where appropriate, conditions imposed to ensure an adequate level of protection.'*

Noise levels across the site are seen to be dominated by road traffic along the A4232, with additional noise from the B4267 (Leckwith Road).

Subsequent detailed noise mapping and site assessments have been carried out to inform and influence the design of the site from an early stage to help mitigate and reduce any noise impact and to increase acoustic comfort in both external and internal spaces. As such, various mitigation options have been reviewed, such as the inclusion of screening at the adjacent roads, as well as using building massing to provide screening to other areas of site.

Results show that screening along the B4267 and building massing can be used successfully to create large areas of outdoor amenity areas that have ambient noise levels below 55dB, thereby falling within WHO and TAN 11 Noise Exposure Category A. However, there will still be areas that fall within TAN11 Noise Exposure Category B.

Additional screening along the A4232 can successfully bring the vast majority of the site to within Noise Exposure Category A levels, however there are a number of practical restrictions to how this can be achieved.

New guidance has been reviewed in regard to internal noise levels when ventilating against overheating in the summer, in which it is seen that the majority of dwellings will achieve this criteria with openable windows. However, façades facing on to the A4232 may require the specification of suitable opening window types and orientation, or through additional façade elements to further improve the acoustic attenuation, such as architectural fins/screening, window baffles, secondary facades or recessed balconies.

It is therefore considered that with the sensitive design of the site and the inclusion of appropriate mitigation measures, the site is suitable for residential purposes.

The development and the residential units themselves are not considered to be a significant source of noise. From reviewing the existing roads, any increase in traffic flow from the development is not anticipated to result in a noticeable increase in traffic noise, while any new roads within the development are not likely to increase traffic noise at any existing nearby dwellings.

INTRODUCTION

This document outlines the noise survey and subsequent site assessment of the proposed Leckwith Quay development in Cardiff.

Due to the site's close proximity to the A4232, there is a risk of high external noise across the development site. This can therefore impact on occupant comfort within dwellings, particularly during the summer months when large ventilation openings are required to avoid overheating, which may result in high levels of noise ingress into the building.

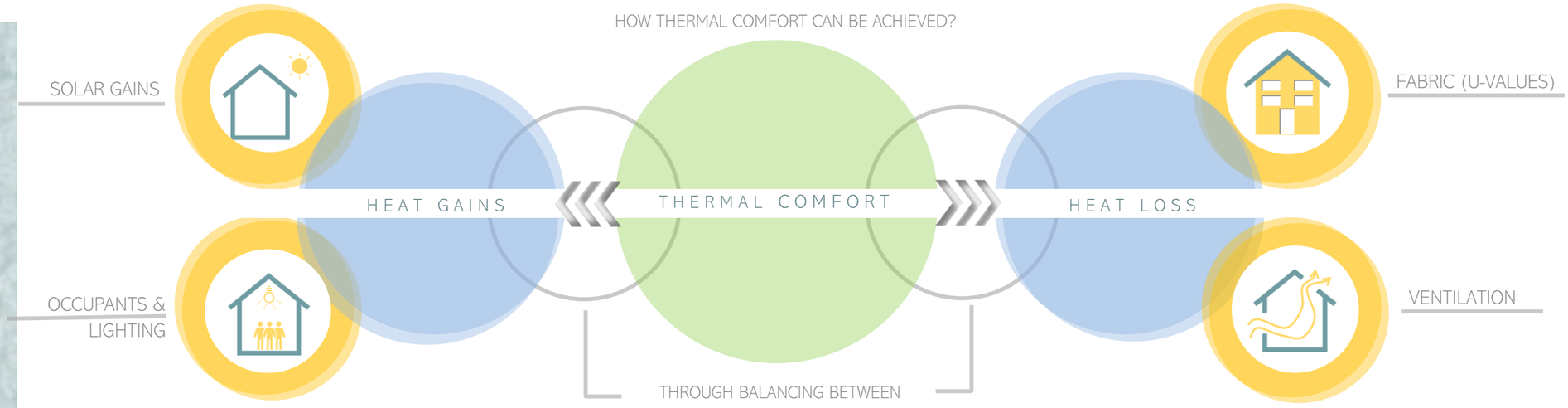
This report outlines the current risks within the site and provides early-stage design input on how these risks can be mitigated to increase acoustic comfort in both external and internal spaces.

DESIGN PHILOSOPHY

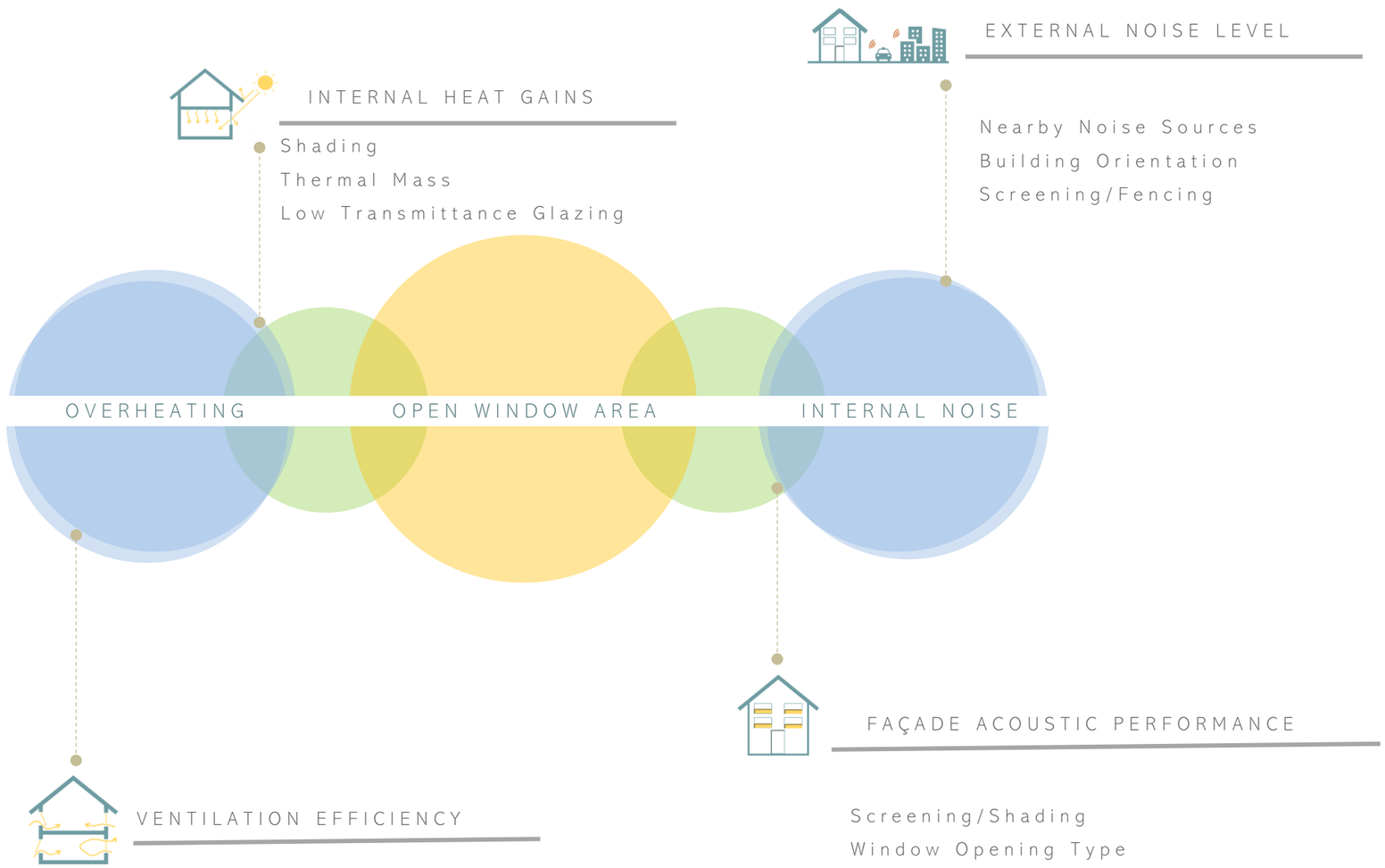
- Thermal comfort can be assessed through the summation of the total heat gains (e.g. solar gains & occupants) within a space, minus the total heat loss through the building fabric or through the ventilation system. For natural or mixed-mode ventilation systems, achieving the required ventilation rate can be seen as a tuned system that balances the efficiency of the ventilation system and the open area within the façade.

- Subsequently, the acoustic performance of the façade is a balancing act between the open area, the external noise level, and the performance of the opening, such as the type of window used or acoustic louvre. The same acoustic performance can be achieved with an acoustic attenuator over a large open area, as an openable window with a small open area.

- Therefore, there is an interconnectivity between each area of design, in which the ventilation design can influence the acoustic comfort in a space. By influencing one aspect, this changes the performance requirements for multiple other elements of the façade. This is illustrated in the figure's opposite.



NOISE INGRESS AND INTEGRATION WITH VENTILATION DESIGN



An openable window is a mechanism that allows for fresh air and cooling, but also noise ingress through the façade. The amount of noise ingress through a window is dependent on a number of factors, in which a significant factor is the total open area of the window. A smaller open area will provide a better acoustic performance, while a larger opening provides more air flow for ventilation and cooling. Therefore, the performance of the ventilation and acoustic design can be seen as a balancing act, as both designs need to consider the impact of each design element to work coherently together.

Design philosophies within the construction industry are changing in regard to avoiding overheating during the summer. The impact of climate change may result in hotter or more extreme temperatures which means that the likelihood of a building operating in 'overheating' mode will be more common. The impact of this needs to be carefully considered, not only on the resultant internal temperature but on the knock-on effect this has on acoustic comfort.

PERFORMANCE CRITERIA

The Noise Policy Statement for England does not provide guidance on internal noise levels within residential buildings. As a result, the advised levels within BS8233: 2014 'Guidance on sound insulation and noise reduction for buildings' have been adopted. BS8233 states that to achieve adequate sleeping and living conditions, background noise levels should be 30 dB L_{Aeq} or less within bedrooms at night, and 35 dB L_{Aeq} or less within Living rooms during the day. The advised levels are tabulated below.

BS 8233: 2014 provides no definitive methodology for assessment of L_{Amax} levels. The standard simply states that a guideline value for the internal level may be set depending on the character of the noise source and number of events occurring. Due to the proximity of the proposed site to sources of road traffic noise, assessment of L_{Amax} is critical to ensuring that disturbance is avoided.

In order to provide an assessment of L_{Amax} levels, the recommendations of the World Health Organisation are recommended. The WHO state that in order to avoid sleep disturbance within bedrooms during the night, the internal sound pressure level should not exceed 45 dB L_{Amax}.

Typically, BS8233 targets apply when a dwelling is being ventilated to achieve background ventilation rates, which can typically be achieved through the use of acoustic trickle vents. As trickle vents can achieve a high level of acoustic attenuation, it is relatively low risk achieving BS8233 noise targets, however there is much higher risk of occupant disturbance when ventilating to avoid overheating.

The Acoustics, Ventilation and Overheating - Residential Design Guide (Feb 2018 – Draft) outlines the extent of risk associated with increased noise levels from increased ventilation openings in 'overheating' mode. The risk categories and associated noise levels are provided in the table opposite. It is recommended that a 'Low' risk approach is targeted for residential dwellings within Leckwith Quay. This translates to a +5dB relaxation to the internal ambient noise level targets outlined within BS8233.

Internal Noise Level Targets - Overheating Mode

The Acoustics, Ventilation and Overheating - Residential Design Guide (Feb 2018 – Draft) outlines the extent of risk associated with increased noise levels from increased ventilation openings in 'overheating' mode. The risk categories and associated noise levels are provided in the table opposite. It is recommended that a 'Low' risk approach is targeted for residential dwellings within Leckwith Quay. This translates to a +5dB relaxation to the internal ambient noise level targets outlined within BS8233.

The targets are to be achieved when the residential units are ventilating in 'overheating' mode which requires much higher rates of ventilation than background ventilation mode. Note, these targets also include contributions from any mechanical ventilation systems.

TAN 11

Technical Advice Note 11 provides guidance in regard to planning criteria for noise levels within residential developments. The different exposure categories and levels are summarised in the tables below.

As summarised below, noise exposure categories A and B are considered to be appropriate for residential developments, however it is clear that there is expectation for noise levels to be considered within the layout and planning of the development.

For road noise, this relates to daytime noise levels up to 55dB L_{Aeq} for Category A and 63dB L_{Aeq} for Category B.

A	Noise need not be considered as a determining factor in granting planning permission, although the noise level at the high end of the category should not be regarded as desirable.
B	Noise should be taken into account when determining planning applications and, where appropriate, conditions imposed to ensure an adequate level of protection.
C	Planning permission should not normally be granted. Where it is considered that permission should be given, for example, because there are no alternative quieter sites available, conditions should be imposed to ensure a commensurate level of protection against noise.
D	Planning permission should normally be refused.

TAN 11 Noise Exposure Categories

Noise Source		Noise Level, $L_{Aeq,T}$ dB			
		Noise Exposure Category			
		A	B	C	D
Road Traffic	07:00 – 23:00	< 55	55 - 63	63 - 72	> 72
	23:00 – 07:00	< 45	45 - 57	57 - 66	> 66

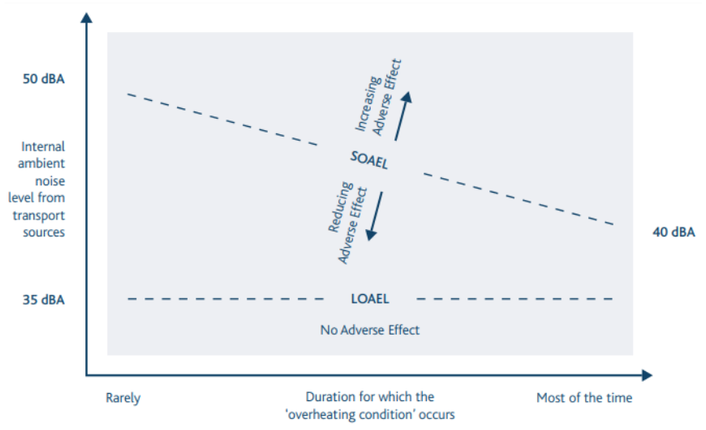
TAN 11 Noise Exposure Levels

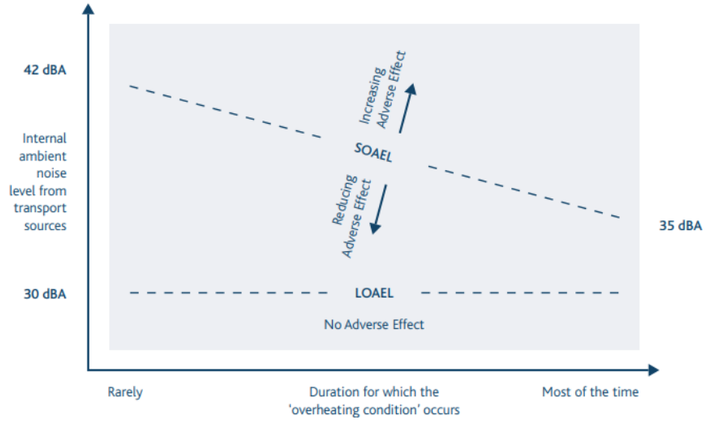
Acoustics, Ventilation and Overheating (AVO) Guide

The '*Acoustics, Ventilation and Overheating*' (AVO) Guide published by the Association of Noise Consultants (ANC) and endorsed by the Institute of Acoustics (IOA) is intended to be used by planners, developers and designer when commissioning new dwellings. Thus, the application of the AVO Guide is intended to demonstrate good acoustic design as described in the ProPG: Planning & Noise, May 2017 ('ProPG'), when considering internal noise level guidelines.

