



LAND SOUTH OF  
LITTLEHAMPTON  
ACADEMY,  
LITTLEHAMPTON

Acoustic Planning  
Assessment

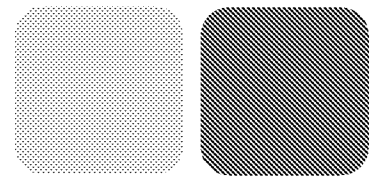
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Prepared: 16 August 2021

Revision Number: 3

BoKlok Housing Ltd

# Acoustic Planning Assessment



## LAND SOUTH OF LITTLEHAMPTON ACADEMY, LITTLEHAMPTON

Reference: 10383.RP01.APR.3

Prepared: 16 August 2021

| Revision | Comment                                                                                                                                                                                       | Date             | Prepared By  | Approved By     |
|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|--------------|-----------------|
| 0        | First issue of report                                                                                                                                                                         | 18 December 2020 | James Stokes | Torben Andersen |
| 1        | Revised to incorporate feedback from EHO                                                                                                                                                      | 24 February 2021 | James Stokes | Torben Andersen |
| 2        | Updated Conclusion and site drawings                                                                                                                                                          | 8 March 2021     | James Stokes | Torben Andersen |
| 3        | Updated to respond to EHO feedback June 2021 – Additional Nursery Noise survey, further modelling of External Amenity Noise and Substation Noise Assessment as well as general clarifications | 16 August 2021   | James Stokes | Torben Andersen |

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The recommendations within this report relate to acoustics performance only and will need to be integrated within the overall design by the lead designer to incorporate all other design disciplines such as fire, structural integrity, setting-out, etc. Similarly, any sketches appended to this report illustrate acoustic principles only and again will need to be developed in to full working drawings by the lead designer to incorporate all other design disciplines. In line with our Environmental Policy, up to two hard copies of the report will be provided upon request. Additional copies of the report, or further hard copies of revised reports, would be subject to an administrative cost of £20.00 (+VAT) per copy.



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## 1.0 INTRODUCTION

A new residential development is proposed at the land south of Littlehampton Academy, Littlehampton. The development will consist of 80 houses and an apartment building containing 32 apartments. The proposed layout is shown in the attached Figure 1.

RBA Acoustics have been appointed by Boklok to assess acoustic compliance of the proposed site layout with the requirements of Arun District Council (ADC). This assessment has been carried out in relation to the noise levels at the facades of the proposed buildings, calculated through the use of 3D modelling software (CadnaA), using traffic noise level predictions produced by WYG Environment and supplemented by RBA noise survey data.

The assessment reviews the proposed acoustic performance specifications of the prefabricated Boklok units to demonstrate that acceptable internal and external noise criteria can be achieved in line with the requirements of Arun District Council (ADC). To be as proactive as possible, early discussions were undertaken with Senior Environmental Health Officer, Carol Reynolds of ADC, to determine the requirements and preferences of the Local Authority and as such, the following assessment aims to demonstrate that the proposed scheme has considered the relevant guidance as well as any additional concerns raised (in January 2021 and June 2021) to provide assurance that suitable acoustic conditions will be achieved throughout the development.

Boklok units are prefabricated and therefore are available in different types (Standard, Medium and High) which provide varying levels of acoustic performance for the glazing and trickle ventilators. The unit type can therefore be selected, depending on the predicted façade-incident noise levels, in order to meet the noise criteria given in BS8233:2014 in all areas. Throughout this report, the 'Standard' unit type is regularly referenced.

## 2.0 LIAISON WITH LOCAL AUTHORITY

### 2.1 January 2021

A copy of the first issue (Rev 0) of this acoustic report was provided to Carol Reynolds, Senior EHO for Arun District Council, in order to receive any initial feedback on the acoustic proposals. An email response was received on 19<sup>th</sup> January 2021 which included multiple comments for consideration. To demonstrate a robust response to these comments we have included a summary below detailing each point and providing a comment/response in each case, to demonstrate that it has been considered:

- **Consideration of Reorientation of Apartment Blocks**  
The proposed flats are required to be in this layout/configuration for the reasons set out in the Design and Access Statement.
- **Balconies and Outdoor Space**  
Although reference was made to roof gardens, we understand these are not proposed in the scheme. Further assessment of the implication of having French windows/Balcony doors on the western façade of the apartment building (see Section 6.1) has demonstrated that resulting internal noise levels will generally be acoustically suitable, even when partially opened for cooling or access.
- **Higher Noise Levels in Gardens**  
Although noise levels are marginally higher in a small portion of gardens to the north-west of the site, it should be noted that noise levels in all gardens meet the target external amenity noise level criteria, as given in BS8233:2014.

- **Additional Liaison with School & Nursery**

Naturally, due to the time constraints of the site application, our initial site noise survey (undertaken in December 2020) was unable to provide us with noise levels of warmer periods, nor those during typical (non-Covid conditions), however this was initially acknowledged in the report. To provide a more robust assessment, in Revision 2 of this report we subsequently liaised further with the Nursery & School to better understand the scope of potentially noisy activity and the daily timetables which dictate periods of increased external noise emissions. The desktop predictions undertaken in Sections 5 and 6 demonstrate that noise emissions from the Nursery or the School are unlikely to cause any significant design risk nor of future noise complaints. It is also notable that the potentially affected units are limited to a very small number which are located adjacent to the outdoor play areas of the nursery & school respectively.

*See also reference to updated Nursery Assessment in Section 2.2 below.*

- **Existing Fencing to School and Nursery**

Reference to the existing fences adjacent to the school and nursery were included for completeness, however it is acknowledged that they are not intended as acoustic barriers. That being said, there will be *some* inherent noise reduction that they provide (particularly in the case of the school fence, which is of a dense construction, see Figure 10). Furthermore, only garden fences have been included in our noise predictions and will provide suitable acoustic screening to external amenity areas for all proposed units.

- **Reference to Pre-Application Transport Note**

RBA have subsequently reviewed the RGP Pre Application Transport Note (ref: BOKL/20/5433/TN01, dated August 2020) and comment that the document refers to predicted traffic flows associated with development. However, given the relatively low traffic flows predicted, it is not typical to undertake an assessment of such noise on existing surrounding noise-sensitive dwellings.

- **Reference to PPG24 (NEC Categories)**

This document was specifically referenced in the Arun Local Plan and as such was initially included. However, on the basis of the latest comments this has now been removed from this report.

- **Open Windows & Mechanical Ventilation**

Mechanical Extract Ventilation (MEV) will be provided which consists of internal extract ventilation and trickle ventilators – The required acoustic performance of the ventilators is given in the report below and the specifications align with the trickle ventilators provided in Boklok's 'Standard'-type prefabricated unit, given that noise levels are permissive of the use of the 'Standard'-type units across the whole site. The 'Standard' unit type has been selected such that internal noise criteria given in BS8233:2014 can be achieved internally in all areas. However, the implications of window opening should be assessed in line with the AVO guidance, which we anticipate will demonstrate acceptability given the low requirement for opening windows, as determined elsewhere.

- **AVO Guidance and Internal Noise Criteria**

The recommendation for relaxing the internal ambient noise limits internally by 5dB when windows are opened is taken directly from BS8233:2014 and the AVO guidelines.

## 2.2 June 2021

Following the submission of Revision 2 of the acoustic report, Carol Reynolds provided further feedback in an email response, received on 29<sup>th</sup> June 2021 which included multiple comments for consideration. A summary of the updates included in Revision 3 of this report are given below, detailing each point and providing a comment/response in each case, to demonstrate that it has been considered:

- **Mechanical Extract Ventilation**  
Although provided in previous report, we have made the ventilation strategy clearer to confirm that Mechanical Extract Ventilation (MEV) is proposed. This approach utilises trickle ventilators, however results in higher ventilation rates due to the increased pressure differential generated by extract ventilation in various rooms of the unit.
- **Electrical Substation**  
A high-level assessment of substation transformer noise has been included in Section 9.0 of this report. The resulting noise level prediction from the proposed transformer is 15dB below the predicted night-time background noise levels at the nearest receptor and therefore no noise disturbance issues are anticipated.
- **Nursery Noise Survey**  
An additional noise survey of noise from the adjacent nursery has been undertaken over a period of 3 working days. Worst-case noise activity, including noise from the use of the children's cars on the wooden bridge were included in the unattended measured levels, as observed following the installation of the meter. Based on these measured levels, noise level predictions in the nearest gardens and at the nearest proposed facades meet the requirements of BS8233:2014.
- **External Amenity Noise**  
Further acoustic modelling has been undertaken to investigate the potential improvements available for the 4no. gardens where external noise levels currently exceed 50dB. Further modelling showed that an increase in height (from 1.8m to 2.4m) would only further reduce noise level by around 2-3dB. As such, given that the increase in height of these fences will have other design implications (e.g. aesthetic/sunlight), it is not deemed that this undesirable design change would warrant the relatively small acoustic improvement of 2-3dB, where resulting noise levels in some gardens would still exceed 50dB. As such, on the basis of this further modelling, it is deemed that the existing design of 1.8m fences is still acoustically suitable.

## 3.0 CRITERIA

This section outlines typical assessment criteria in terms of the relevant standards as well as guidance specific to the Arun District. A brief explanation of the acoustic terminology used in this report is shown within Appendix A.