Version 1.1 of the AVO guide was published in January 2020 and represents the most current and considered approach for the acoustic assessment of new residential developments and takes due regard of the interdependence of provisions for acoustics, ventilation, and overheating, which affects indoor environmental quality, and thus the overall well-being of future residential occupants of a development.

The AVO guide provides advice on suitable Significant Observed Adverse Effect Levels for day and night time periods, which varies based upon how often the assessed dwelling will overheat. This can range from +5dB above BS8233 to +12/15dB if windows only need to be open rarely during the summer months.





Approved Document S (Draft Version) & Approved Document O

Approved Document O (England) has been released in Dec 2021 and a draft version of Approved Document S (Wales) was released in Sep 2021. Both documents outline overheating criteria for all new dwellings, providing design guidance on minimising solar heat gains, or alternatively requiring TM59 assessments to assess overheating risk. As well as overheating criteria, these documents also provide advice on 'Ensuring the overheating strategy is usable', which covers aspects such as air pollution, security, protection from falling, protection from entrapment and noise.

Approved Document S states the following;

> *When the removing excess heat part of the overheating strategy is in use, noise levels in bedrooms should be kept to a minimum during the sleeping hours of 23:00 – 07:00.*

As part of the performance targets, Approved Document O provides a set of noise ingress criteria;

> *When the removing excess heat part of the overheating strategy is in use, noise levels in bedrooms should be kept to a minimum during the sleeping hours of 23.00 – 07.00. Noise within bedrooms should not normally exceed the following limits.*
>
> *a. When openings are used*
>
> *i. 40 dB LAeq, T, averaged over 8 hours.*
>
> *ii. 55 dB LAFmax, maximum no more than 10 times a night.*
>
> *b. When a mechanical system is used*
>
> *i. 30 dB LAeq, T, averaged over 8 hours.*

This is shown to be a set of targets that exceed BS8233 criteria by +10dB.

Summary of Guidance and Proposed Targets

When considering the performance targets outlined within Approved Documents S and O, and the Acoustics, Ventilation & Overheating Guide, it is shown that targets during the summer months can be relaxed by typically up to +10dB.

However, from discussions with the local authority, it is understood that there is an expectation of high levels of noise control during the summer. As such it is considered that a relaxation of +5dB above typical BS8233 levels would be appropriate during the summer months, when additional ventilation is required for cooling.

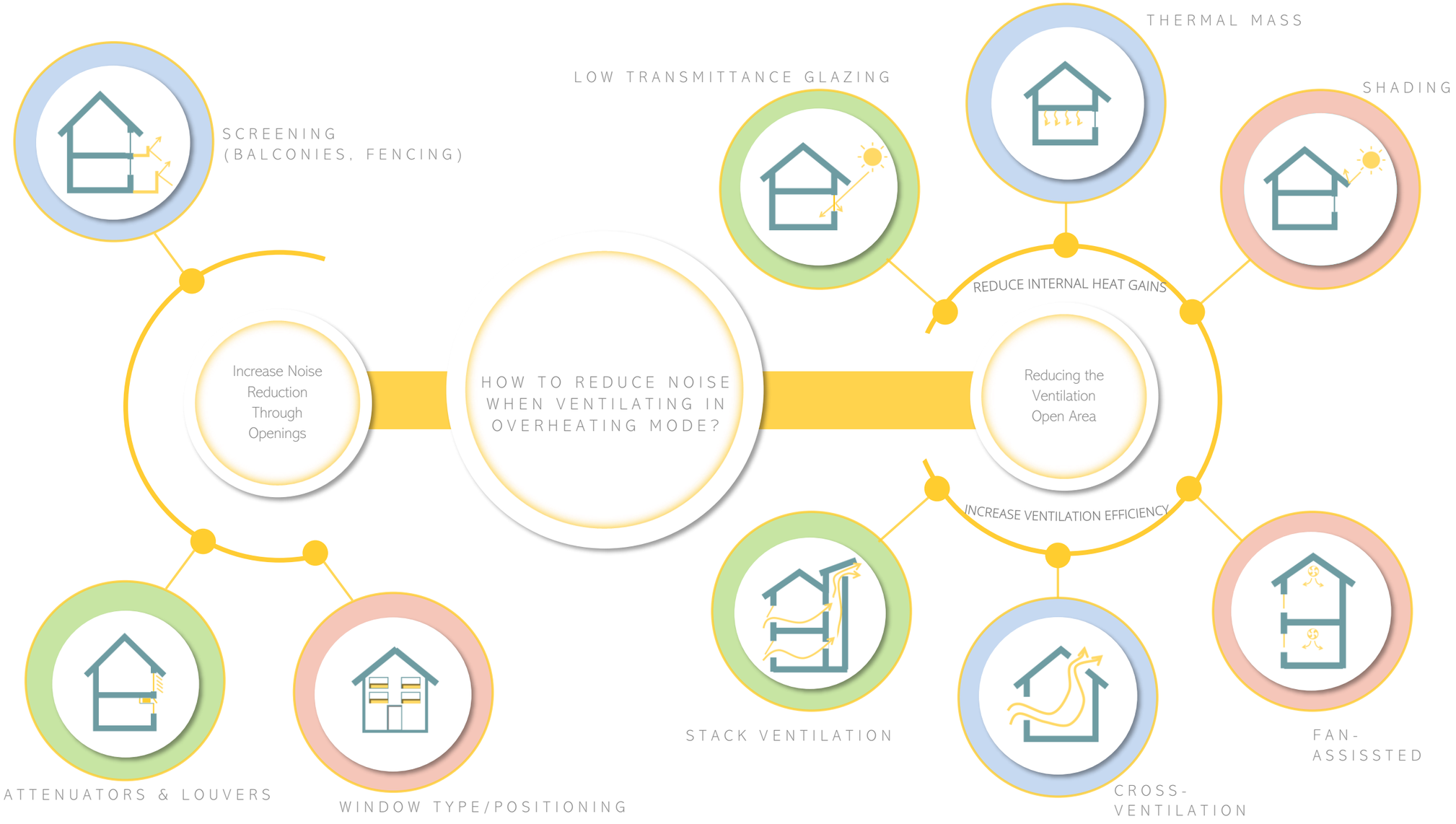
INTEGRATED DESIGN

As stated previously, noise levels across the site are above the recommended 55dB limit and as such it is recommended to include mitigation measures to reduce risk of high levels of noise ingress through ventilation openings in bedrooms and living rooms, particularly when ventilating to avoid overheating during the summer months.

The diagram below shows how noise break-in can be reduced through different methods. This focuses on either reducing the total open window requirement, increasing the acoustic performance of a window opening, or by decreasing the level of external noise on the building facade.

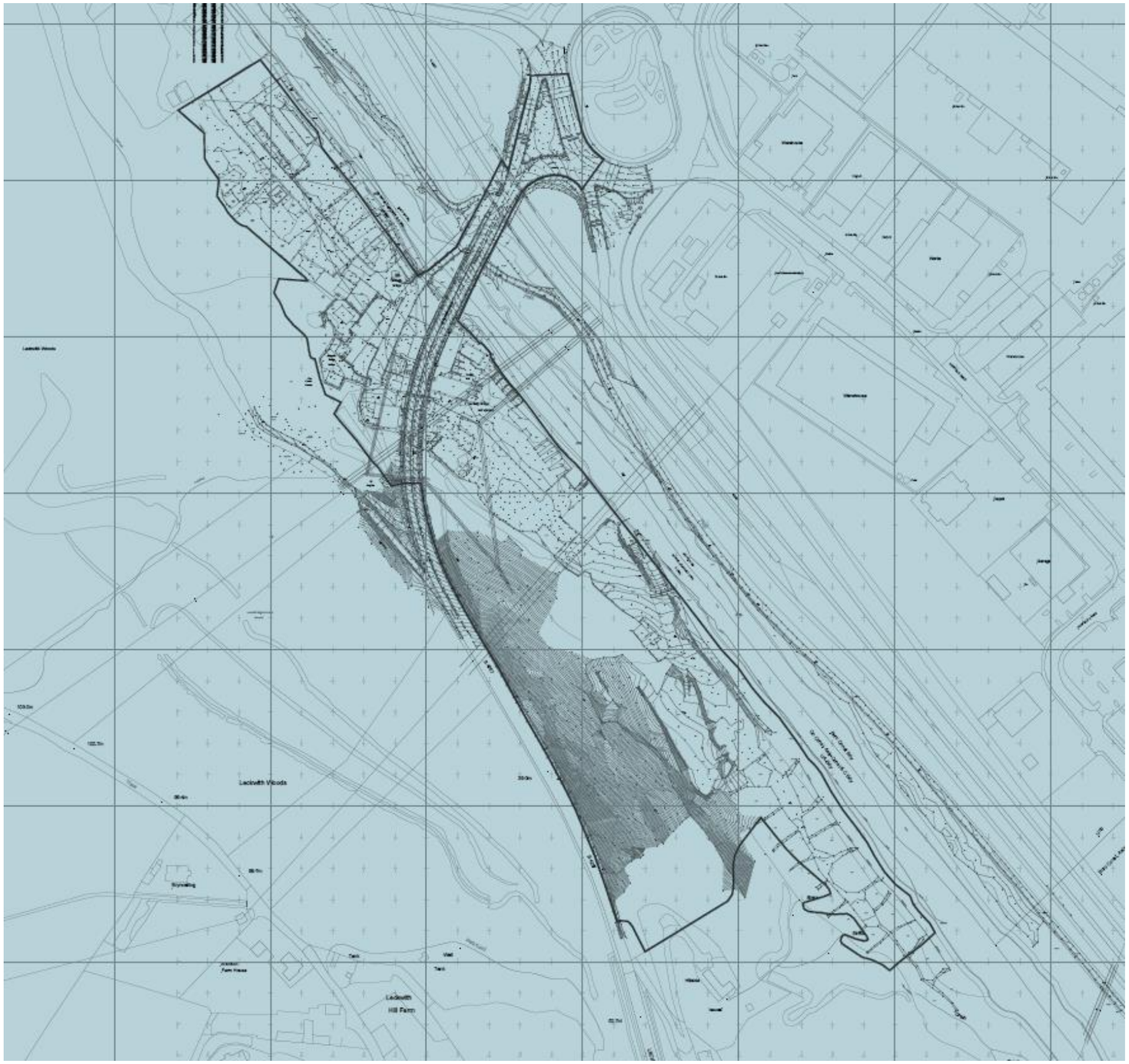
If a room has lower internal heat gains, the need to open windows is reduced to avoid overheating, and thus reduces the total open window area requirement. As a result of this the noise break-in is reduced through the smaller opening. This same improvement can be achieved by employing a more efficient ventilation system, to achieve the same levels of fresh air while reducing the total open area.

Alternatively, the acoustic performance of a ventilation opening can be improved through numerous different options, such as changing the window opening type or orientation, as well as adding additional baffles or screening to the façade.


HOW TO REDUCE NOISE WHEN VENTILATING IN OVERHEATING MODE?
Increase Noise Reduction Through Openings
Reducing the Ventilation Open Area
SCREENING (BALCONIES, FENCING)
ATTENUATORS & LOUVERS
WINDOW TYPE/POSITIONING
LOW TRANSMITTANCE GLAZING
THERMAL MASS
SHADING
REDUCE INTERNAL HEAT GAINS
INCREASE VENTILATION EFFICIENCY
STACK VENTILATION
CROSS-VENTILATION
FAN-ASSISSTED


Enterprise Rent-A-Car - Cardiff West
Bessemer Close

THE SITE & SURVEY



The proposed plans are for a new residential development on the site located at Leckwith Quay. The proposed development is situated in close proximity to the A4232 to north-east of the site, with an additional road (B4267) cutting through the site and continuing to the south-west.

The site in relation to its surroundings is shown in the site plan opposite.

The noise sources on site are primarily traffic along the A4232, with road traffic along the B4267 contributing to a lesser extent, although the dominant noise source to the far south-west of the site. Ambient noise levels over the whole day time period are relatively high, with a reduction in levels to the night.

Noise Survey Methodology and Results

MACH carried out a noise survey at the proposed site from Thursday 9th May to Monday 13th May 2019. A combination of short and long-term noise monitoring positions were carried to establish environmental noise levels across the site.

The image on the left shows the development site and boundary.

PROPOSED SITE PLAN

The image to the right provides the proposed site plan and site boundary.

The site is a mix of apartments, duplexes and houses, as shown with the site map legend.

This site plan has been used for the noise maps shown on the following pages.

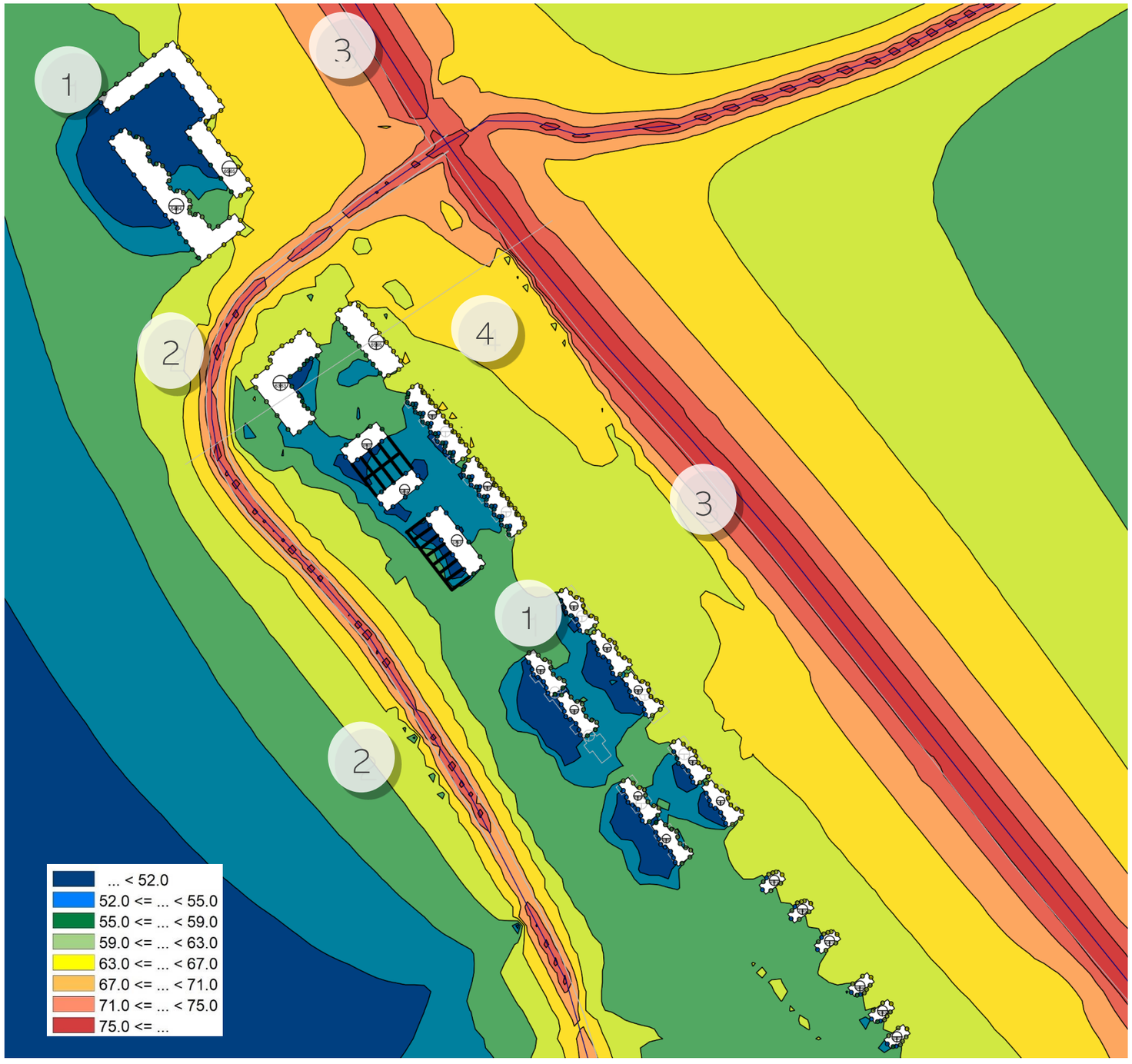
NOISE MAPPING

The results of the noise survey have been used to calibrate a noise map of the development site. The following sections show the predicted sound pressure levels across the proposed site using CadnaA noise mapping software. The results of these noise maps can be used to determine risk of high noise levels and review options for improvement, where applicable. The image adjacent provides a noise map of the proposed site with changes to the existing bridge.

Noise contours have been grouped as per TAN 11 categories, in which blue areas show Category A noise levels, Green shows Category B, Yellow/Orange shows Category C and Red shows Category D. The results opposite show that the noise levels across the site vary between Noise Exposure Categories A and B. It should be noted that where the site falls within NEC B, it is only by 4dB (up to 59dB).

When considering internal noise levels when ventilating against overheating in the summer months, noise levels are typically seen to be up to 59dBL_{Aeq} during the day, which is in line with the guidance outlined within the Acoustics, Ventilation and Overheating Guide (AVO Guide) and Approved Document O (England) and S (Wales).

The following pages review each section of site in detail and outline how passive design measures have been introduced to minimise noise ingress and maximise the amount of good quality amenity areas. This has been achieved through multiple iterations of design and workshops with the design team.



1 Proposed Site

2 B4267

3 A4232

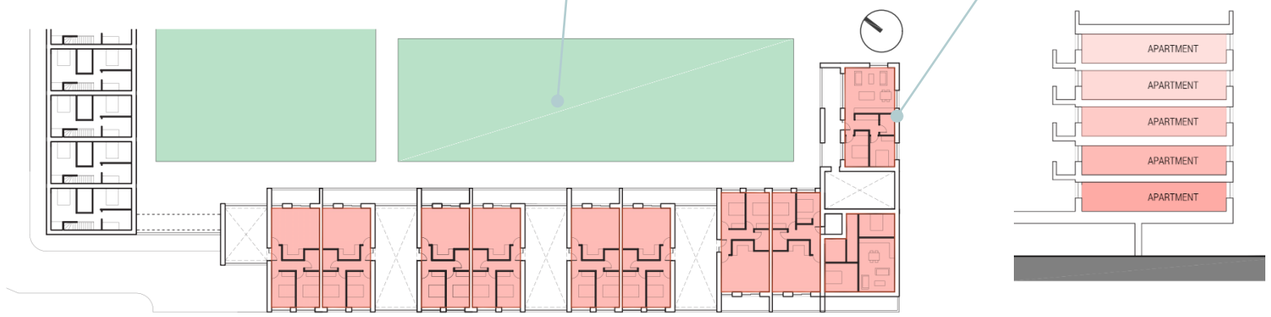
4 Ely River

HOUSING TYPES – BLOCK A & B

Noise levels are generally quiet, with majority of the facades achieving TAN 11 Category A or B.

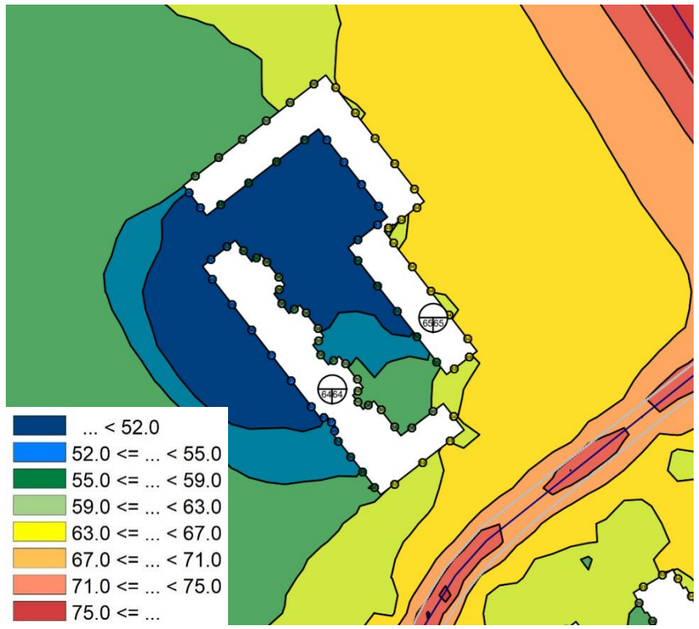
Good quality amenity space, with low noise levels due to screening from building massing

Some acoustic attenuation may be needed on the south-east elevation. This will need to be assessed in detail in the design stage.

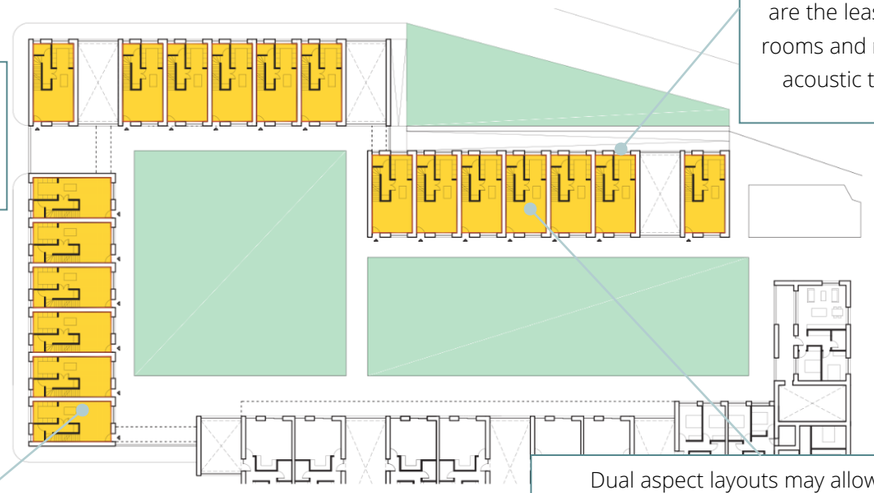


BLOCK A - FIRST FLOOR LEVEL PLAN

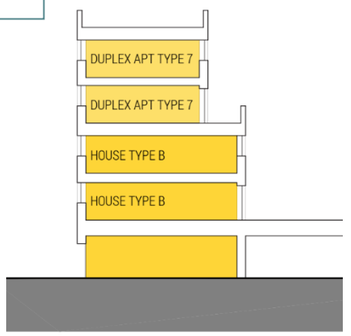
Kitchens located on noisiest facades – these are the least sensitive rooms and require less acoustic treatment



TAN 11 Category C to North facades, Category A to South facades.



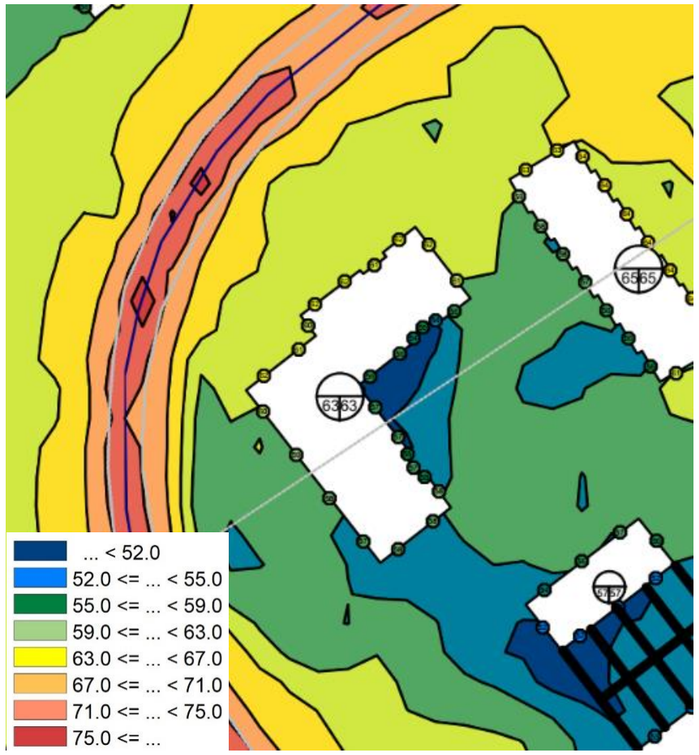
BLOCK B - PODIUM LEVEL PLAN [HOUSE TYPE B]



Living Areas and Bedrooms are generally located on quieter south facades and thus minimise the need for acoustic treatment.

Dual aspect layouts may allow for dwellings to be ventilated on the quiet south side only, however there may be a requirement for acoustically attenuated ventilation to north facing bedrooms. North facing bedrooms are easier to ventilate due to lower heat gains.

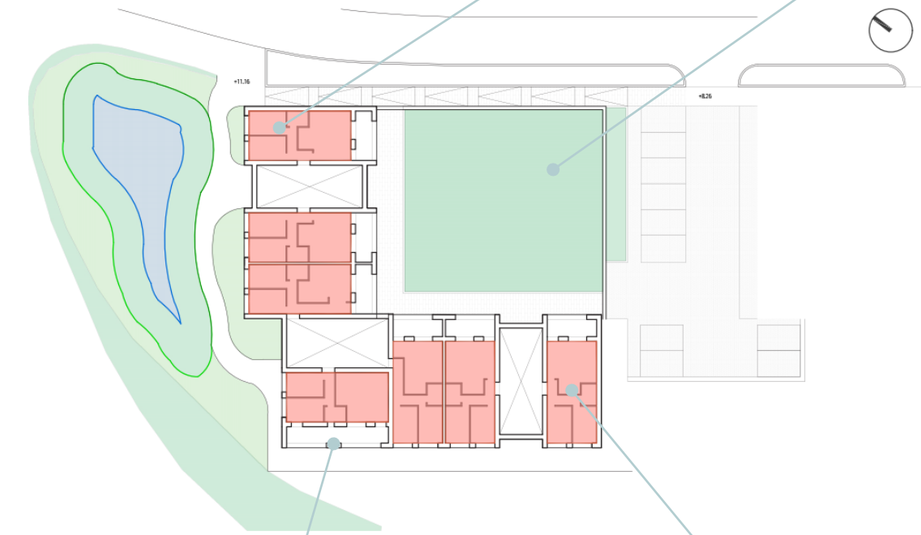
HOUSING TYPES – BLOCK C



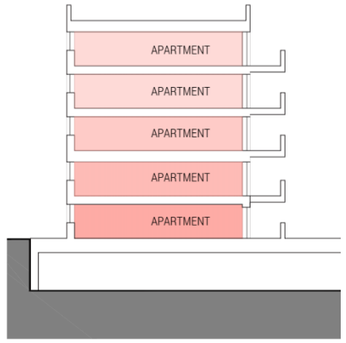
Noise levels are generally quiet, with majority of the facades achieving TAN 11 Category A or B.

Sensitive rooms facing Leckwith Road may require attenuation. This will need to be assessed in detail in the design stage.

Good quality amenity space, with low noise levels due to screening from building massing



BLOCK C - FIRST FLOOR LEVEL PLAN

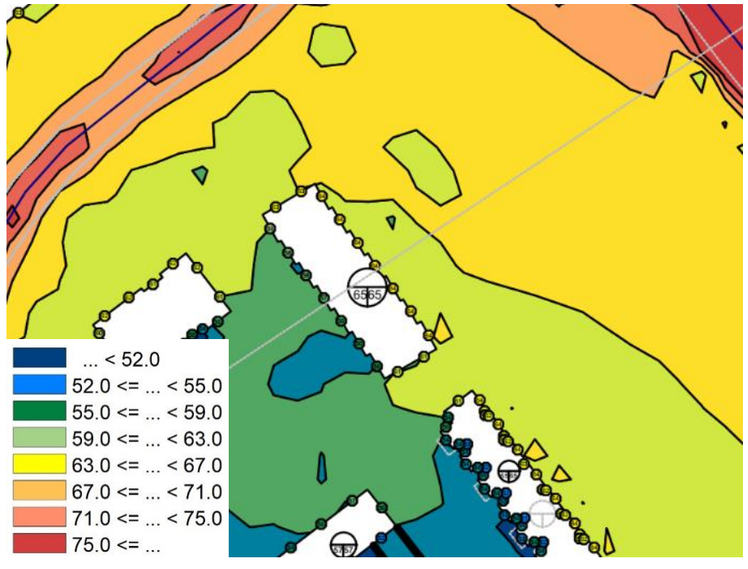


BLOCK C - INDICATIVE SECTION

Balconies can be used to provide additional acoustic attenuation. Balustrades recommended to be solid where possible.