### 3.1 Arun Design Guide SPD (April 2020)

Section J.06 ('Noise & Overshadowing') from the Arun Design Guide Supplementary Planning Document (April 2020) provides the following initial design guidance relating to noise:

- Orientates habitable rooms and amenity space away from potential noise sources.*
- Incorporates appropriate design features to mitigate noise pollution, which may include recessed balconies, acoustic lobbies, barriers between noise sources and dwellings and noise-absorbing materials*
- Locates noisy activities in sufficient proximity to dwellings for safe access, but far enough away to minimise disturbance.*
- Considers the configuration of the Strategic Road Network in relation to dwellings in order to avoid likely future occupants seeking to restrict the network on the basis of noise or other impacts on amenity."*

Consideration has been given to the above in terms of the general design of the development, with a "buffer zone" of land proposed to create some distance (≈30m) between the proposed Fitzalan Link Road and the nearest apartment units. Furthermore, by positioning the 4-storey apartment building on the western edge of the development, this provides additional acoustic screening to the rest of the development, meaning noise levels are further reduced across the site for most units.

Although consideration has been given to the reorientation of the main apartment building [to rotate by 90 degree, such that there is a smaller surface area facing the road], in reality, this would not be feasible due to apartments being single-aspect units, as such an approach would result in many of the apartments being only-north-facing, which poses issues both in terms of natural light & heating.

### 3.2 Adoption Arun Local Plan 2011-2031 (July 2018)

The Adoption Arun Local Plan provide additional guidance relating to noise in the form of Policy QE DM1 which states the following:

Section 1.0 of this policy requires the following:

#### *1. New noise sensitive development*

*Residential development likely to experience noise from road, rail or air, in particular development in close proximity to A284/A259 Wick roundabout, Stretches of the A27 around Arundel and Fontwell, Sections of the A29 and A259 in Bognor Regis, A284 in Littlehampton and The stretch of railway line that runs through Barnham station must:*

- a. Be supported by a noise exposure category (NEC) assessment and designed to ensure that residents will not be adversely affected by noise.*
- b. Consider both the likely level of exposure at the time of application and any increase that might be reasonably expected in the foreseeable future.*

*To safeguard the continued use of existing industrial and commercial uses and to protect amenity, noise sensitive development should not normally be permitted where:*

- c. High levels of noise will continue throughout the night, especially during the hours when people are normally sleeping.*
- d. There is a likelihood of complaints about noise from industrial development.*

At our proposed development, the nearest existing major noise source is the A259, however this is located at a distance of around 700m from the site meaning resulting noise levels experience a significant level of distance attenuation and are controlled comfortably to within the required levels. However, given that the proposed Fitzalan Road Link will be in close proximity to the west of site, it is appropriate that the above points are considered further.

Responding to the above considerations are as follows:

a) The first revision of this report contained such an assessment of the NEC of the site, however this has now been removed following recommendation from Arun District Council that this is not required.

b) Noise level predictions are based on future anticipated increased traffic levels, predicted in the year 2032.

Given that there are no significant commercial or industrial units adjacent to the development site, items c) and d) are not relevant. However, additional consideration has been given to noise from the adjacent school to the north of site, Littlehampton Academy, and a small nursery to the east of the site, Littlehampton Day Nursery (see Section 5.7).

### 3.3 Planning Noise Advice Document Sussex (2015)

Section 5.0 of the Planning Noise Advice Document Sussex (2015) details considerations relating to noise for New Noise Sensitive Developments. Several key points raised in this section are summarised below:

- Regard should be had to the National Planning Policy Framework (NPPF) – see Section 2.4 below for more guidance.
- A noise assessment should be carried out at pre-application stage
- The CRTN ('Calculation of Road Traffic Noise') method is recommended for road traffic noise (note that our assessment was based on detailed CRTN noise predictions made by WYG Environment using future road traffic level predictions)
- Night-time noise monitoring is recommended, however in our case this is not possible, given that the Fitzalan Link Road is not yet constructed. Consideration has been given to this in the following assessment.
- Internal noise level criteria should be in line with BS8233:2014 and WHO guidelines.
- Computer modelling of noise is recommended.

### 3.4 National Planning Policy Framework

The current National Planning Policy Framework (NPPF), July 2018, sets out the Government's planning policies for England. In respect of noise, Paragraph 180 of the NPPF states the following:

*"Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should:*

*a) mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life<sup>60</sup>;*

*b) identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason; and*

*c) limit the impact of light pollution from artificial light on local amenity, intrinsically dark landscapes and nature conservation. "*

Paragraph 182 adds:

*Planning policies and decisions should ensure that new development can be integrated effectively with existing businesses and community facilities (such as places of worship, pubs, music venues and sports clubs). Existing businesses and facilities should not have unreasonable restrictions placed on them as a result of development permitted after they were established. 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.*

### 3.5 British Standard 8233:2014

BS 8233:2014 *Guidance on Sound insulation and noise reduction for buildings* draws on the results of research and experience to provide information on achieving internal acoustic environments appropriate to their functions.

The noise level values given are in terms of an average ( $L_{Aeq}$ ) level.

The standard advises internal ambient noise levels for achieving suitable resting and sleeping conditions within residential properties as set out in Table 1. A brief explanation of the acoustic terminology used in this report is shown in Appendix A attached.

Table 1 – BS 8233:2014 Residential Criteria

| Room             | 07:00 to 23:00         | 23:00 to 07:00        |
|------------------|------------------------|-----------------------|
| Living Rooms     | 35 dB $L_{Aeq,16hour}$ | --                    |
| Dining Room/area | 40 dB $L_{Aeq,16hour}$ | --                    |
| Bedrooms         | 35dB $L_{Aeq,16hour}$  | 30 dB $L_{Aeq,8hour}$ |

### 3.6 World Health Organisation: Environmental Noise Guidelines

This document sets out to define "recommended exposure levels for environmental noise in order to protect population health". The guidance documents relates specifically to external noise levels, and recommends that "all CNG [WHO Community Noise Guidelines, 1999] indoor guideline values and any values not covered by the current guidelines [such as industrial noise and shopping areas] should remain valid". We therefore make reference to the WHO Community Noise Guidelines for recommendations on internal noise levels.

The WHO document "Guidelines for Community Noise" describes guideline levels that are "essentially values for the onset of health effects from noise exposure". A table of guideline values is included, relating to adverse health effects, referred to as any temporary or long-term deterioration in physical, psychological, or social functioning that is associated with noise exposure. The following is an extract from the Table 4.1: Guideline values for community noise in specific environments, as stated in the WHO document.

Table 2 – Guideline Values for Community Noise

| Specific Environment | Critical Health Effect(s)                                          | $L_{Aeq}$ (dB) | Time Base (hours) | $L_{Amax}$ (dB) |
|----------------------|--------------------------------------------------------------------|----------------|-------------------|-----------------|
| Dwelling, indoors    | Speech intelligibility and moderate annoyance, daytime and evening | 35             | 16                | -               |
| Inside bedrooms      | Sleep disturbance, night-times                                     | 30             | 8                 | 45              |
| Outside bedrooms     | Sleep disturbance, window open (outdoor values)                    | 45             | 8                 | 60              |

With reference to maximum noise levels the following guidance is provided within the WHO guidance:

*"For a good sleep, it is believed that indoor sound pressure levels should not exceed approximately 45dB  $L_{Amax}$  more than 10-15 times per night [Vallet & Vernet 1991] and most studies show an increase in the percentage of awakenings at SEL values of 55-60 dBA [Passchier-Vermeer 1993; Finegold et al. 1994; Pearsons et al. 1995]. For intermittent events that approximate aircraft noise, with an effective duration of 10-30s, SEL values of 55-60*

corresponds to a  $L_{Amax}$  value of 45dB. Ten to 15 of these events during an 8 hour night-time implies a  $L_{Aeq, 8h}$  of 20-25dB. This is 10-15dB below the  $L_{Aeq, 8h}$  or 30dB for continuous night-time noise exposure, and shows that intermittent character of noise must be taken into account when setting night-time noise limits for noise exposure. For example, this can be achieved by considering the number of noise events and the difference between the maximum sound pressure level and the background of these events."

Therefore the frequency of occurrence of maximum noise events should not typically exceed 10-15 times in any night.

Furthermore the standard also advises on design criteria for external amenity spaces as follows:

"For traditional external areas that are used for amenity space, such as gardens and patios, it is desirable that the external noise level does not exceed 50dB  $L_{Aeq,T}$ , with an upper guideline value of 55dB  $L_{Aeq,T}$  which would be acceptable in noisier environments. However, it is also recognised that these guideline values are not achievable in all circumstances where development might be desirable. In higher noise areas, such as city centres or urban areas adjoining the strategic transport network, a compromise between elevated noise levels and other factors, such as the convenience of living in these locations or making efficient use of land resources to ensure development needs can be met, might be warranted. In such a situation, development should be designed to achieve the lowest practicable levels in these external amenity spaces, but should not be prohibited.

### 3.7 Summary

The project internal noise criteria adopted are therefore as follows;

|                        |                          |                                                         |
|------------------------|--------------------------|---------------------------------------------------------|
| Bedroom                | Night-time (23:00-07:00) | 30dB $L_{Aeq}$<br>45dB $L_{Amax,T}$                     |
| Living Rooms           | Daytime (07:00-23:00)    | 35dB $L_{Aeq}$                                          |
| External Amenity Areas | Daytime (07:00-23:00)    | 50dB $L_{Aeq}$ (desired)<br>55dB $L_{Aeq}$ (acceptable) |

## 4.0 3D NOISE MODEL PREDICTIONS

Noise level predictions have been established across the proposed site using 3D acoustic modelling software, CadnaA (Datakustik). Given that the dominant noise source at the proposed development will be the Fitzalan Link Road, which is not yet built, we have used noise level predictions produced by WYG Environment as part of input into previous Planning Application (ref: LU/234/16/RES) relating to the proposal for the road itself). Resulting noise level predictions are shown in the attached Figures 5 and 6.