Dual aspect layouts may allow for dwellings to be ventilated on the quiet south side only, however there may be a requirement for acoustically attenuated ventilation to north facing bedrooms. North facing bedrooms are easier to ventilate due to lower heat gains.

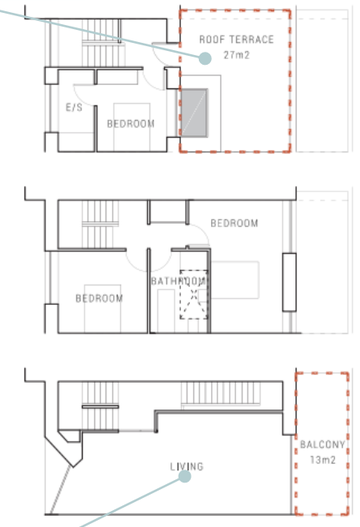
HOUSING TYPES – HOUSE TYPE E



Noise levels are generally quiet, with majority of the facades achieving TAN 11 Category A or B.

Angled wall to front façade creates opportunities for inclusion of angled window types or attenuation. To be developed later in design.

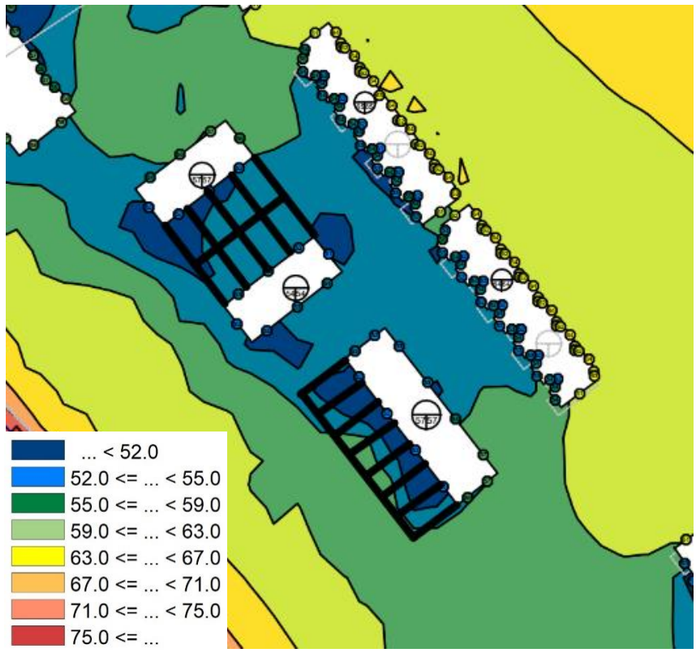
The south facing elements of the houses achieve Category A levels, and thus the rooftop terrace will be of good acoustic quality.



There may be a requirement for acoustically attenuated ventilation to north facing bedrooms. North facing bedrooms are easier to ventilate due to lower heat gains.

Dual aspect layouts may allow for living spaces to be ventilated on the quiet south side only

HOUSING TYPES – HOUSE TYPE A & C

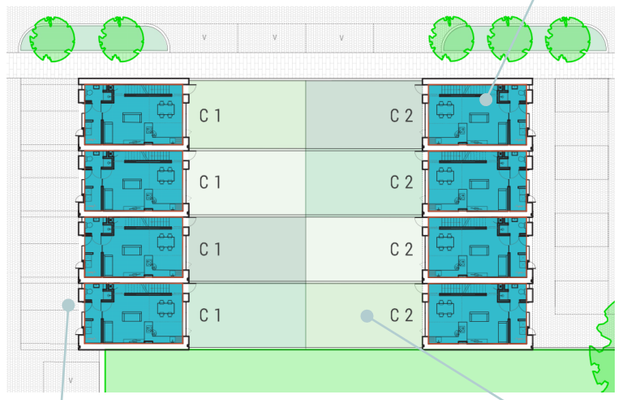


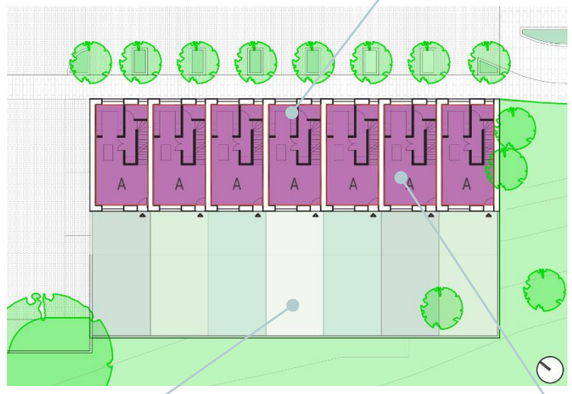
Noise levels are generally quiet, with north facades achieving TAN 11 Category B and south facades Category A.

Both House types benefit from screening from adjacent buildings.

Orientating dwellings east-west will minimise heat gains and thus reduce open area needed for cooling. This increases the acoustic performance.

Kitchens located on noisiest facades – these are the least sensitive rooms and require less acoustic treatment



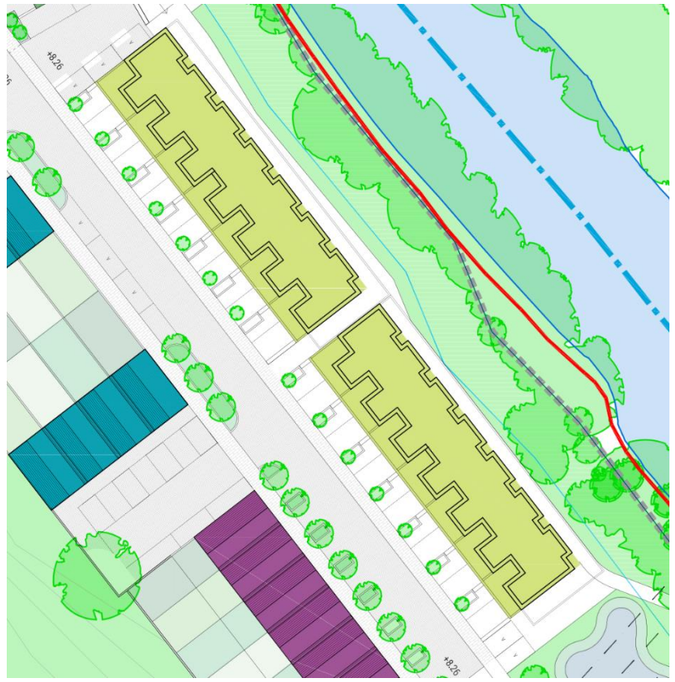


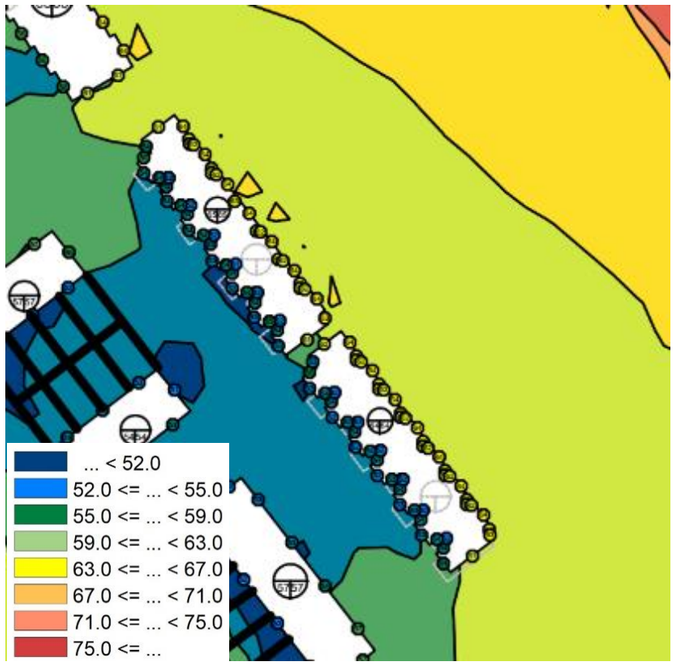
Orientating window openings to open away from the A4212 will further improve noise ingress to dwellings

Good quality amenity space, with low noise levels due to screening from building massing and fencing

Dual aspect layouts may allow for living spaces to be ventilated on the quiet south side only

HOUSING TYPES – BLOCK D

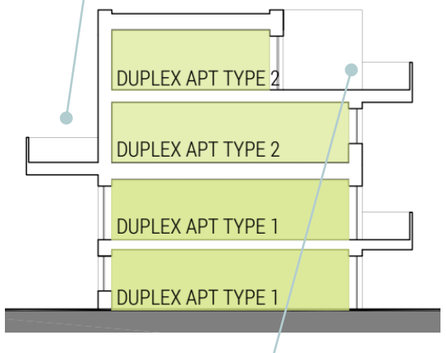




Noise levels are generally quiet, with north facades achieving TAN 11 Category B and south facades Category A.

Kitchens and Dining located on noisiest facades – these are the least sensitive rooms and require less acoustic treatment

Balconies to north façade can be used to provide additional acoustic attenuation. Balustrades recommended to be solid where possible.

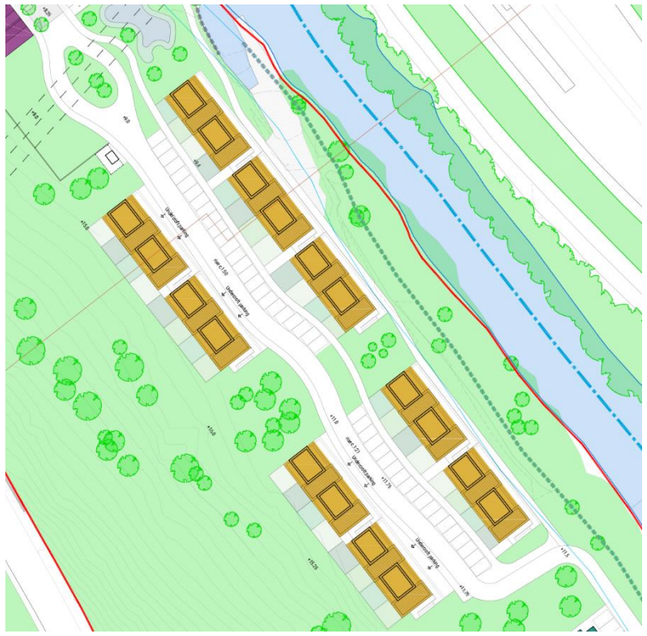


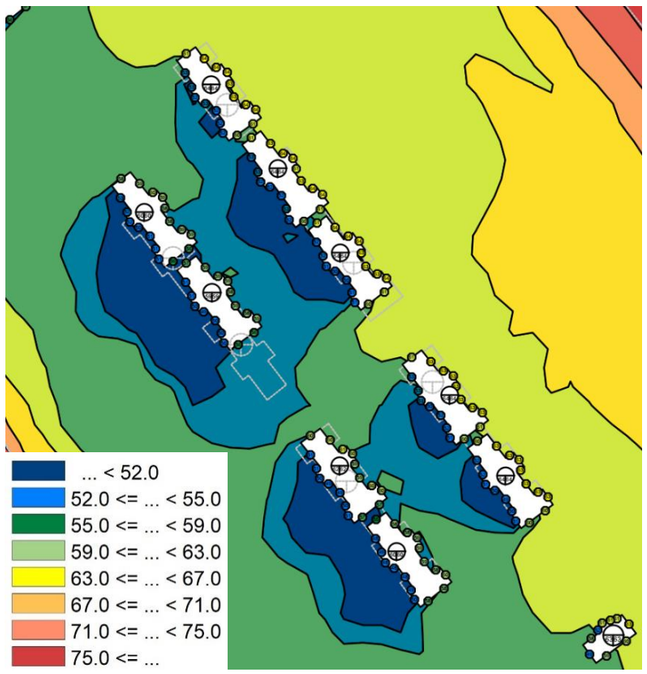
Bedrooms on north facades may require some acoustic attenuation. To be developed later in design stage.

Dual aspect layouts may allow for living spaces to be ventilated on the quiet south side only

The south facing roof terraces and balconies achieve Category A levels, and thus will be of good acoustic quality.

HOUSING TYPES – BLOCK E

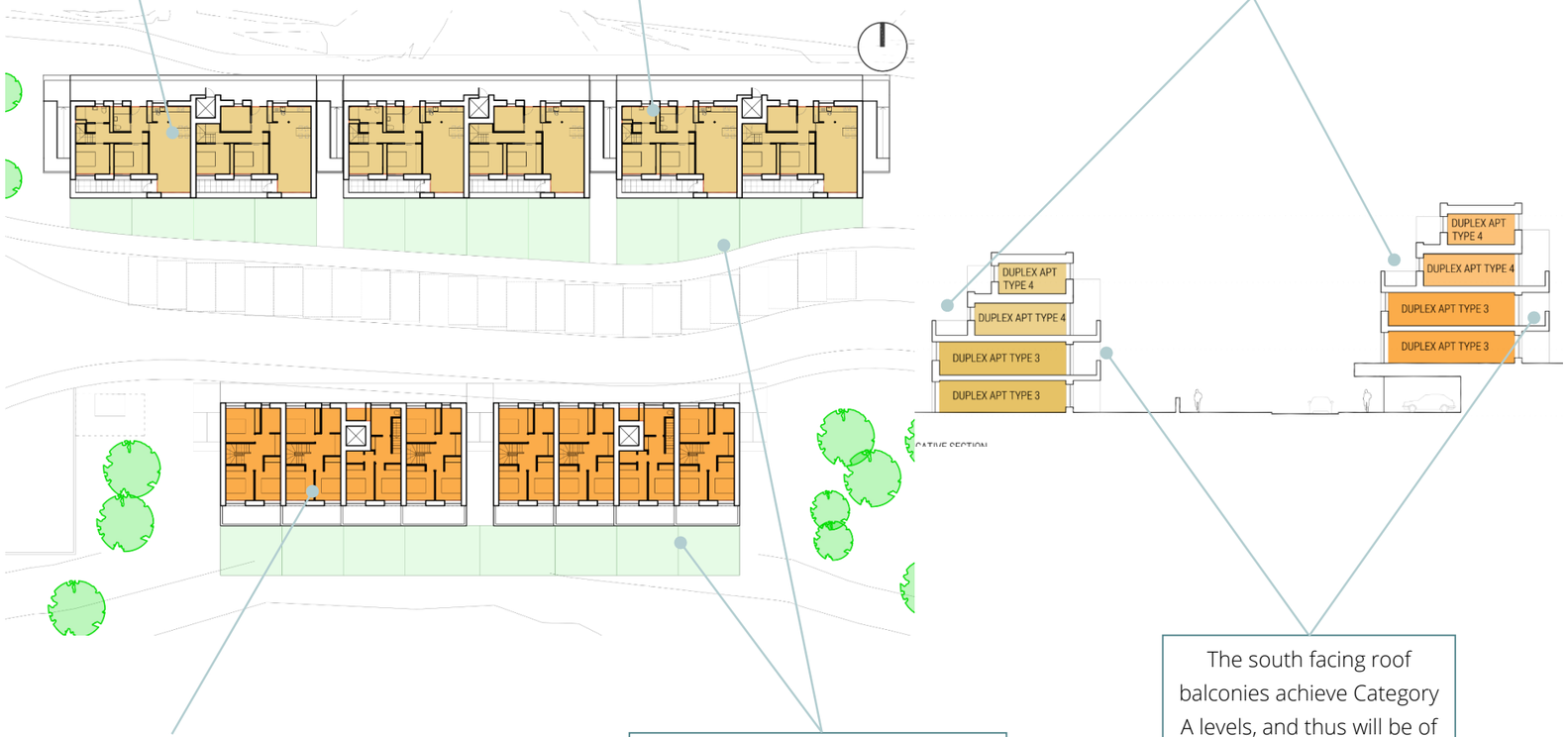




Dual aspect layouts may allow for living spaces to be ventilated on the quiet south side only

Kitchens and Bathrooms located on noisiest facades – these are the least sensitive rooms and require less acoustic treatment

Balconies to north façade can be used to provide additional acoustic attenuation. Balustrades recommended to be solid where possible.