### 4.1 Fitzalan Link Road Future Traffic & Noise Level Predictions

As part of the assessment undertaken by WYG Environment (in report ref: 'Discharge of Condition 18, Fitzalan Link Road, North Littlehampton' dated July 2016) detailed noise level predictions were calculated at a number of receptor locations, based on noise model predictions in line with the CRTN calculation methodology. Noise level predictions were calculated on the basis of traffic levels for 2017 as well as future predictions for 2032. Given that traffic levels are anticipated to increase from 2017 to 2032, our assessment has used the worst-case 2032 traffic levels to ensure the development remains compliant with the ADC requirements in the future. For reference, the WYG Environment assessment used a worst-case 18hr AAWT (Annual Average Weekday Traffic) for future traffic levels on the Fitzalan Link Road of 11410.

The assessment also included an acoustic fence to the west side of the Fitzalan Link Road, intended to reduce noise emissions to the existing residential estate to the west. This was proposed to be 3.5m high at the time of the assessment. Although it is understood that this acoustic fence is now proposed to be 2.5m high, this is not considered to have a significant impact on noise emissions to the east of the Fitzalan Link Road (where our proposed development site is located).

In line with the CRTN prediction methodology, noise levels were calculated as an  $LA_{10,18hr}$  level, however criteria given in BS8233:2014 and WHO Guidelines (stated in Section 2.0) are assessed as time-averaged  $LA_{eq,T}$  noise levels. Therefore, to convert from one parameter to the other, we have used guidance given in PPG 24 which states that for road traffic with noise levels falling into Noise Exposure Category (NEC) C or D, the following approximation can be used:  $LA_{eq,16hr} \approx LA_{10,18hr} - 2dB$ . Although our site falls into NEC B, an argument could be made that noise levels will still be predictably dominated by road traffic noise, similar to the diurnal patterns experienced in busier road traffic areas (such as NEC C or D). As such, daytime noise levels have been established from the CRTN noise level predictions made by WYG Environment in this way.

Furthermore, given that no night-time road traffic levels were predicted, time-averaged night-time levels,  $LA_{eq,8hr}$ , have been calculated relative to the daytime noise predictions. From our extensive experience of the diurnal fluctuations in noise levels in areas where road traffic noise is dominant, there is typically a reduction of between 5-10dB from day to night-time average levels,  $LA_{eq,T}$ . To represent the worst-case, we have therefore assumed a difference of 5dB between daytime and night-time levels in our noise model. The road traffic prediction locations (determined by WYG Environment) that were used to calibrate our acoustic model are shown in the attached Figure 2.

### 4.2 Screening in Acoustic Model

In addition to the 2.5m acoustic fence to the west of the Fitzalan Link Road, described above, the following features were also included in the acoustic model:

- 1.8m solid timber garden fences were included to all residential gardens
- Existing 3m solid wooden fence between the eastern part of the school grounds and our site
- Existing 2m solid fence between the nursery and our site

Throughout our assessment we have not made any allowance for acoustic fencing to the site-side (east) of the Fitzalan Link Road – You will note in our subsequent analysis that suitable acoustic conditions can still be achieved without it being required.

### 4.3 Results

#### *Time-averaged Noise Levels*

The time-averaged day and night-time façade noise levels were calculated at a height of 4m, representing a worst-case for traffic noise for both the nearest houses and the apartment building on the western edge of the site. By assessing the two worst-case locations for apartments and houses, we were able to determine compliance of the whole development, as such, the assessment locations are shown in the attached Figure 3.

Table 3 – Predicted Time-Averaged Façade-incident noise levels at worst-case locations

| Measurement Position | Time-Averaged Noise Level, $L_{Aeq,T}$ |                            |
|----------------------|----------------------------------------|----------------------------|
|                      | Daytime (07:00 – 23:00)                | Night-time (23:00 – 07:00) |
| Worst-case Apartment | 59                                     | 54                         |
| Worst-case House     | 57                                     | 52                         |

#### *Maximum Noise Levels*

Given that maximum noise data was not available for the Fitzalan Link Road, as it has not yet been built, maximum noise data was used from a previous similar survey location, as measured at a distance of 3m from busy roads B4534 and A419 in Swindon, thereby being highly representative of the maximum noise levels expected from typical traffic activity. A maximum noise level of 91dB,  $L_{Amax}$  was measured during a 15-minute period of constant traffic. Therefore, when distance corrected to the nearest units located, resulting levels were 71dB,  $L_{Amax}$  at the apartment unit (30m from the nearest edge of the road) and 69dB,  $L_{Amax}$  at the house unit (37m from the nearest edge of the road).

#### *Summary of Future Traffic Noise from Fitzalan Road*

Given that the Fitzalan Link Road, which will be the dominant noise source across the site, has not yet been built, future noise predictions have been based on previous noise survey data and modelling undertaken by WYG Environment. The following points can be summarised from RBA's subsequent acoustic modelling for the proposed scheme:

- Resulting façade-incident noise levels at the worst-affected apartment units facing the Fitzalan Link Road are anticipated to be 59dB,  $L_{Aeq,16hr}$  (daytime), 54dB,  $L_{Aeq,8hr}$  (night-time) and up to 71dB,  $L_{Amax}$  for typical maximum events during the night-time.
- Resulting façade-incident noise levels at the worst-affected house nearest the Fitzalan Link Road are anticipated to be 57dB,  $L_{Aeq,16hr}$  (daytime), 52dB,  $L_{Aeq,8hr}$  (night-time) and up to 69dB,  $L_{Amax}$  for typical maximum events during the night-time.

## 5.0 SCHOOL ACTIVITY NOISE

Although not considered as a commercial enterprise, we have nonetheless considered noise emissions from the adjacent school (Littlehampton Academy). The main noise source is anticipated to be raised voices of the children, with the locations for worst-case noise emissions shown indicatively in the attached Figure 10.

The following predictions only include screening contributions from proposed residential fences, however the presence of existing fences bordering the school will provide further noise reduction.

### 5.1 Raised Voices

To predict the anticipated noise levels due to activity from the adjacent nursery and school, we can use guidance given in Building Bulletin 93 ('Acoustic Design for Schools') which states that a typical raised voice has an overall level of 66dB,  $L_{Aeq}$  as measured at 1m directly in front of the speaker.

### 5.2 School Activity Noise Prediction

During a site visit on Monday 7<sup>th</sup> December 2020, noticeable noise was only noted from the school during the lunch period, however on the day of the survey there was some light drizzle and low temperatures so it would not be representative of activity during more clement periods.

Furthermore, through additional liaison with the school, we understand restrictions are in place due to the Covid-19 Pandemic to stagger the daily schedule of different age groups. The below timetable has been provided by Ian Lineham (Director of Resources, The Littlehampton Academy):

Table 4 – School Timetable for The Littlehampton Academy (Current Covid-19 staggering schedule)

| Year group | P1 + P2     | Break       | P3 + P4     | Lunch       | P5          |
|------------|-------------|-------------|-------------|-------------|-------------|
| Y7         | 08:30-10:30 | 10:30-11:00 | 11:00-13:00 | 13:00-13:30 | 13:30-14:30 |
| Y8         | 08:35-10:35 | 10:35-11:05 | 11:05-13:05 | 13:05-13:35 | 13:35-14:35 |
| Y9         | 08:40-10:40 | 10:40-11:10 | 11:10-13:10 | 13:10-13:40 | 13:40-14:40 |
| Y10        | 08:45-10:45 | 10:45-11:15 | 11:15-13:15 | 13:15-13:45 | 13:45-14:45 |
| Y11        | 08:50-10:50 | 10:50-11:20 | 11:20-13:20 | 13:20-13:50 | 13:50-14:50 |
| Y12 & Y13  | 08:55-10:55 | 10:55-11:25 | 11:25-13:25 | 13:25-13:55 | 13:55-14:55 |

Although the specific schedules vary depending on the year group, it is clear that a typical school day (during non-pandemic periods) would consist of two 30-minute breaks every day during which pupils would be outside for a prolonged period.

As a worst-case assessment, we have predicted noise levels during a break-time during the warmest periods of the year, during which the majority of school children are likely to be outside. It is notable that there is a large playing field to the north of site where we anticipate most students would congregate during the warmest periods (where noise would be significantly screened by the school buildings) therefore we only assessed noise from the nearest outdoor play yard to the south-east corner of the site and have assumed a worst-case situation of 100no. children playing and that, at any given moment, half of those children would simultaneously have raised voices and be facing the direction of the nearest proposed residential units – Note that in reality, we do not expect this situation to arise regularly. During such a period, assuming an average distance of 15m between the nearest children in the school yard and a position 2m from the rear of a future occupant's garden (at a standing height of 1.5m) we predict noise levels due to children playing to be 53dB,  $L_{Aeq}$ . This resulting noise level both meets the external amenity area noise target of 50-55dB given

in BS8233:2014. Furthermore, from an annoyance perspective, the sound of children playing is generally considered to be a pleasant sound so further reduces any risk of future noise disturbance.

Note that for all units, whose gardens are not directly adjacent to the school, external noise levels will be comfortably below 55dB, L<sub>Aeq</sub>. Also, although not included in our predictions, the presence of a large, dense existing timber fence to the south-west corner of the outdoor yard (and an existing building), noise would likely be further screened to houses with no line-of-sight to the yard.

### 5.3 Summary of School Activity Noise

The predicted resulting noise levels from the adjacent school are not deemed to cause any significant concerns from a noise perspective due to the following:

- Predicted resulting noise levels in External Amenity Areas meet the BS8233:2014 criteria
- Worst-case façade noise levels are well below the thresholds for increased glazing/ventilation systems, meaning internal noise levels would still be comfortably met with background ventilation.
- The sound of children playing is generally considered to be a pleasant sound so risk of future noise disturbance is further reduced.

All noise emissions occur during daytime periods and would not occur on weekends for school noise nor any time after 15:00 meaning evenings and weekends would largely be unaffected by noise from these sources.

## 6.0 NURSERY ACTIVITY NOISE

Although not considered as a commercial enterprise, we have nonetheless considered noise emissions from the adjacent nursery (Littlehampton Day Nursery). Following feedback from the EHO in June 2021, a more robust noise survey was undertaken at the Nursery

### 6.1 Initial Desktop Assessment of Nursery Activity Noise

The main noise source is anticipated to be raised voices of the children, with the locations for worst-case noise emissions shown indicatively in the attached Figure 3. The following predictions only include screening contributions from proposed residential fences, however the presence of existing fences bordering the nursery and school will, in reality, provide further noise reduction.

During a site visit on Monday 7<sup>th</sup> December 2020, no noise was noted from the nursery, however on the day of the survey there was some light drizzle and low temperatures so it would not be representative of activity during more clement periods.

Having liaised directly with the manager of Littlehampton Day Nursery we understand the Nursery typically operates from 08:30-17:30 and incorporates a combination of indoor and outdoor play, however during the warmer periods, the majority of the day would be spent with the children outside with an anticipated upper limit of around 40no. children playing at any one time. Typically, the children are brought inside the premises between 11:30-13:00 to eat lunch. The intake of children is between the ages of 3months to 5 years.

Therefore, as a worst-case assessment, we have assumed the warmest periods, during which nursery children are likely to be outside for a large proportion of the day. We have also assumed a worst-case situation of all 40no. children being outside and that, at any given moment, half of those children would simultaneously have raised voices and be facing the direction of the nearest proposed residential units – Note that, in reality, we do not expect this situation to arise regularly. During such a period, assuming an average distance of 5m between the nearest children in the nursery and a position 2m from the rear of a future occupant's garden (at a standing height of 1.5m) we predict noise levels due to children playing to be 54dB,  $L_{Aeq}$ . This resulting noise level both meets the external amenity area noise target of 50-55dB given in BS8233:2014. Furthermore, from an annoyance perspective, the sound of children playing is generally considered to be a pleasant sound so further reduces any risk of future noise disturbance.

Note that for all units, whose gardens are not directly adjacent to the nursery, resulting external noise levels due to nursery noise will be comfortably below 55dB.  $L_{Aeq}$ .

## 6.2 Additional Noise Survey of Nursery Activity Noise

Following feedback from the EHO in June 2021, a noise assessment was undertaken at site over 3 working days, to ensure that representative noise levels were obtained in relation to the nursery activity. The survey consisted of unattended measurements of activity noise in the outdoor play area of the nursery from 10:15 on Monday 2<sup>nd</sup> August to 10:15 on Thursday 5<sup>th</sup> August 2021. Due to security reasons, the meter was brought inside during evening periods and then re-positioned externally each morning by the nursery staff. The survey position, shown in Figure 3, was located at a distance of 1m from the adjacent fence and therefore includes façade reflections. The survey location was selected to pick up both noise from the nursery building, as well as external noise of the children playing. Photos of the measurement positions are shown in the attached Figure 11.

The unattended noise measurements were initially façade corrected [-3dB] to account for the reflections received from the adjacent fence during the survey. The worst-case noise source from the children playing was assumed to be at a distance of 2m from the microphone. For noise level predictions to a position 2m

inside the gardens, a distance correction from 2m to 5m was applied, as well as a 5dB line-of-sight screening loss. The resulting noise level predictions are shown in Table 5, below.

To predict noise levels at the nearest facades, the façade-corrected noise levels received a distance correction from 2m to 14m. To then predict internal levels a typical noise reduction of 12dB has been applied. The resulting noise level predictions are shown in Table 5, below.

Table 5 – Measured and Predicted Nursery Activity Noise Levels

| Day           | Facade corrected measured ambient noise level<br>$L_{Aeq,1hr}$ [dB] | Resulting noise level in gardens<br>$L_{Aeq,1hr}$ [dB] | Resulting facade levels<br>$L_{Aeq,1hr}$ [dB] | Resulting internal noise level with open windows<br>$L_{Aeq,1hr}$ [dB] |
|---------------|---------------------------------------------------------------------|--------------------------------------------------------|-----------------------------------------------|------------------------------------------------------------------------|
| Mon 02 Aug 21 | 58                                                                  | 45                                                     | 42                                            | 30                                                                     |
| Tue 03 Aug 21 | 55                                                                  | 42                                                     | 39                                            | 27                                                                     |
| Wed 04 Aug 21 | 58                                                                  | 45                                                     | 42                                            | 30                                                                     |
| Thu 05 Aug 21 | 56                                                                  | 43                                                     | 39                                            | 27                                                                     |

Note: The above measurements were undertaken with 12no. children in the Nursery. Assuming a linear increase in noise for full capacity (40no. children), then the above measurements would be increased by 5dB.

As such, on the basis of the above noise level predictions, even when including the 5dB correction for a full capacity nursery, the resulting noise levels in the gardens still meet the target level of 50dB,  $L_{Aeq}$ . Furthermore, internal noise levels in the nearest habitable rooms of the adjacent houses would also meet the daytime noise limit of 35dB,  $L_{Aeq}$ . It should be noted that the above noise predictions include contributions from all nursery activity, including the use of children's cars on the wooden bridge and other noise-generating activity.

### 6.3 Summary of Nursery Activity Noise

The predicted resulting noise levels from the adjacent nursery are not deemed to cause any significant concerns from a noise perspective due to the following:

- Predicted resulting noise levels in External Amenity Areas meet the BS8233:2014 criteria
- Worst-case façade noise levels are well below the thresholds for increased glazing/ventilation systems, meaning internal noise levels would still be comfortably met with background ventilation.
- The sound of children playing is generally considered to be a pleasant sound so risk of future noise disturbance is further reduced.

All noise emissions occur during daytime periods and would not occur on weekends (for school noise) nor any time after 15:00 (for the school) and 17:30 (for the nursery) meaning evenings and weekends would largely be unaffected by noise from these sources.

## 7.0 EXTERNAL BUILDING FABRIC ASSESSMENT

### 7.1 Background

Analyses of the external noise levels have been undertaken in order to ascertain that the proposed acoustic performances of the external building fabric will comply with the acoustic criteria given in BS8233:2014.

### 7.2 Assumptions

Our external building fabric analyses have assumed the following:

#### (a) Drawings

The assessment has been based on the information provided in the following drawings:

- Little SK06 rev D (Illustrative Site Plan) produced by ECE architects

#### (b) Noise Levels

The assessment has been based on the CadnaA acoustic model which was calibrated using the predicted noise levels given in WYG Environment's report ('Discharge of Condition 18 Fitzalan Link Road, North Littlehampton Rev 2, dated 29/07/16) detailing future anticipated road noise emissions from the Fitzalan Road Link.

#### (c) Room Absorption

The bedrooms are assumed to be acoustically "soft" with carpets, curtains and other soft furnishings. For the purposes of our analyses, we have assumed the absorption coefficients detailed in Tables 5 and 6.

Table 5 – Bedroom Absorption Coefficients

| Absorption Coefficient (α) at Octave Band Centre Frequency (Hz) |      |      |      |      |      |      |      |
|-----------------------------------------------------------------|------|------|------|------|------|------|------|
| 63                                                              | 125  | 250  | 500  | 1k   | 2k   | 4k   | 8k   |
| 0.15                                                            | 0.18 | 0.25 | 0.27 | 0.31 | 0.32 | 0.32 | 0.32 |

The living rooms are assumed to be less acoustically absorptive (with a hard floor finish, although with furnishings). For the purposes of our analyses we have assumed the following absorption coefficients.

Table 6 – Living Room Absorption Coefficients

| Absorption Coefficient (α) at Octave Band Centre Frequency (Hz) |      |      |      |      |      |      |      |
|-----------------------------------------------------------------|------|------|------|------|------|------|------|
| 63                                                              | 125  | 250  | 500  | 1k   | 2k   | 4k   | 8k   |
| 0.15                                                            | 0.18 | 0.20 | 0.22 | 0.22 | 0.22 | 0.23 | 0.27 |

## (d) External Wall

We understand external non-glazed areas are to comprise the following:

- 1No. layer 15mm fireboard (11.7kg/m<sup>2</sup>)
- 1No. layer 13mm standard density plasterboard (8.3kg/m<sup>2</sup>)
- 45mm timber batten with 50mm mineral wool insulation in void (10-36kg/m<sup>3</sup>)
- 1No. layer 12mm particleboard (15kg/m<sup>2</sup>)
- 170mm independent timber studs with 175mm mineral wool insulation in void (10-36kg/m<sup>3</sup>)
- 1No. layer 12mm particleboard (15kg/m<sup>2</sup>)
- Façade batten + board according to specification

As such, we have assumed the following sound reduction indices (equating to an overall  $R_w$  of 53dB) for all non-glazed façade areas comprising the above construction:

Table 7- Non-Glazed SRIs

| Assumed Sound Reduction Index (dB) at Octave Band Centre Frequency (Hz) |     |     |     |    |    |    |    |
|-------------------------------------------------------------------------|-----|-----|-----|----|----|----|----|
| 63                                                                      | 125 | 250 | 500 | 1k | 2k | 4k | 8k |
| 21                                                                      | 32  | 45  | 55  | 55 | 55 | 55 | 55 |

Should the proposals for non-glazed areas change, it is critical we are informed at the earliest opportunity as this could have a significant impact on the sound insulation performance requirements of the glazing systems.

## (e) Acoustic Bund/Fence

Note that no additional acoustic fence has been proposed between the Fitzalan Link Road and the proposed site as the screening is deemed to have a marginal impact on the development acoustically and resulting noise levels are still considered to meet the target criteria.

## (f) Ventilation Type

Mechanical Extract Ventilation (MEV) is proposed which utilises trickle ventilators, however results in higher ventilation rates due to the increased pressure differential generated by extract ventilation in various rooms of the unit. Therefore, the trickle ventilator performance specifications are given in the following section although this still constitutes a form of mechanical ventilation.