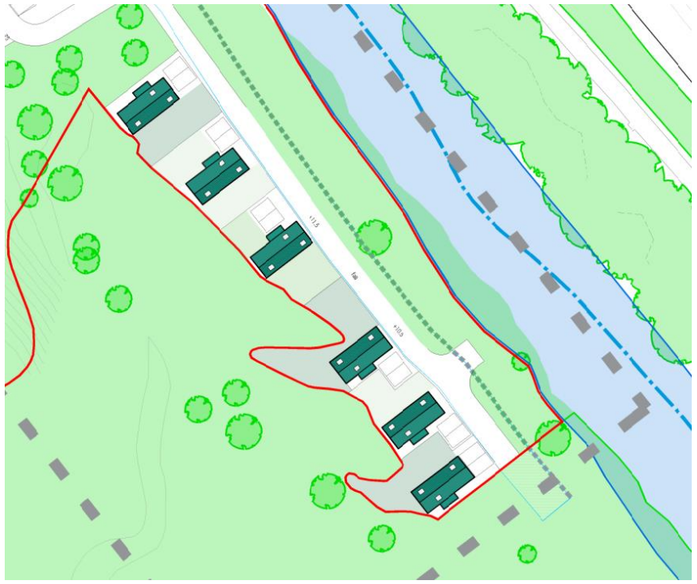


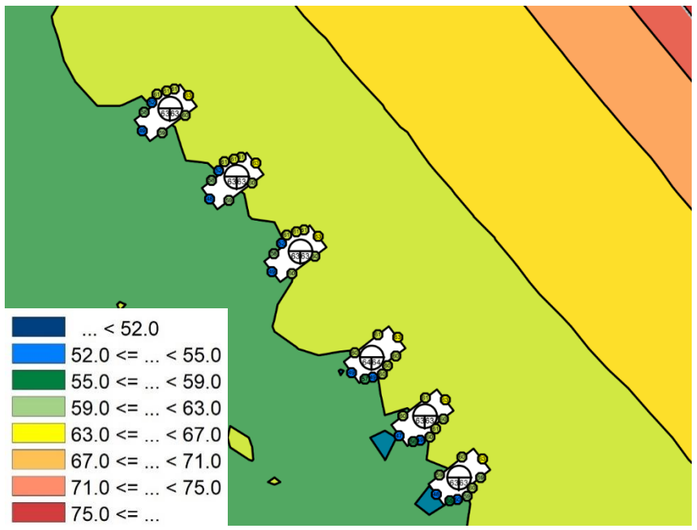
Majority of Bedrooms located on quieter south facades. This is good passive design for reducing need for acoustic attenuation.

Good quality amenity space, with low noise levels due to screening from building massing and fencing

The south facing roof balconies achieve Category A levels, and thus will be of good acoustic quality.

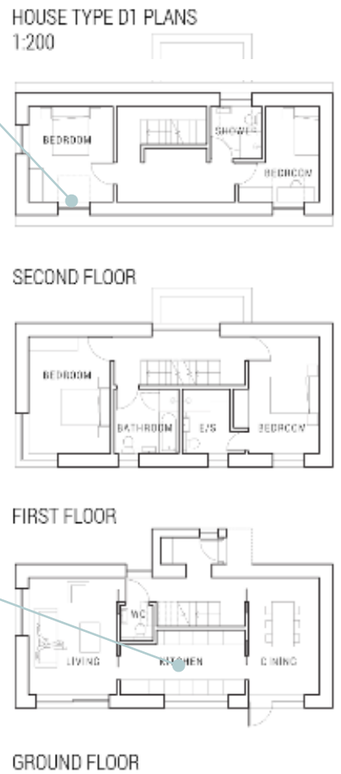
HOUSING TYPES – HOUSE TYPE D





Orientating window openings to open away from the A4212 will further improve noise ingress to dwellings

Dual aspect layouts may allow for living spaces to be ventilated on the quiet south side only



Reduced number of windows facing directly on to the A-road. The use of side windows improves the acoustic performance.

Dining rooms located on noisiest facades – these are the least sensitive rooms and require less acoustic treatment

ACOUSTIC RISKS AND OPPORTUNITIES OF THE SITE

The noise mapping and analysis carried out shows that the vast majority of the site will achieve either TAN 11 categories A or B, and thus noise levels are seen to be suitably low.

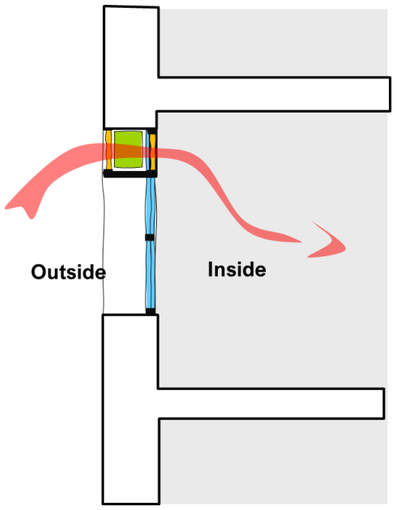
From multiple design iterations and improvements, the building massing has been adapted to create good amounts of acoustic screening that will create large areas of good quality amenity spaces that fall below 55dB(A).

The internal layouts of dwellings have also been optimised to maximise the acoustic quality of occupied spaces, where noise sensitive spaces such as living rooms and bedrooms are located on the quieter southern facades. Furthermore, as all dwellings are dual aspect, this improves the efficiency of any summertime ventilation, and thus reduces the open area required for cooling, thereby reducing the amount of noise ingress.

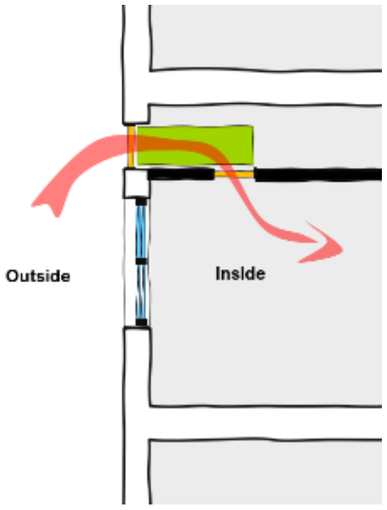
The design also creates opportunities for improving the acoustic performance of the façade, such as the inclusion of balconies, which if detailed correctly with solid balustrades (and potentially absorbent soffits) can reduce noise ingress. Baffled windows or acoustic attenuators can also be used on specific facades to further control noise ingress where possible, whilst avoiding the need for unnecessary carbon emissions from natural ventilation.

The majority of dwellings/rooms across the site can be ventilated through typical openable windows, however for the slightly noisier facades, various acoustic improvements can be reviewed and assessed later on in the design stage. The figures opposite provide examples of how attenuation can be included within the façade, or how internal cross ventilation can be used to further improve acoustic and ventilation efficiency. These opportunities in detail on in the report.

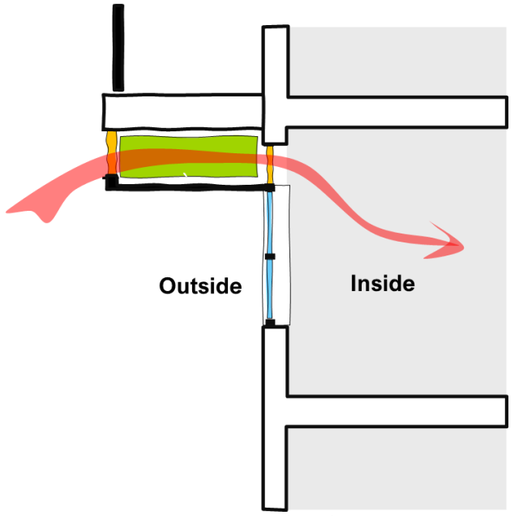
Note that a separate design note provided by Loyn+Co Architects outlines the total areas of proposed amenity spaces, and how much of it achieves TAN 11 Category A criteria.



Attenuator Within Window System

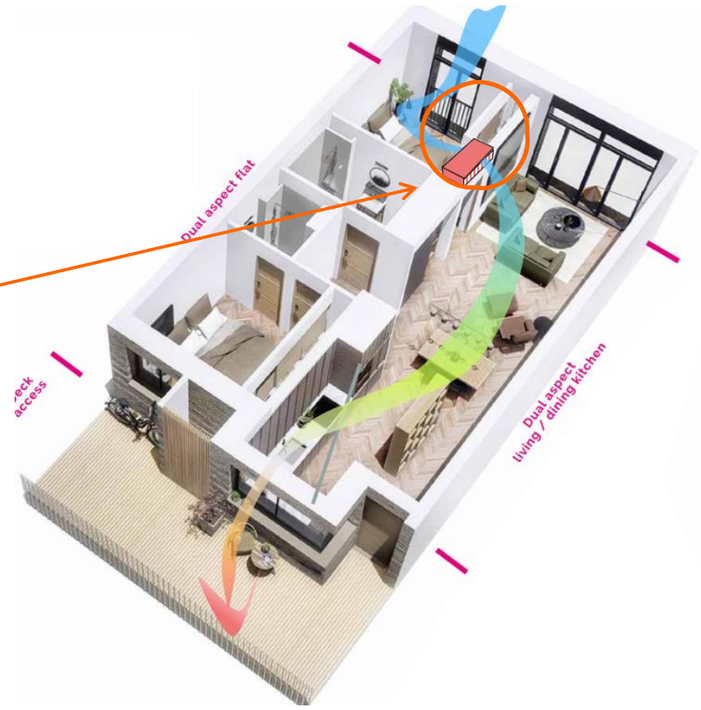


Attenuator Within Bulkhead



Attenuator Beneath Balcony

Cross ventilation opening between bedrooms and living areas allow for real cross ventilation of dwellings during night and day



SUMMARY

The methodology and noise exposure categories outlined in TAN 11 are to ensure good quality design in two areas; noise levels to outdoor amenity areas, and minimising internal noise ingress within dwellings.

These two areas have been considered within the design of the Leckwith Quay masterplan, in which the building massing and internal layouts of the development have been carefully designed to minimise the impact of the A4232 and B4267 on the acoustic quality of both amenity areas and internal noise levels within dwellings.

As demonstrated in the report, the proposed scheme achieves good external noise levels (Category A or B) within all external amenity areas, and as such the proposed development is considered to provide external amenity areas with good quality acoustics.

Furthermore, the layouts of the proposed dwellings maximise the use of the quieter south facades, and the use of dual aspect design allows for effective cross ventilation strategies. Spaces that are less noise-sensitive are located on the noisier facades, whilst bedrooms and living areas are located on the quieter facades.

Due to the proximity of the A4232, however, there are a small percentage of facades that will experience noise levels within noise exposure categories B & C. Whilst it is straight forward to achieve good internal noise levels (as defined in BS 8233) during the majority of the year, when the windows are closed, there will be periods during the summer that additional ventilation will be required for cooling.

It is acknowledged that simple openable windows may not be suitable for these facades, and as such the design can consider the use of passive acoustic attenuators to provide natural ventilation and minimise use of mechanical ventilation. There are also opportunities for passive attenuation through the use of balconies as acoustic screening, and positioning windows perpendicular to the road and using acoustic baffles, which has been applied successfully on other large scale developments.

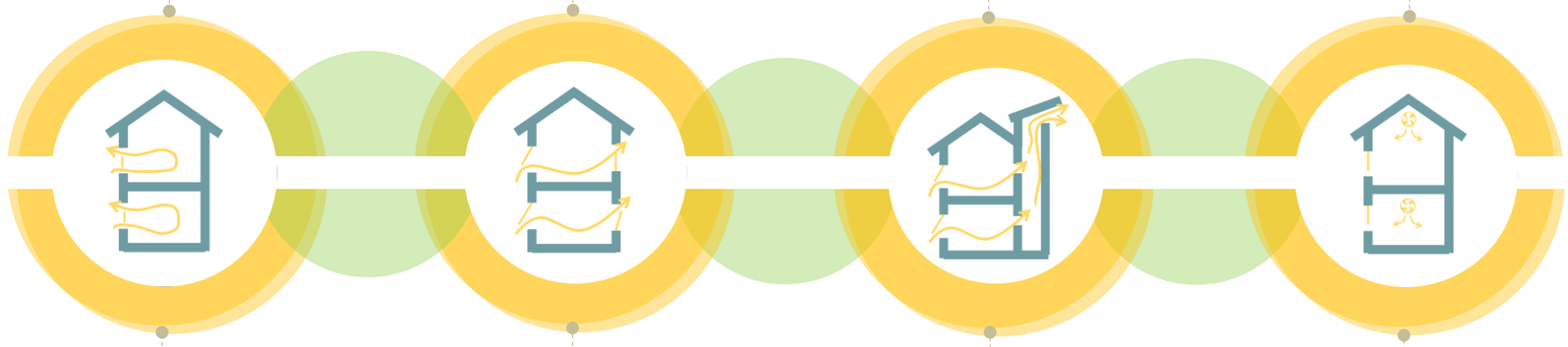
As such, the site is shown to provide sufficient screening from nearby noise sources to allow for naturally ventilated, low carbon dwelling, as well as providing low noise amenity areas for future occupants.

IMPROVING VENTILATION EFFICIENCY

As the noise mapping is shown that a number of facades will experience noise levels above 55dBA, it is important to review the design opportunities available that will allow the dwellings to be naturally ventilated and still achieve good internal noise levels,

The efficiency of a natural ventilation system will determine how big the open window requirement is to provide sufficient flow rates. It is therefore an important acoustic design tool.

The main driver of a natural ventilation system is the temperature difference across the window openings. By providing a defined low-level ventilation opening for fresh air, and a high level opening for hot air



SINGLE-SIDED VENTILATION

ADVANTAGES

- Can be improved by including low-level and high-level openings on the same façade to benefit from thermal buoyancy.

CHALLENGES

- Inefficient strategy that requires large open window areas.
- Not suitable for deep room plans.

CROSS VENTILATION

ADVANTAGES

- Efficient strategy that reduces the open window area requirements.
- Effective at reducing open window area on noisy facades.
- Can allow for deeper room layouts.

CHALLENGES

- Requires dual aspect dwellings, which introduces limitations on room layout.
- Noise level of both facades needs to be considered.

STACK VENTILATION

ADVANTAGES

- Increased thermal buoyancy increases ventilation efficiency significantly.
- Requires very small open window areas compared to single-sided strategies, and thus effective method of decreasing noise break-in.
- Can be ventilated through central atriums and circulation spaces,

CHALLENGES

- Dwelling specific ‘chimneys’ are also an option, however, may impact upon available floor areas on upper levels.
- Cross-talk may be an issue and requires acoustic attenuation.

FAN-ASSISSTED VENTILATION

ADVANTAGES

- Effective means of increasing ventilation rates for single-aspect dwellings.
- Reduces open window requirements and therefore increases acoustic performance.

CHALLENGES

- Noise from fan needs to be considered.
- Increased energy use during the summer months.

IMPROVING THE ACOUSTIC PERFORMANCE OF A FAÇADE

Historically, the acoustic loss across a façade has been assumed as 10-15dB for an open window, however research by MACH and various higher education establishments have identified that there are a number of other factors that can significantly impact the acoustic performance.

Window Type & Orientation

The acoustic performance of an open window can vary significantly depending on the window type. Outward-opening panes (such as top and side-hung windows) can provide the best performance. The total open area is also a very significant factor on the acoustic performance – the smaller the better.

The direction of noise propagation across a window can significantly vary the performance. Window openings angled away from a noise source can provide significant increase in performance.

Depending on proximity to the A4232, there is a strong directionality to the dominant noise source across Leckwith Quay; and thereby it is appropriate to assess the directionality of the window opening in regard to noise break-in. This can be assessed once window and building locations have been proposed.

Attenuators

If noise levels are too high for openable windows, it may be appropriate to use acoustic attenuators within the façade for increased performance. The images across show how attenuators can be incorporated within a façade, with thermal dampers and grilles.

Architectural Fins

To accurately determine the effect of the proposed architectural fins, in-house FDTD modelling was carried out to determine the screening benefit provided, and the subsequent reflections on to adjacent windows.

Balconies

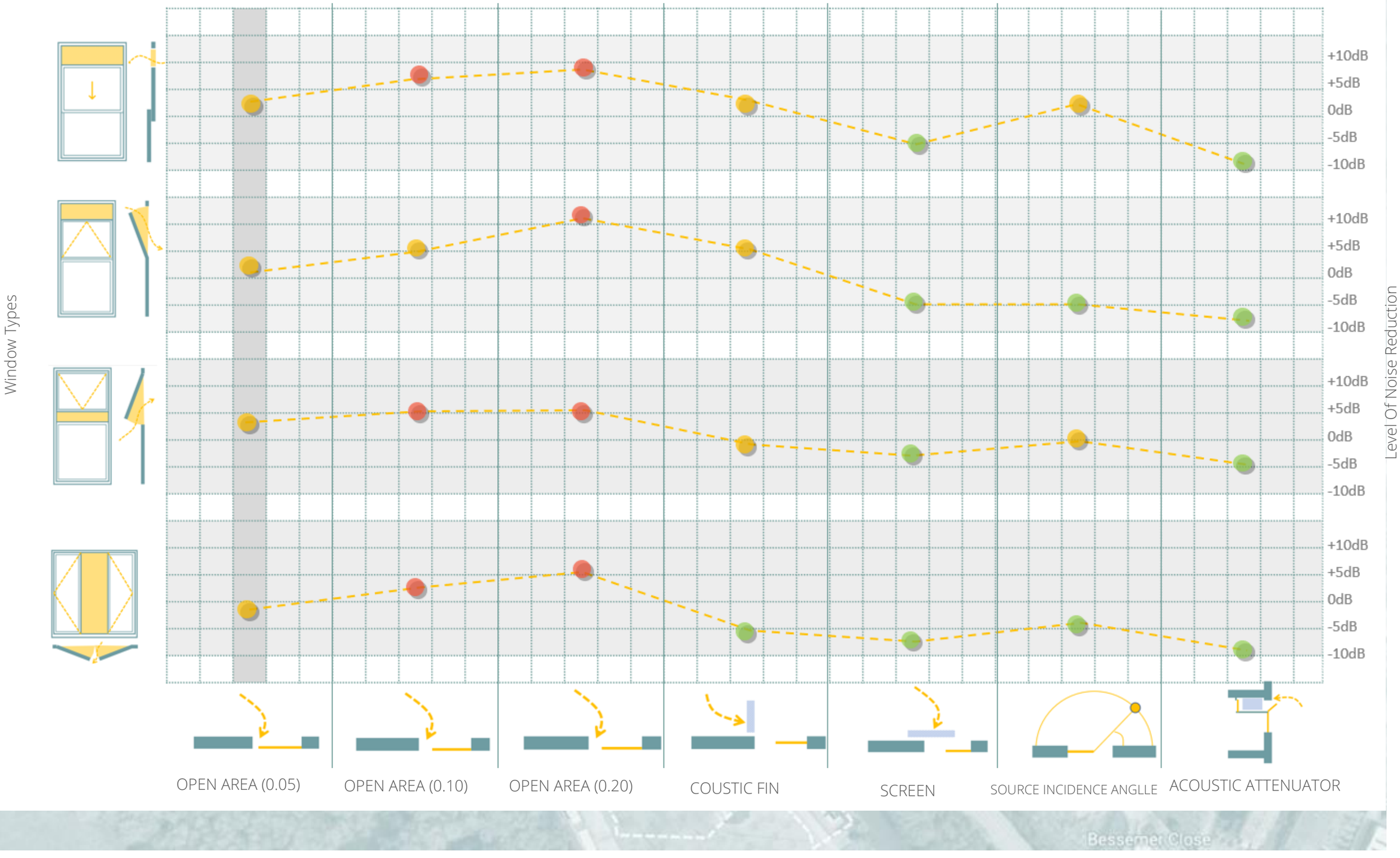
Acoustic modelling of the balconies was also carried out, however due the angle of noise propagation, it was found that the balconies provided little benefit to the acoustic performance of the façade.

SASH WINDOW

BOTTOM-HUNG

TOP-HUNG

SIDE-HUNG


Window Types
Level Of Noise Reduction
+10dB
+5dB
0dB
-5dB
-10dB
OPEN AREA (0.05)
OPEN AREA (0.10)
OPEN AREA (0.20)
COUSTIC FIN
SCREEN
SOURCE INCIDENCE ANGLLE
ACOUSTIC ATTENUATOR

REDUCING INTERNAL GAINS

Shading is an effective method for reducing solar gains within a space. Simple shading fins and overhangs can produce good results when properly designed, while louvres and movable blinds can provide additional improvements.

Architectural Fins

Well-placed brise soleil or screening can be used effectively to significantly decrease solar gains. As mentioned previously, there are also opportunities for shading to provide acoustic screening to a window too, so it is possible to increase both acoustic performance and decrease open window area through adding shading fins to a facade.

Balconies

Balconies are a common design feature that can be an effective means of providing shading to a development. The previous pages outlined examples of how this can provide shading, but it is also possible for a balcony to add acoustic screening too, if recessed or vertical screens are added too.

Building Envelope

Positioning of window orientation can change the solar gains dramatically, where north facing windows are less likely to overheat. Shading can also be achieved by using the building mass to provide screening to south facing windows, such as through courtyards.

Glazing Specification

The glazing g-value determines the amount of solar energy that passes through the window. By choosing a low g-value, this can be an effective means of controlling solar gains without making significant changes to the façade.

Through thermal modelling, it is possible to significantly reduce solar gains through improving the glazing g-values. Care will need to be taken to not reduce the visible transmittance of the glazing too much to impact on internal daylight levels.

Thermal Mass

Adding thermal mass within a space is an effective way of moderating internal temperatures. Exposed concrete or brickwork will heat up during the day, removing heat from the space, until the cooler night-time, in which the heat will be released from the thermal mass back into the room. Thermal mass works the best when there is a night time ventilation strategy that allows the room to remove the released heat.

BUILDING ENVELOPE

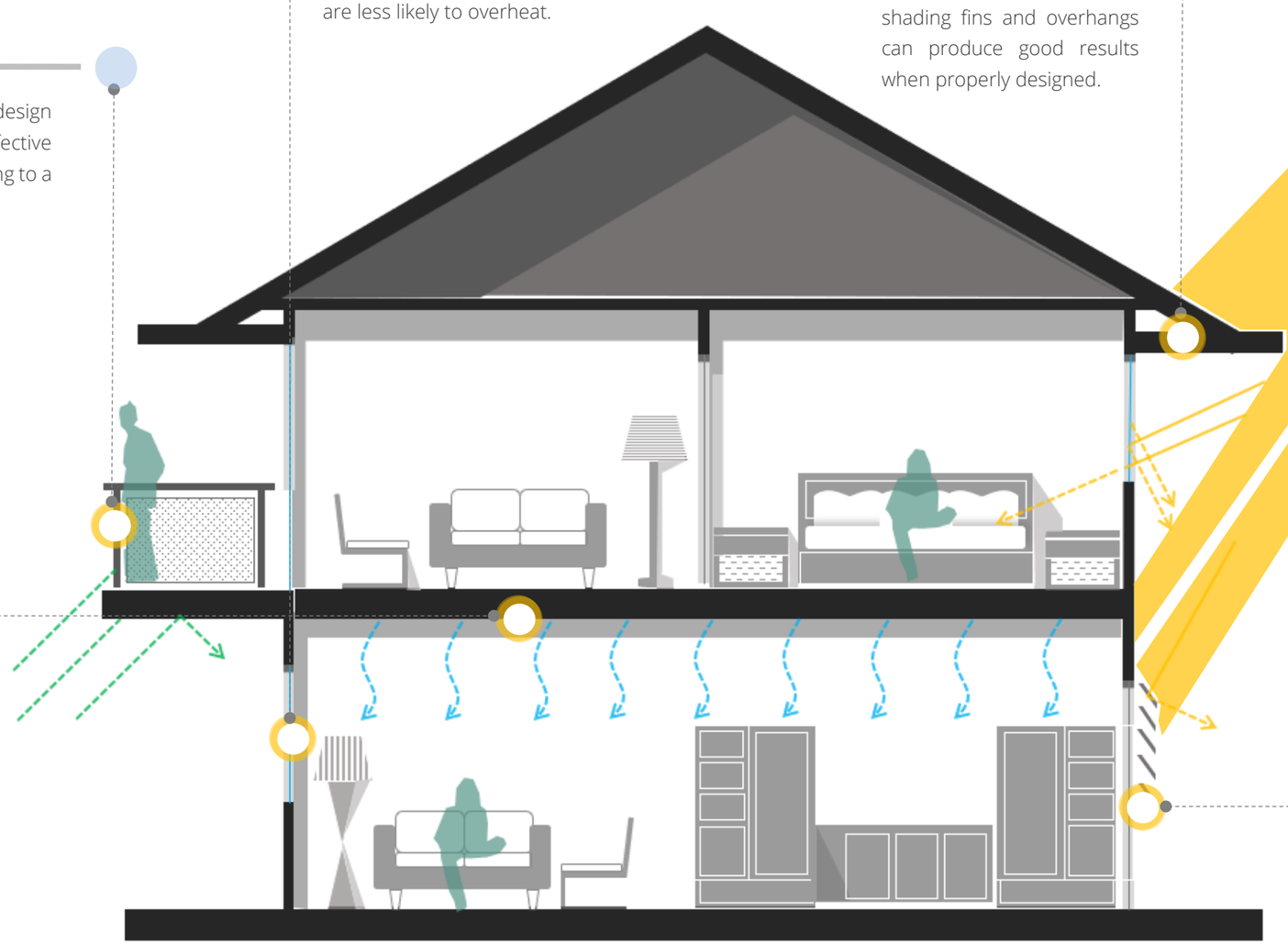
Positioning of window orientation can change the solar gains dramatically, where north facing windows are less likely to overheat.

SHADING

Shading is an effective method for reducing solar gains within a space. Simple shading fins and overhangs can produce good results when properly designed.

BALCONIES

Balconies are a common design feature that can be an effective means of providing shading to a development.



THERMAL MASS

Adding thermal mass within a space is an effective way of moderating internal temperatures. Exposed concrete or brickwork will heat up during the day, removing heat from

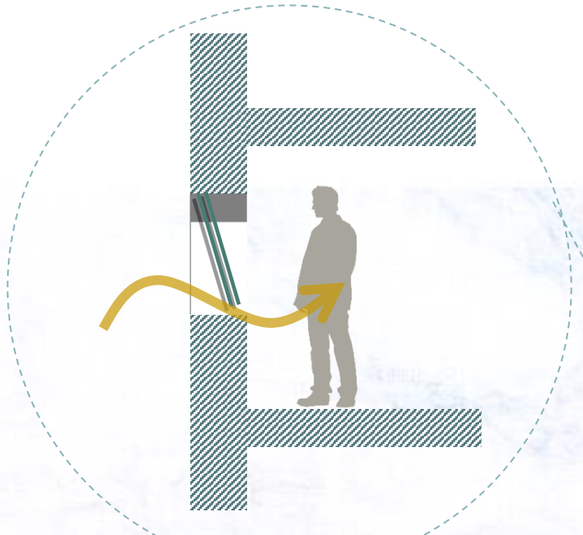
ARCHITECTURAL FINS

Well-placed brise soleil or screening can be used effectively to significantly decrease solar gains. As mentioned previously, there are also opportunities for shading to provide acoustic screening to a window too.