### 7.3 Glazing and Ventilator Specification and Guidance Constructions

We would note that the overall performance and internal noise levels are determined by the amount of wall area exposed, the window opening size and the number of trickle ventilators provided.

In addition to the average daytime and night-time average  $L_{eq,T}$  noise levels, consideration has also been given to the maximum noise levels generated by discrete events which occur during the night-time period, as determined in Section 3.3.

Given that the entire site permits the use of the Boklok Standard unit types, as shown in attached Figure 7, the following façade treatment can be utilised across the whole scheme:

Table 8– Guidance Glazing Construction

| Boklok Specification | Glazing Configuration                                                                                                        | $R_w$ (dB) |
|----------------------|------------------------------------------------------------------------------------------------------------------------------|------------|
| Standard             | Standard thermal acoustically-rated double glazing with differing pane thicknesses, e.g. 4mm glass / 12mm cavity / 8mm glass | 34         |

For guidance purposes we would typically expect the following trickle ventilator types to prove commensurate with achieving the sound insulation performance specification detailed within Appendix B.

Table 9– Guidance Trickle Ventilator Type

| Boklok Specification | Example Ventilator Type                                                         | $D_{p,w}$ (dB) |
|----------------------|---------------------------------------------------------------------------------|----------------|
| Standard             | Any standard “through-the-frame” type trickle ventilator with indirect air path | 34             |

## 7.4 Façade Treatment Zone

All units fall within the same acoustic treatment zone with regards to glazing & ventilation specification.

## 7.5 External Amenity Areas

### General

Noise predictions were also determined in the proposed external amenity areas located across the site. The resulting daytime noise levels at a height of 1.5m across the site are shown in Figure 8. We understand that the initial position of ADC is that noise levels in external amenity spaces should ideally not exceed a level of 50dB,  $L_{Aeq,16hr}$  during daytime periods.

As clarified in Section 2.6 above, although a target of noise levels between 50-55dB,  $L_{Aeq,T}$  is desirable, that such guidelines limits are not achievable in noisier environments. Furthermore the standard mentions that:

*“In higher noise areas, such as city centres or urban areas adjoining the strategic transport network, a compromise between elevated noise levels and other factors, such as the convenience of living in these locations or making efficient use of land resources to ensure development needs can be met, might be warranted. In such a situation, development should be designed to achieve the lowest practicable levels in these external amenity spaces, but should not be prohibited.”*

Based on the above wording, it is acknowledged that the slightly higher threshold of 55dB would be acceptable in noisier environments; the wording goes on to clarify that this limit could be relaxed further where proximity to nearby transport networks (i.e.: the Fitzalan Link Road in this case) cannot be avoided.

We therefore feel the predicted levels are suitable, given that these marginally higher levels are only experienced in a small number of gardens. With regards to the apartment on the western edge of site, the main amenity area for residents in this block will be the central area located at the centre of the site between the two blocks of house (as highlighted in Figure 8), where noise levels will be comfortably below 50dB,  $L_{Aeq,16hr}$ .

Following the feedback from the EHO in June 2021, further modelling was undertaken to determine whether increased fence heights to the 4no. gardens at the north-western corner of the site could reduce resulting noise levels in the gardens to below 50dB. Further modelling was undertaken with the rear fences to these 4no. gardens having an aesthetically unrealistic worst-case height of 2.4m (where typically they are 1.8m across the site). The resulting noise levels in these gardens still between 50-55dB in some areas, therefore indicating that the increase in height would only further reduce noise level by around 2-3dB. As such, given that the increase in height of these fences will have other design implications (e.g. aesthetic/sunlight), it is not deemed that this undesirable design change would warrant the relatively small acoustic improvement of 2-3dB. As such, on the basis of this further modelling, it is deemed that the existing design of 1.8m fences is still acoustically suitable.

### **Balconies**

It should be noted that no balconies are proposed for the house units. Small balconies are proposed for the apartment units, therefore consideration has been given to those small balconies which are overlooking the proposed Fitzalan Link Road. The following clarification is given in BS8233:2014:

*"Other locations, such as balconies, roof gardens and terraces, are also important in residential buildings where normal external amenity space might be limited or not available, i.e. in flats, apartment blocks, etc. In these locations, specification of noise limits is not necessarily appropriate. Small balconies may be included for uses such as drying washing or growing pot plants, and noise limits should not be necessary for these uses."*

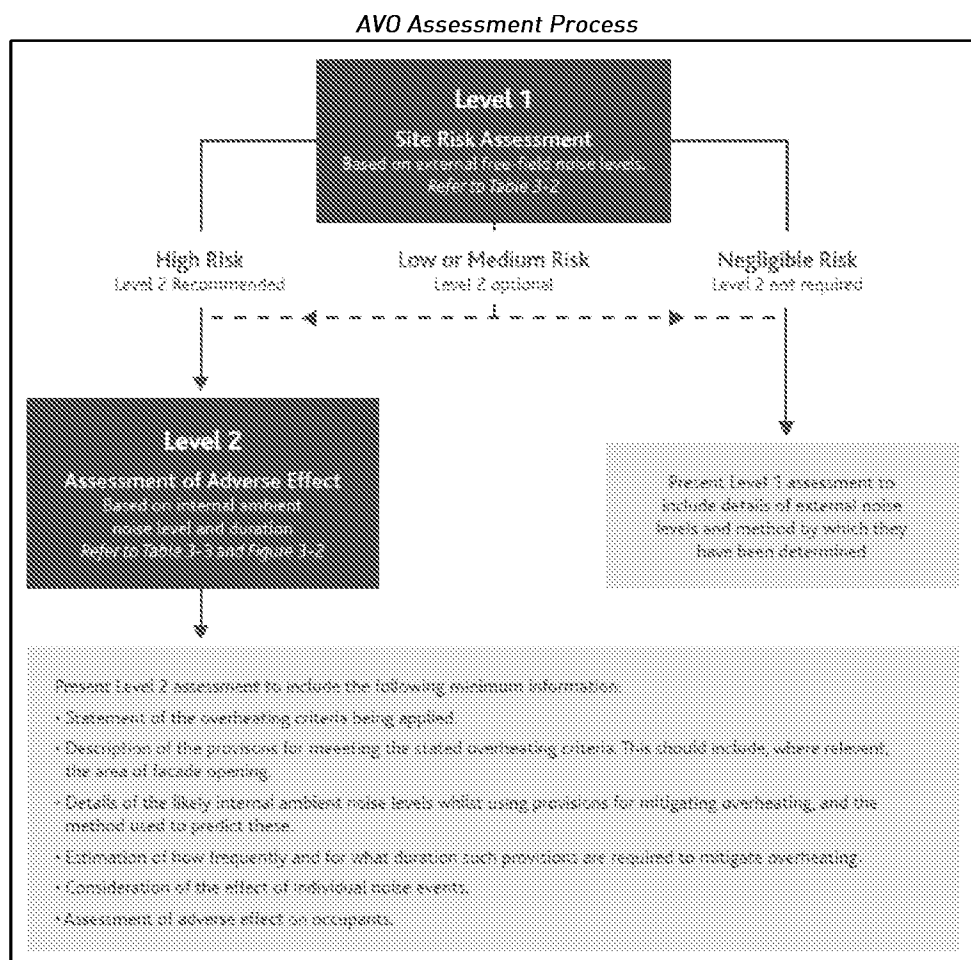
As such, we would recommend that the balcony proposals are suitable. Furthermore, any of the initial proposals to include low-level barrier screening to the east of the Fitzalan Link Road would provide no noise reduction for the upper floors of this block.

## 8.0 ACOUSTICS, VENTILATION & OVERHEATING (AVO)

As part of our acoustic assessment of the proposed development we have also given consideration to the risk of overheating, relating to acoustics.

Many buildings require closed windows to provide good internal acoustic conditions, however, opening a window is the normal way to keep a building cool during the warmer summer months. These opposing requirements have become a major issue in the design of buildings, in particular for housing, especially given the general desire to avoid the widespread use of mechanical cooling.

The recently released Acoustics Ventilation & Overheating (AVO) guide by the Association of Noise Consultants (ANC) attempts to address this increasingly urgent need for an integrated approach to consider noise, ventilation, and overheating. The guide involves a two-level approach to addressing issues of overheating with respect to noise:



The following section presents our Level 1 assessment in order to determine risk of overheating at this site due to noise issues.

## 8.1 AVO Level 1 Assessment

### Criteria

In order to assess the possibility of overheating within the development it is necessary to predict internal ambient noise levels and compare these with the criteria set by BS 8233:2014 *Guidance on Sound insulation and noise reduction for buildings* as shown in Table 1. In line with the guidance provided by BS8233:2014 it is appropriate to increase these values by 5dB to account for the natural increase in internal ambient noise levels from opening a window.

Based on the above the AVO guide seeks to determine the level of risk associated with overheating within a new development based on the developments surrounding noise climate. The AVO risk categories and their associated noise levels are detailed below:

Table 10 – AVO Level 1 Risk Assessment Guide

| Daytime Noise Levels<br>[L <sub>Aeq</sub> 07:00-23:00] | Night-time Noise Levels<br>[L <sub>Aeq</sub> 23:00-07:00] | Risk Category   | Mitigation                                                                                                                                   |
|--------------------------------------------------------|-----------------------------------------------------------|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------|
| ≤ 53 dBA                                               | ≤ 48 dBA                                                  | Negligible Risk | None required – openable windows suitable for ventilation                                                                                    |
| 54 – 62 dBA                                            | 49 – 54 dBA                                               | Low/Medium Risk | Level 2 assessment optional in order to give more confidence regarding the suitability of internal noise conditions                          |
| ≥ 63 dBA                                               | ≥ 55 dBA                                                  | High Risk       | Level 2 assessment recommended. Windows which are unopenable on grounds of noise will inevitably create issues for the overheating strategy. |

The AVO risk category associated with the different facades of the developments have been shown in the attached Figure 9.