DESIGN FEATURES OF NEARBY DEVELOPMENTS

WATKISS WAY

The blocks of flats along Watkiss Way show large architectural fins that run parallel with the dual carriageway nearby. The fins are therefore able to provide significant amounts of acoustic screening to windows adjacent to the screen. The portholes located within the fins will create an acoustic weakness in the screening performance and as such are not a recommended feature



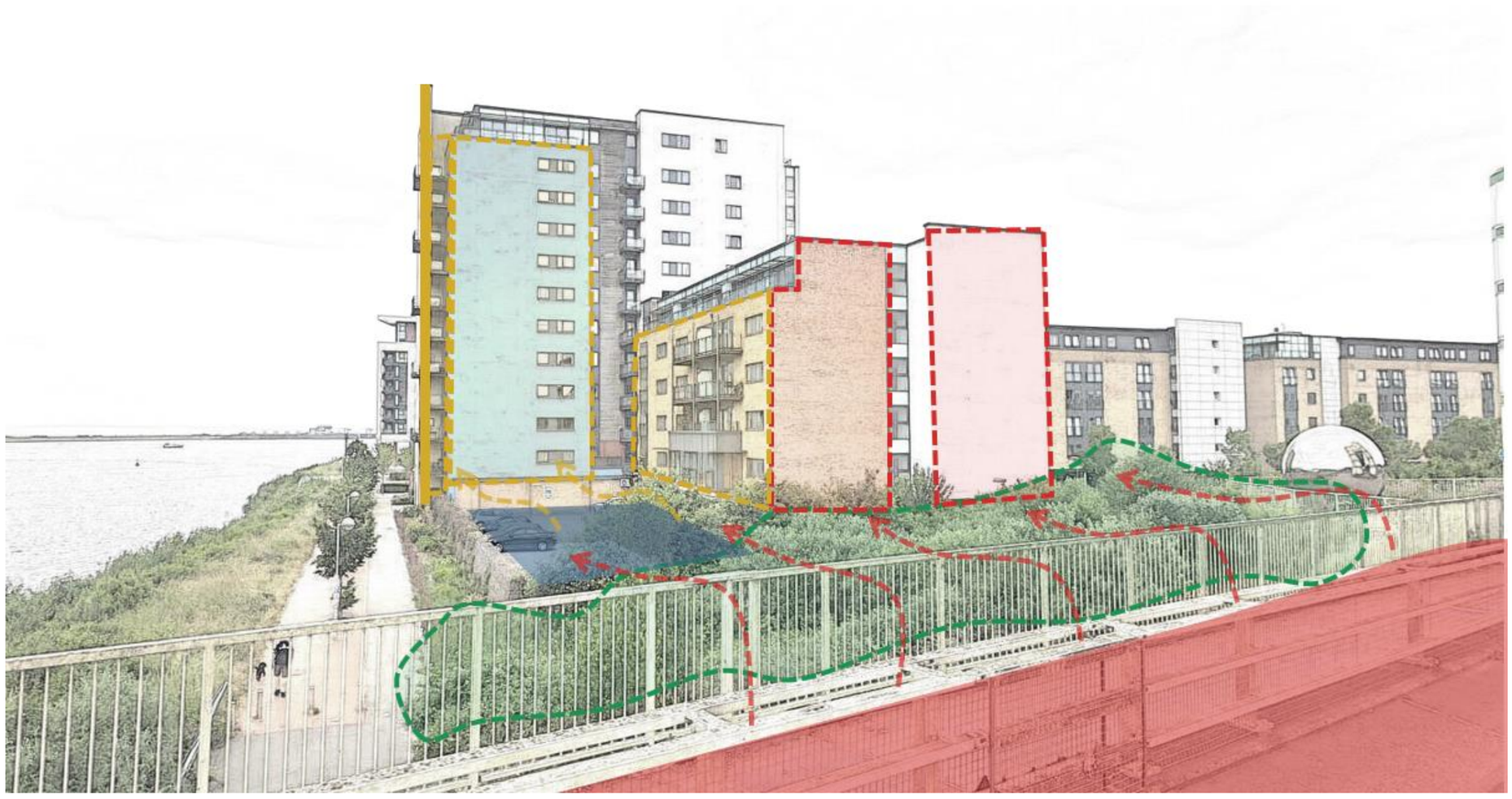
FERRY ROAD - 1

The photo below shows recessed windows within another development along Ferry Road. The positioning of the windows deeper within the façade will create a small amount of acoustic screening, and when paired with the right window opening type, can produce high levels of attenuation across the façade. Care will have to be taken, however, to ensure that this does not compromise the ventilation efficiency.

FERRY ROAD - 2

FERRY ROAD - 2

The layout of the residential blocks along Ferry Road uses the building mass to provide screening from the adjacent road and create a quieter communal green space behind it. Also note that for facades facing on to the road, the number of openable windows have been minimised, and may be to less sensitive spaces such as kitchens or bathrooms.

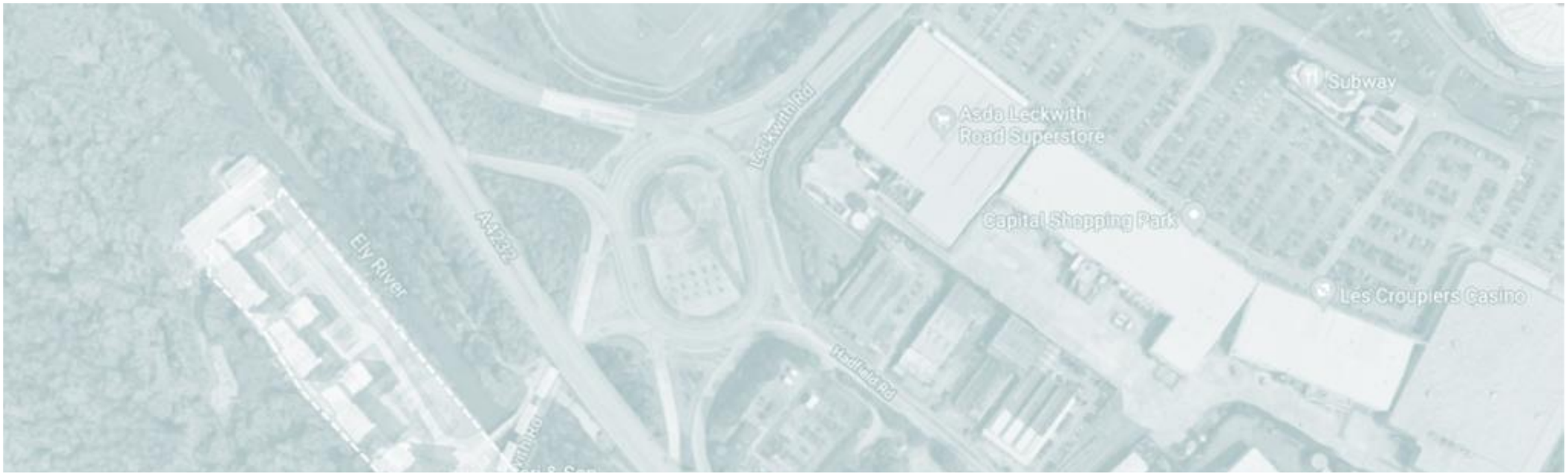


BRITANNIA QUAY

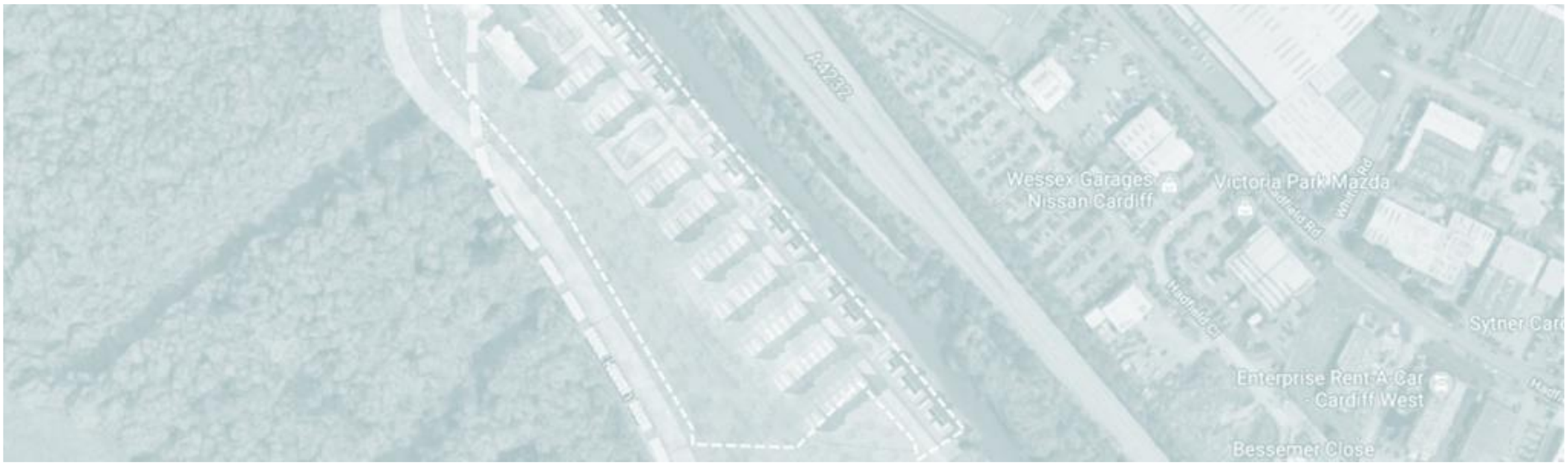
The Britannia Quay development utilises both recessed balconies and staggered facades to create an effecting acoustic screening device. These elements can be effective when

BUTE PLACE

The recessed balcony at this development along Bute Place provides an effective means of reducing noise break-in to sensitive spaces. Additional performance can be achieved by adding acoustically absorptive materials to the soffit or walls of the balcony area, to minimise reflections back into the internal space.


Subway
Asda Leckwith Road Superstore
Leckwith Rd
Capital Shopping Park
Les Croupiers Casino
A4232
Ely River
Wedfield Rd

APPENDICES


A4232
Wessex Garages Nissan Cardiff
Victoria Park Mazda
Wedfield Rd
Enterprise Rent-A-Car Cardiff West
Bessemer Close

1.0 APPENDIX A – NOISE SURVEY METHODOLOGY AND DETAILS

1.1 The Site & Survey

The proposed plans are for a new residential development on the site located at Leckwith Quay. The proposed development is situated in close proximity to the A4232 to north-east of the site, with an additional road (B4267) cutting through the site and continuing to the south-west.

The site in relation to its surroundings is shown in the site plan opposite.

The noise sources on site are primarily traffic along the A4232, with road traffic along the B4267 contributing to a lesser extent, although the dominant noise source to the far south-west of the site. Ambient noise levels over the whole day time period are relatively high, with a reduction in levels to the night.

1.2 Noise Survey Methodology and Results

MACH carried out a noise survey at the proposed site from Thursday 9th May to Monday 13th May 2019. A combination of short and long-term noise monitoring positions were carried to establish environmental noise levels across the site.

Please refer to Appendices A & B for further information in regards to survey methodology and results.

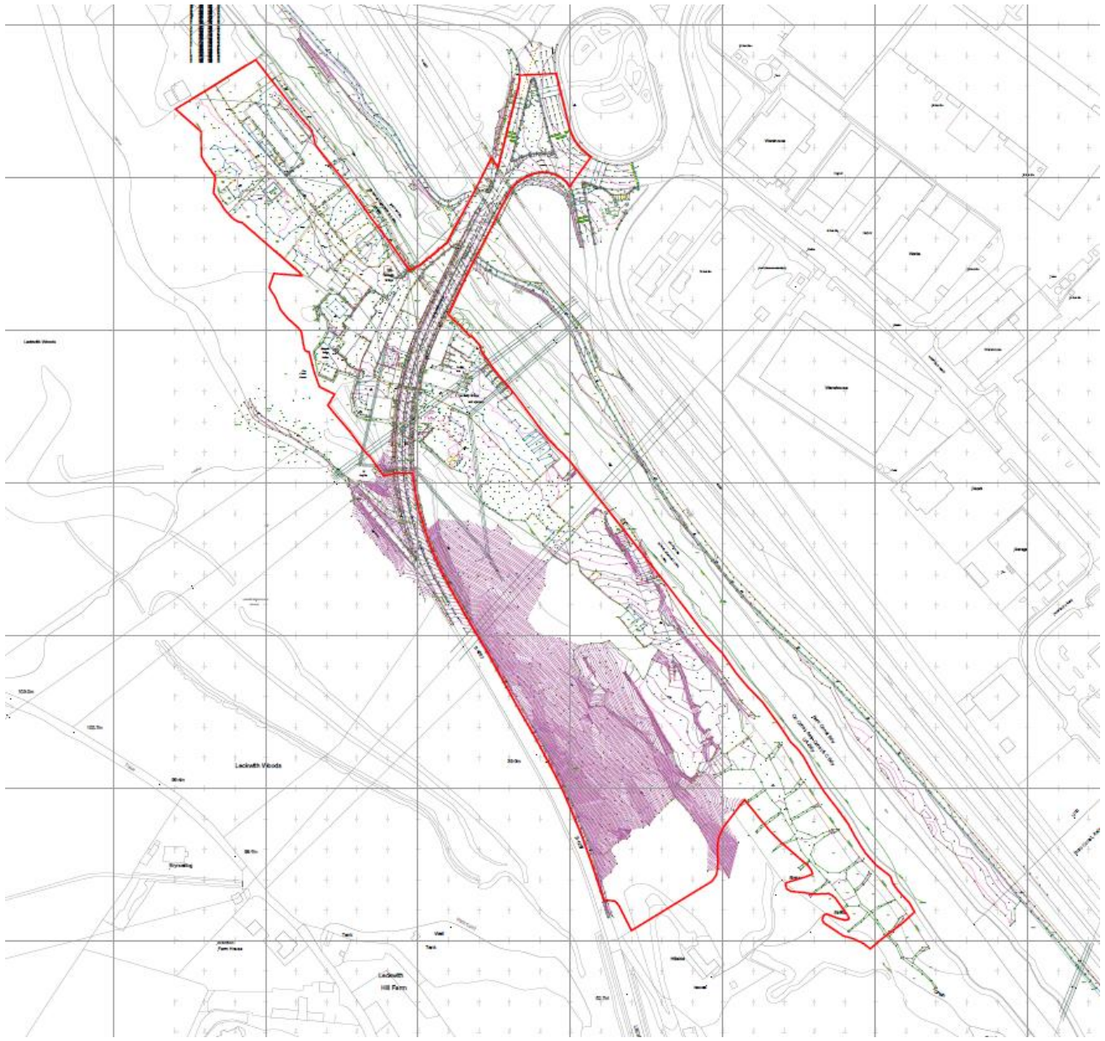


Figure 1.1: Site Outline

1.3 Measurement Equipment

The measurement equipment illustrated in Table 3.1 was used during the survey, all equipment complies with BS EN 60942:2003 i.e. a class 1 device.

Name	Serial Number	Last Calibrated	Certificate number	Calibration Due
Norsonic Precision Sound Analyser Type 140	1403249	Oct-17	26727	Oct-19
Norsonic Type 1209 Pre-amplifier	12563	Oct-17	26727	Oct-19
NTI Microphone Capsule MC230A	A14417	Nov-17	STD92711	Nov-19

Table 1.1: Noise Measurement Equipment

1.4 Weather Conditions

The following climate conditions were recorded for the site:

Wind: Less than 5 m/s.
Humidity: Clear, sunny, low precipitation.
Temperature: 17 20ºC.