**Abstract**

It can be seen from analysis of the attached Figure 9 that the majority of the site falls into the Negligible Risk category with regards to overheating risk. In these areas it should be considered acceptable for openable windows to provide sufficient relief from overheating.

A small number of apartment and house units located nearest to the proposed Fitzalan Link Road fall within the Low/Medium risk category with several units on the west façade of the apartment building falling within the High Risk category on the basis of night-time noise levels. For these units, it is necessary to understand in more detail what the overheating risks are based on the site location, orientations/heights of the buildings and façade arrangements. This requires detailed modelling studies to be undertaken by an energy & sustainability consultant, in accordance with TM59 '*Design methodology for the assessment of overheating risk in homes*', before further advice may be provided on the likelihood of more robust ventilation and acoustic attenuation measures being required. It should be noted that the Boklok design of their pre-fabricated units has been tested and demonstrated that the risk of overheating was a relatively low risk. As such windows are unlikely to be required to be opened for any significant length of time to overcome heating issues.

Given that areas of the development have been identified as 'High Risk' with regards to ventilation and overheating, it would be prudent to undertake a Level 2 AVO assessment at a later design stage. Such an assessment would help to ensure that issues relating to acoustics/overheating have been address early into the design process.

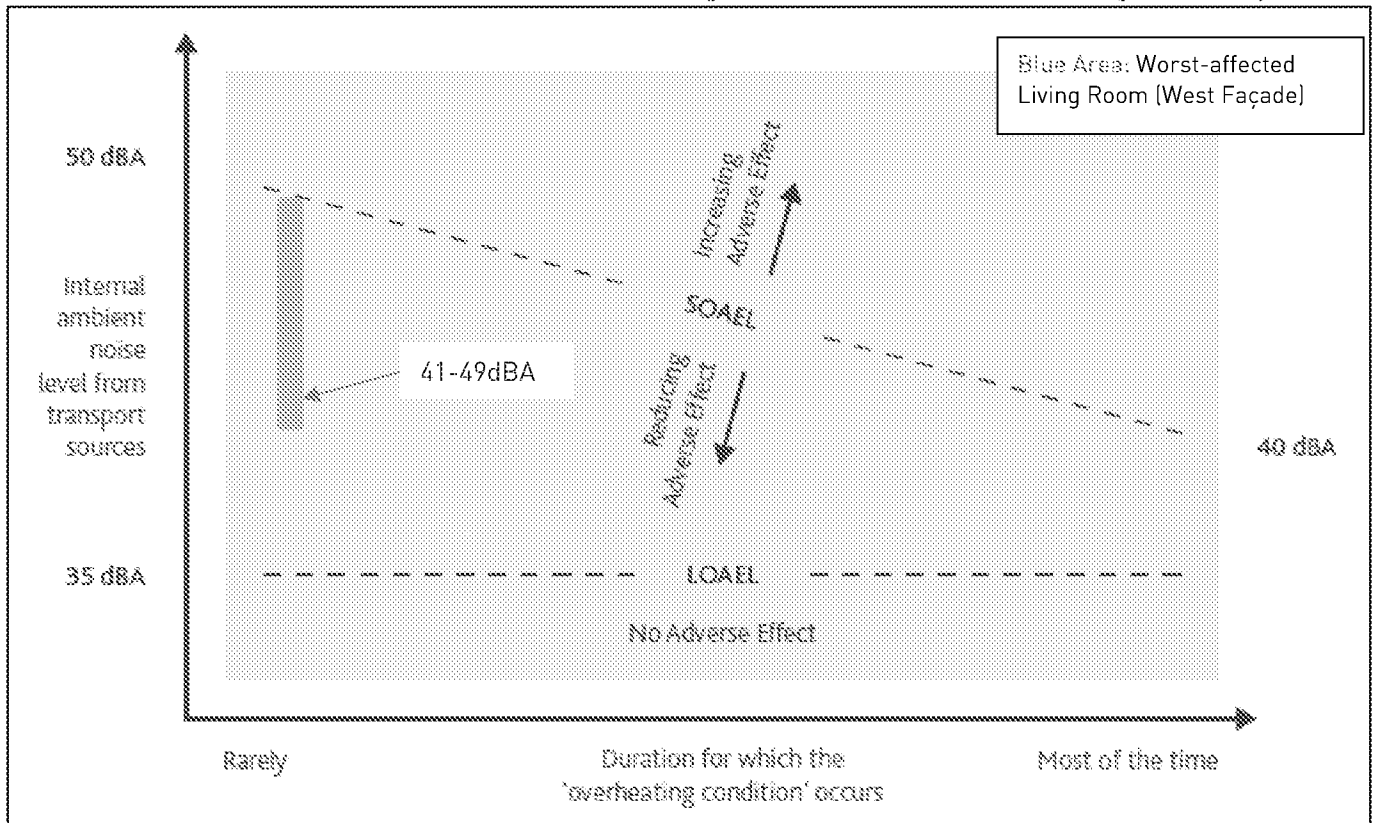
### Noise Ingress due to Balcony Doors

Although a full AVO Level 2 assessment has not been undertaken at this stage of the design, we have provided further detail below relating to the usage of balcony doors and resulting internal ambient noise levels. Given the prefabricated nature of Boklok units, an overheating assessment has been undertaken as part of the overall Boklok apartment design scheme for south-facing properties (worst-case for overheating) and this indicated that south facing rooms would only experience an overheating condition for 5% of the time during the daytime – During such a condition, windows and/or balcony doors could be opened to provide additional purge ventilation. Considering this, in our assessment we have assumed south-facing units (on the worst-case façade) would experience the overheating condition for 10% of the time, as a worst-case assessment. In the proposed scheme at Littlehampton, due to the layout of the apartment building, the worst-case for noise ingress during overheating is the west-façade, overlooking the proposed Fitzalan Link Road, however we have used the above 10% to ensure the assessment is worst-case.

For our assessment, we have assumed a noise reduction of between 10dB (fully open) to 18dB (partially open) from a balcony door – such levels are based on noise reduction figures given in BS8233:2014 and the relevant DEFRA study ('Sound Insulation through Ventilated Domestic Windows, dated February 2006). Balconies are only connected to living areas used during the daytime, therefore we are only concerned with daytime façade-incident noise levels, which are 59dB,  $L_{Aeq,16hr}$  in the worst-case location. We have therefore predicted worst-case internal noise levels of between 41-49dB,  $L_{Aeq,16hr}$ .

BS8233:2014 states that where openable windows are used as a means of natural ventilation (which is equivalent to having balcony doors open) the internal noise level criteria can be relaxed by 5dB, to account for the inherently lower noise reduction available. As such, with the 5dB relaxation, the internal daytime noise criterion would be 40dB,  $L_{Aeq,10hr}$  meaning the predicted level in the worst-affected unit would exceed this target by between 1-9dB. However, it is acknowledged that some exceedance of this criterion can be deemed acceptable subject to the frequency that it occurs – To help all parties involved (e.g.: clients, design teams, Local Authorities) to determine what is acceptable, the following table (Figure A) given in the AVO Guidelines can be consulted:

Figure A – Level 2 Assessment (Living Rooms Daytime Leq)



The results of the above assessment show that:

- Noise levels within Living Rooms to the unit will be acceptable even if windows or balcony doors are opened given that this is only likely to occur for 10% of the time (worst-case)

As these are the worst affected rooms, it can be assumed the conditions elsewhere across the site would be equally acceptable.

## 9.0 SUBSTATION PLANT NOISE

The proposed substation is located close to the proposed Fitzalan Link Road at the south-west corner of site, as shown in the attached Figure 10. The substation is located at a distance of 21m from the nearest window of the apartment buildings.

The precise details of the proposed transformer are not currently available, however, RBA Acoustics has previously measured noise levels associated with the operation of 500kVA transformer located within a similar size plant room and the measured a reverberant sound pressure level of 53dB,  $L_{p,rev}$ . In our experience this is a fairly typical size installation for a residential development and is therefore considered sufficient for the purposes of our assessment.

A 6dB correction is applied to account for the conversion of a reverberant level to a free-field sound pressure level at 1m from the louvred door of the unit. A further 26dB correction is made to account for the distance loss of 21m. The resulting predicted noise level at the nearest receptor window would therefore be 26dB,  $L_p$ .

Note that due to the Fitzalan Link Road not yet being fully constructed or operational, current noise levels across the site will be significantly lower than future noise levels. Furthermore, although ambient noise level predictions were available, no future noise predictions were made for the background noise ( $L_{A90}$ ). However, during a recent site survey a background noise level of 46dB,  $L_{A90}$  was measured during the middle of the day in the approximate location of the nearest receptor. Given that there is typically a difference of 3-5dB between day and night background noise levels adjacent to a road, then a resulting night-time background noise level prediction of 41dB,  $L_{A90}$  is determined.

As such, given that the substation transformer noise levels prediction is 15dB below the predicted night-time background noise level, then no issues of noise disturbance are anticipated.

## 10.0 DISCUSSION

### 10.1 Western Site Boundary Acoustic Screen

It is understood that initial recommendations for an acoustic screen were proposed by ADC, however our above assessment has demonstrated that suitable noise levels can be achieved without the need for such a screen. This includes assessment of internal resulting noise levels (in line with BS8233:2014 and WHO Guidelines) as well as external amenity areas largely achieving the target 50dB,  $L_{Aeq,16hr}$ . It should be noted in the small number of gardens where noise levels are predicted to be between 50-55dB,  $L_{Aeq,16hr}$ , the inclusion of an additional screen adjacent to the Fitzalan Link Road would likely have a marginal impact on the resulting noise levels, given that the gardens are already surrounded by 1.8m fences.

Furthermore, the inclusion of such a screen would provide little to no screening to the upper 2-3 storeys of the apartment building which is nearest to the Fitzalan Link Road, thereby rendering it's benefit in these areas virtually negligible.

### 10.2 Amenity Space Noise

On the basis of our analyses, we have determined that the majority of site will experience noise levels in external amenity areas/gardens that are comfortably below 50dB,  $L_{Aeq,16hr}$ . In a small number of gardens, noise levels will be between 50-55dB,  $L_{Aeq}$  which is commonly accepted as suitable for relaxing, and aligns with the guidance given in BS8233:2014 and WHO Guidelines for Community Noise. Given the context of living marginally closer to a main road, occupants expectation to hear some road traffic noise will naturally be higher, therefore the likelihood of complaints or disturbance from road traffic is low. Further analysis has also identified that a marginal improvement to noise levels could be achieved through the use of aesthetically unrealistic fence heights of 2.4m but would still result in noise levels above 50dB; as such, when considered in light of other design implications for the gardens (e.g. aesthetic/sunlight), the current design of 1.8m fences is proposed.

### 10.3 Summary of Glazing & Ventilation Proposals

The resultant predicted noise levels have been used in the assessment of the glazing requirements to ensure suitable internal noise levels are achieved at the proposed development with reference to BS 8233 and WHO. Resulting façade noise levels across the site were suitable for the prefabricated Boklok unit type 'Standard' specification - The proposed glazing & ventilation specifications for this unit type are commensurate with achieving suitable internal noise levels in line with the above target criteria.

General guidance configurations have been suggested for the glazing constructions that should be capable of achieving the required specifications detailed within Appendix B. A configuration of 4/12/8 double glazing and standard trickle ventilators are recommended to all units.

## 11.0 CONCLUSION

RBA Acoustics have undertaken an assessment at the proposed development site at the land South of Littlehampton Academy, Littlehampton. Noise levels have been predicted across the site using 3D acoustic modelling software (CadnaA), based on road traffic noise level predictions produced by WYG Environment.

Our assessment has demonstrated that the proposed site layout and BoKlok unit selections will result in external and internal noise levels across the site which meet the proposed noise criteria given in WHO Guidelines for Community Noise and BS8233:2014, with units in the centre of the development being comfortably within these limits. Our assessment has given additional consideration to the acoustic guidance given in the Arun Design Guide SPD (April 2020), the Adoption Arun Local Plan 2011-2031 (July 2018), Planning Noise Advice Document Sussex (2015) and the National Planning Policy Framework to ensure the scheme is acoustically robust.

Additionally, assessment of potential noise from the adjacent nursery and school has shown that resulting absolute noise levels would meet the external amenity areas noise criteria.

We have therefore demonstrated that the scheme is suitable for Planning Approval on the grounds of Acoustics.

# Appendix A - Acoustic Terminology

|                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|----------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| dB                                     | Decibel - Used as a measurement of sound pressure level. It is the logarithmic ratio of the noise being assessed to a standard reference level.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| dB(A)                                  | The human ear is more susceptible to mid-frequency noise than the high and low frequencies. To take account of this when measuring noise, the 'A' weighting scale is used so that the measured noise corresponds roughly to the overall level of noise that is discerned by the average human. It is also possible to calculate the 'A' weighted noise level by applying certain corrections to an un-weighted spectrum. The measured or calculated 'A' weighted noise level is known as the dB(A) level. Because of being a logarithmic scale noise levels in dB(A) do not have a linear relationship to each other. For similar noises, a change in noise level of 10dB(A) represents a doubling or halving of subjective loudness. A change of 3dB(A) is just perceptible. |
| $L_{eq}$                               | $L_{eq}$ is defined as a notional steady sound level which, over a stated period of time, would contain the same amount of acoustical energy as the actual, fluctuating sound measured over that period (1 hour).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| $L_{Aeq}$                              | The level of notional steady sound which, over a stated period of time, would have the same A-weighted acoustic energy as the A-weighted fluctuating noise measured over that period.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| $L_{An}$ (e.g. $L_{A10}$ , $L_{A90}$ ) | If a non-steady noise is to be described it is necessary to know both its level and the degree of fluctuation. The $L_n$ indices are used for this purpose, and the term refers to the level exceeded for n% of the time, hence $L_{10}$ is the level exceeded for 10% of the time and as such can be regarded as the 'average maximum level'. Similarly, $L_{90}$ is the average minimum level and is often used to describe the background noise.                                                                                                                                                                                                                                                                                                                           |
| $L_{max}$ /                            | The instantaneous maximum sound pressure level which occurred during the measurement period, T. It is commonly used to measure the effect of very short duration bursts of noise, such as for example sudden bangs, shouts, car horns, emergency sirens etc. which audibly stand out from the general level of, say, traffic noise, but because of their very short duration, maybe only a very small fraction of a second, may not have any effect on the $L_{eq}$ value.                                                                                                                                                                                                                                                                                                    |

# Appendix B – External Building Fabric Acoustic Specification

External facade constructions and components, such as brise soleil, grilles, ventilators, curtain walling systems or other architectural features, are not to give rise to intrusive whistling, creaking, rattling or other noises as a result of wind or other climatic effects.

The Contractor shall take reasonable precautions to avoid unwanted noise including creaking, rattling and whistling being generated by the Contractors works when subject to environmental conditions (including wind) and thermal expansion over the life of the façade.

## 1.0 Window Sound Insulation Performance

Glazed units (inclusive of glazing, louvres, timber panels, spandrel panels, infill panels, framing, opening lights, balcony/terrace doors, seals, etc. as appropriate) should achieve the following minimum sound reduction indices as tested in general accordance with BS EN ISO 10140-2:2010:

| Boklok Glazing Type | Minimum Recommended Sound Reduction Index (dB) at Octave Band Centre Frequency (Hz) |     |     |     |    |    |    |    | R <sub>w</sub> (dB) |
|---------------------|-------------------------------------------------------------------------------------|-----|-----|-----|----|----|----|----|---------------------|
|                     | 63                                                                                  | 125 | 250 | 500 | 1k | 2k | 4k | 8k |                     |
| Standard            | 19                                                                                  | 26  | 22  | 28  | 38 | 41 | 42 | 42 | 34                  |

Note: R<sub>w</sub> is the “overall weighted sound reduction index” tested in a laboratory.

N.B. as the internal noise criteria are expressed in dBA terms, other frequency-specific performance levels may ultimately prove acoustically acceptable. Test data for representative samples of all glazing systems shall be submitted to RBA Acoustics for approval to demonstrate compliance with the above performance specifications.

## 2.0 Trickle Ventilator Sound Insulation Performance

Trickle ventilators (in their open state) should achieve the following minimum element-normalised level differences as tested in accordance with BS EN 20140-10:1992:

| Boklok Ventilation Type | Minimum Recommended D <sub>n,e,w</sub> (dB) at Octave Band Centre Frequency (Hz) |     |     |     |    |    |    |    | D <sub>n,e,w</sub> (dB) |
|-------------------------|----------------------------------------------------------------------------------|-----|-----|-----|----|----|----|----|-------------------------|
|                         | 63                                                                               | 125 | 250 | 500 | 1k | 2k | 4k | 8k |                         |
| Standard                | 22                                                                               | 28  | 31  | 34  | 33 | 31 | 31 | 31 | 33                      |

Note: D<sub>n,e,w</sub> is the “overall weighted element normalised level difference” tested in a laboratory.

N.B. as the internal noise criteria are expressed in dBA terms, other frequency specific performance levels may ultimately prove acoustically acceptable. Test data for the trickle vents in their open state shall be submitted to RBA Acoustics for approval.

## Appendix C - Instrumentation

The following equipment was used for the RBA survey measurements:

| Manufacturer                      | Model Type | Serial No. | Calibration     |                  |
|-----------------------------------|------------|------------|-----------------|------------------|
|                                   |            |            | Certificate No. | Valid Until      |
| Norsonic Type 1 Sound Level Meter | Nor140     | 1406116    | U36615          | 17 December 2022 |
| Norsonic Pre Amplifier            | 1209       | 20295      |                 |                  |
| Norsonic ½" Microphone            | 1225       | 344468     | 36614           | 17 December 2022 |
| Norsonic Sound Calibrator         | 1251       | 34307      | U36613          | 17 December 2022 |

| Manufacturer                      | Model Type | Serial No. | Calibration     |                |
|-----------------------------------|------------|------------|-----------------|----------------|
|                                   |            |            | Certificate No. | Valid Until    |
| Norsonic Type 1 Sound Level Meter | Nor140     | 1403226    | U36698          | 5 January 2023 |
| Norsonic Pre Amplifier            | 1209       | 12556      | U36695          | 4 January 2023 |
| Norsonic ½" Microphone            | 1225       | 25179      |                 |                |
| Norsonic Sound Calibrator         | 1251       | 31988      | U36696          | 4 January 2023 |

| Manufacturer                      | Model Type | Serial No. | Calibration     |               |
|-----------------------------------|------------|------------|-----------------|---------------|
|                                   |            |            | Certificate No. | Valid Until   |
| Norsonic Type 1 Sound Level Meter | Nor140     | 1406258    | U37479          | 24 March 2023 |
| Norsonic Pre Amplifier            | 1209       | 20490      |                 |               |
| Norsonic ½" Microphone            | 1225       | 225526     | 37478           | 24 March 2023 |
| Norsonic Sound Calibrator         | 1251       | 34397      | U37477          | 24 March 2023 |

## Appendix D – CDM Considerations

The likelihood the harm will occur can be assessed by applying an indicative score (from 1 to 5) as follows:

- 1 – Remote (almost never)
- 2 – Unlikely (occurs rarely)
- 3 – Possible (could occur, but uncommon)
- 4 – Likely (recurrent but not frequent)
- 5 – Very likely (occurs frequently)

The severity of harm can be assessed by applying an indicative score (from 1 to 5) as follows:

- 1 – Trivial (e.g. discomfort, slight bruising, self-help recovery)
- 2 – Minor (e.g. small cut, abrasion, basic first aid need)
- 3 – Moderate (e.g. strain, sprain, incapacitation > 3 days)
- 4 – Serious (e.g. fracture, hospitalisation > 24 hrs, incapacitation > 4 weeks)
- 5 – Fatal (single or multiple)

The rating value is obtained by multiply the two scores and is then used to determine the course of action.