The above weather conditions are suitable for the measurement of environmental noise in accordance with BS7445 Description and Measurement of Environmental Noise.

1.5 Methodology

In order to establish environmental noise levels on site, continuous 5-minute samples of the acoustic parameters $L_{Aeq,\ T}$, $L_{A90,\ T}$, and $L_{Amax,T}$ were measured between 09:00 on 17/09/2018 and 09:00 on 18/09/2018, at a fixed microphone position (location (F)) on site. Data has been gathered over an approximate 24-hour period, in order to provide L_{Aeq} and L_{Amax} levels for both day and night.

As stated in Section 2.0, Traffic along the M4 form the primary contribution to ambient noise levels. Figure 3.1 below provides the location of fixed measurement position F. The microphone was placed at the boundary of the proposed property in free field conditions, approximately 2m above ground. The long-term meter was set to measure consecutive 'A' weighted 5-minute time samples.

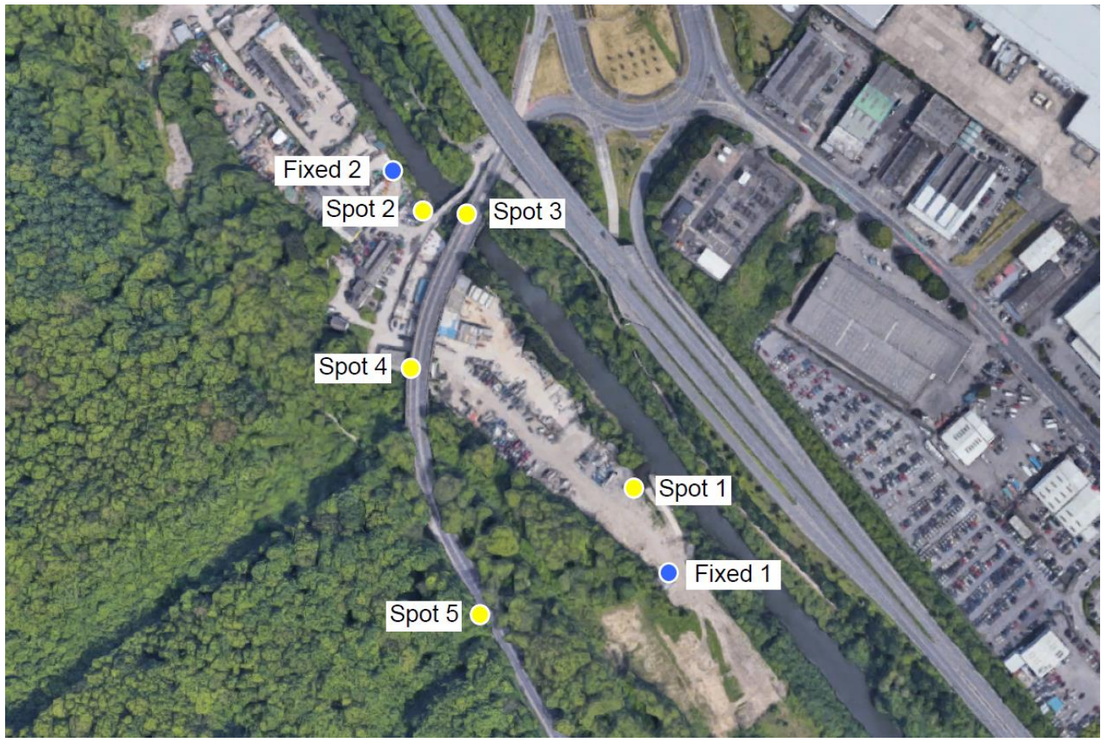


Figure 1.2: Measurement Location Map

2.0 APPENDIX B – NOISE SURVEY RESULTS

2.1 Fixed Measurement Results

The following graph and table show the measured noise levels at fixed measurement location F. All measurements are shown in dB(A). The complete set of measurement data is available on request. The graph in Figure 2.1 below provides the L_{Amax}, L_{Aeq} and L_{A90} levels measured during the noise survey.

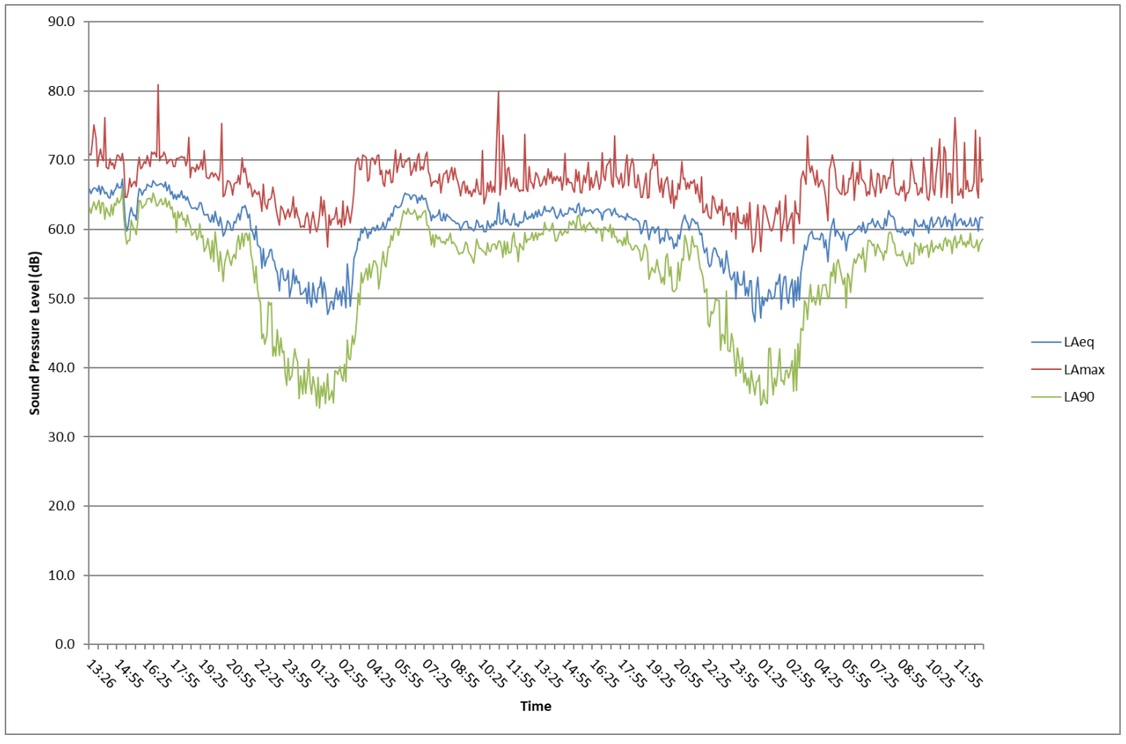


Figure 2.1: Graph of on-site environmental noise measurements (Fixed 1)

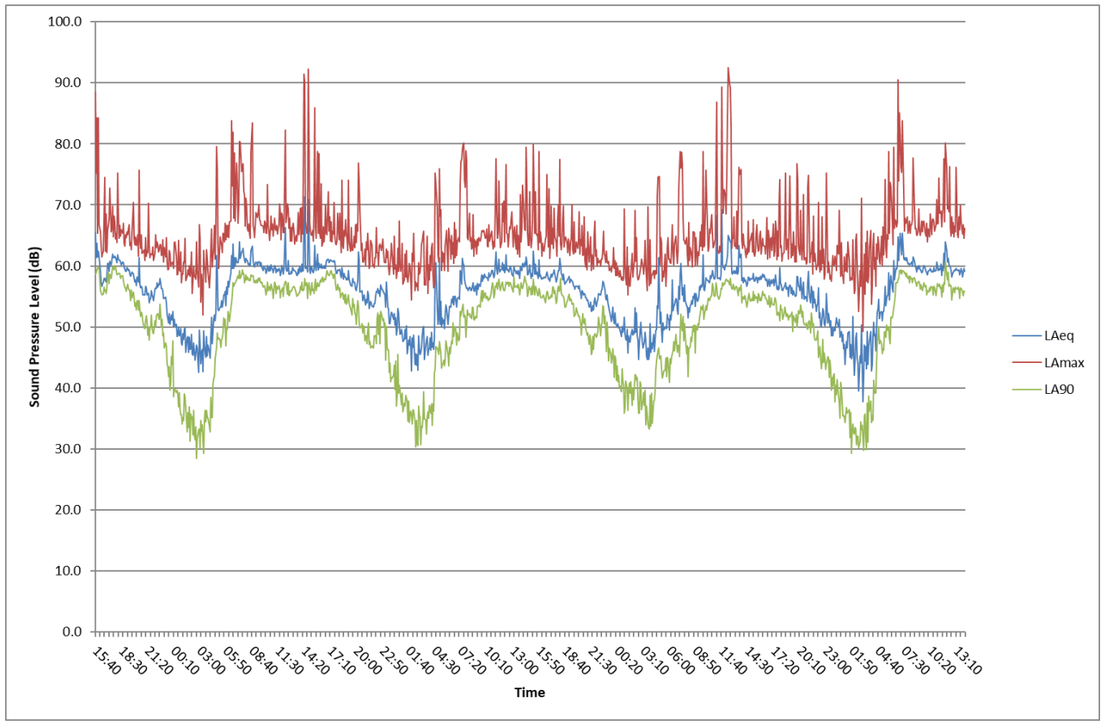


Figure 2.2: Graph of on-site environmental noise measurements (Fixed 2)

2.2 Spot Measurement Results

Measurement Position	Times (hh:mm)		Measured Noise Levels (dB)
S1	14:10 – 14:25	L_{Amax}	74
		$L_{Aeq,5min}$	64
		L_{A90}	61
S2	15:15 – 15:25	L_{Amax}	79
		$L_{Aeq,5min}$	61
		L_{A90}	58
S3	15:55 – 16:00	L_{Amax}	82
		$L_{Aeq,5min}$	73
		L_{A90}	67
S4	16:05 – 16:10	L_{Amax}	84
		$L_{Aeq,5min}$	74
		L_{A90}	66
S5	15:15 – 16:20	L_{Amax}	87
		$L_{Aeq,5min}$	73
		L_{A90}	67

Table 2.1: Summary of Spot Measurements

3.0 APPENDIX C - TYPICAL PERFORMANCE CRITERIA

3.1 Internal Noise Level Targets – Background Ventilation

The Noise Policy Statement for England does not provide guidance on internal noise levels within residential buildings. As a result, the advised levels within BS8233: 2014 'Guidance on sound insulation and noise reduction for buildings' have been adopted. BS8233 states that to achieve adequate sleeping and living conditions, background noise levels should be 30 dB L_{Aeq} or less within bedrooms at night, and 35 dB L_{Aeq} or less within Living rooms during the day. The advised levels are tabulated below.

Activity	Location	0700 - 2300	2300 - 0700
Resting	Living Room	35 dB $L_{Aeq, 16\ Hour}$	-
Dining	Dining Room	40 dB $L_{Aeq, 16\ Hour}$	-
Sleeping	Bedroom	35 dB $L_{Aeq, 16\ Hour}$	30 dB $L_{Aeq, 8\ Hour}$

Table 3.1: BS8233 internal noise levels

BS 8233: 2014 provides no definitive methodology for assessment of L_{Amax} levels. The standard simply states that a guideline value for the internal level may be set depending on the character of the noise source and number of events occurring. Due to the proximity of the proposed site to sources of road traffic noise, assessment of L_{Amax} is critical to ensuring that disturbance is avoided.

In order to provide an assessment of L_{Amax} levels, the recommendations of the World Health Organisation are recommended. The WHO state that in order to avoid sleep disturbance within bedrooms during the night, the internal sound pressure level should not exceed 45 dB L_{Amax}.

Typically, BS8233 targets apply when a dwelling is being ventilated to achieve background ventilation rates, which can typically be achieved through the use of acoustic trickle vents. As trickle vents can achieve a high level of acoustic attenuation, it is relatively low risk achieving BS8233 noise targets, however there is much higher risk of occupant disturbance when ventilating to avoid overheating.

3.2 Internal Noise Level Targets - Overheating Mode

The Acoustics, Ventilation and Overheating - Residential Design Guide (Feb 2018 – Draft) outlines the extent of risk associated with increased noise levels from increased ventilation openings in 'overheating' mode. The risk categories and associated noise levels are provided in the table opposite. It is recommended that a 'Low' risk approach is targeted for residential dwellings within Leckwith Quay. This translates to a +5dB relaxation to the internal ambient noise level targets outlined within BS8233.

The targets are to be achieved when the residential units are ventilating in 'overheating' mode which requires much higher rates of ventilation than background ventilation mode. Note, these targets also include contributions from any mechanical ventilation systems.

Internal Ambient Noise Level			
Daytime, $L_{Aeq,T}$ 07:00 – 23:00	Night Time, $L_{Aeq,2h}$ 23:00 – 07:00	Examples of Outcomes	Risk Category
≤ 35 dB	≤ 30 dB	Noise can be heard but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life	Negligible
> 35 dB and < 40 dB	> 30 dB and < 35 dB	Noise can be heard and causes small changes in behaviour and/or attitude, e.g. turning up volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance. Affects the acoustic environment inside the dwelling such that there is a perceived change in the quality of life.	Low
> 40 dB and < 50 dB	> 35 dB and < 43 dB	Increasing risk of adverse effect due to impact on reliable speech communication during daytime or sleep disturbance at night. Although noise levels at the lower end of this category will cause changes in behaviour, they may still be considered suitable. Noise levels at the upper end of this category will result in more significant changes in behaviour and are only likely to be considered suitable if they occur for limited periods.	Medium
> 50 dB	> 43 dB	The noise causes a material change in behaviour and/or attitude, e.g. avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area.	High

Table 3.2: Internal ambient noise level relaxations and likely outcomes for overheating (AVO Guide)

Activity	Location	0700 - 2300	2300 - 0700
Resting	Living Room	40 dB $L_{Aeq, 16\ Hour}$	-
Dining	Dining Room	45 dB $L_{Aeq, 16\ Hour}$	-
Sleeping	Bedroom	40 dB $L_{Aeq, 16\ Hour}$	35 dB $L_{Aeq, 8\ Hour}$

Table 3.3: Recommended Internal Noise Levels – Overheating Ventilation Mode

3.3 Outdoor Amenity

With regards to outdoor amenity areas, BS8233 states a lower exposure value of 50 dBA and a higher exposure value of 55 dBA (which would be acceptable in noisier environments). Due to the nature of the noise climate on site, MACH warrant that the Higher (55 dBA) exposure value will be applicable.

These values are specified as $L_{Aeq,T}$, where T refers to the activity period of the outdoor space. For this development, assessment is based on gardens during daytime hours. Although L_{Amax} levels will exceed the upper value of 55 dBA, assessment must be based on an $L_{Aeq, 16\ Hour}$ value.