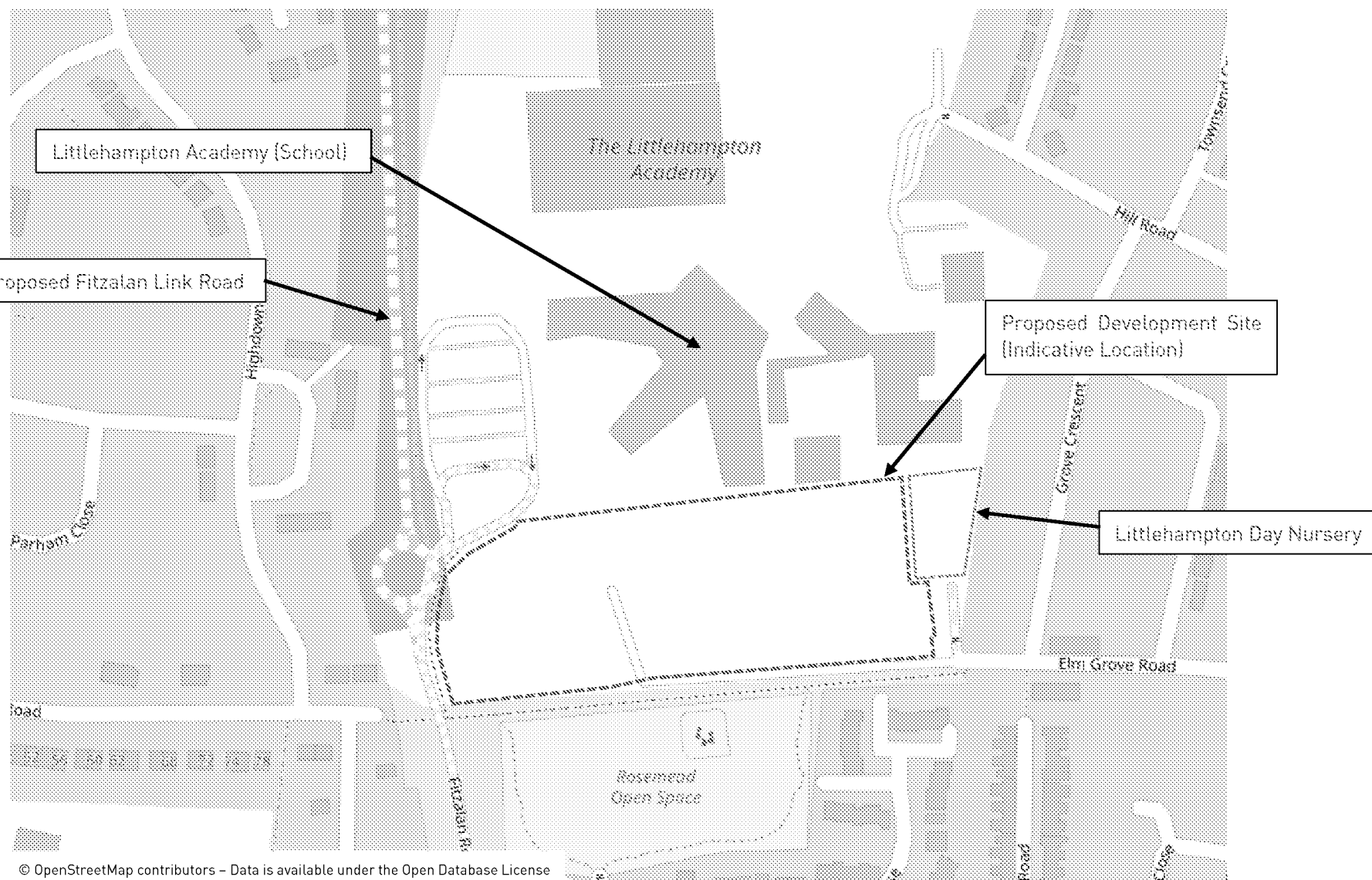
| Rating Bands (Severity x Likelihood)                |                                                                                   |                                                                                                                                                                   |
|-----------------------------------------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Low Risk [1 – 8]                                    | Medium Risk [9 –12]                                                               | High Risk [15 – 25]                                                                                                                                               |
| May be ignored but ensure controls remain effective | Continue, but implement additional reasonable practicable controls where possible | Avoidance action is required; therefore alternative design solutions must be examined. Activity must not proceed until risks are reduced to a low or medium level |

The following hazards pertinent to our design input have been identified and control measures suggested:

| Hazard                    | Risk Of                                          | At Risk     | Rating |   |    | Control Measures                                                 | Controlled |   |   |
|---------------------------|--------------------------------------------------|-------------|--------|---|----|------------------------------------------------------------------|------------|---|---|
|                           |                                                  |             | L      | S | R  |                                                                  | L          | S | R |
| Acoustic glazing - weight | Strain of neck, limbs or back. Fall from height. | Contractors | 3      | 5 | 15 | Provide sufficient manpower, lifting gear and structural support | 1          | 5 | 5 |

L: Likelihood    S: Severity    R: Rating

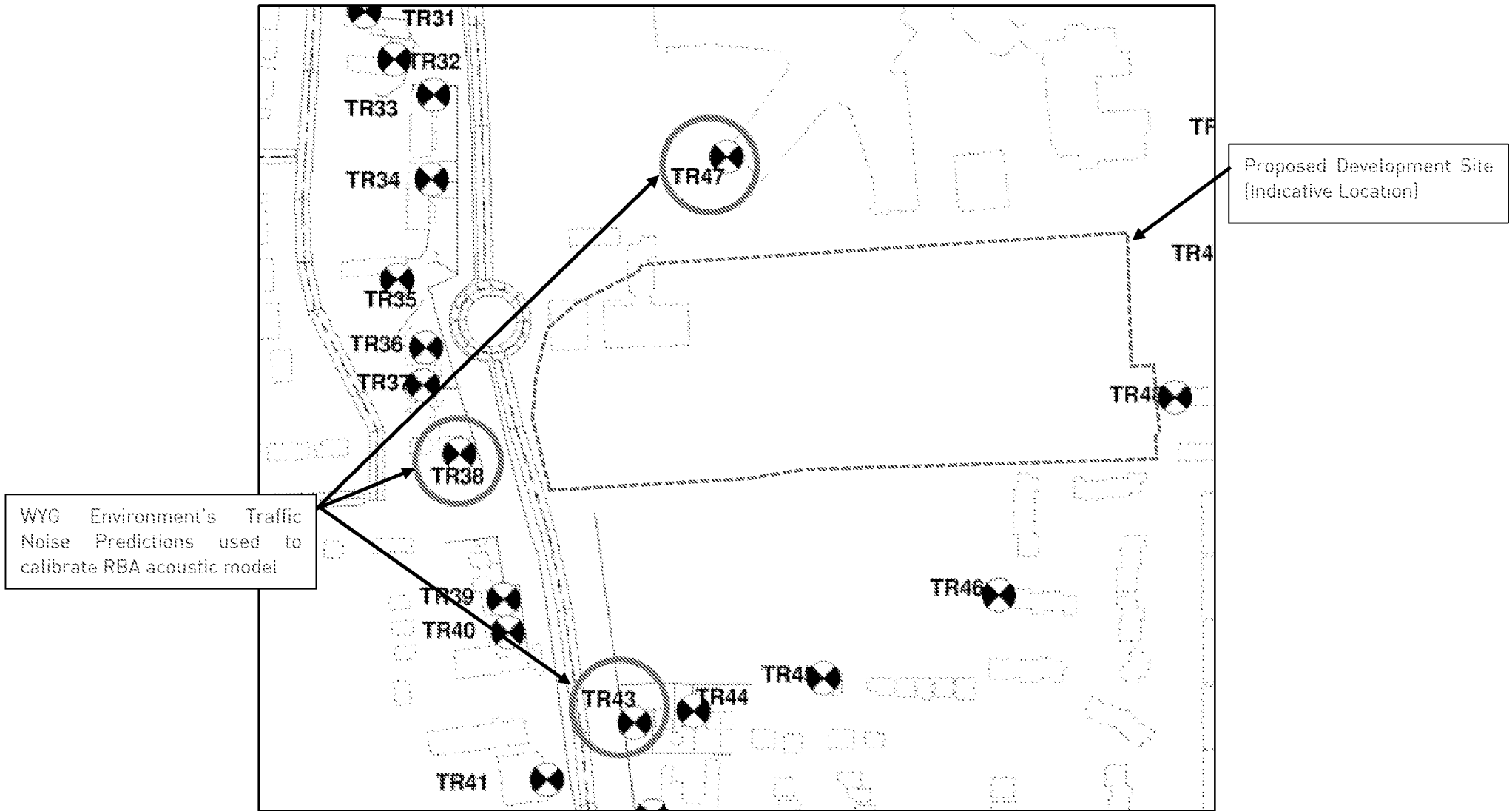
## Appendix E – Graphs and Site Plans



Land South of Littlehampton Academy, Littlehampton  
 Proposed Site Layout  
 Project 10383

Figure 1  
 16 August 2021  
 Not to Scale

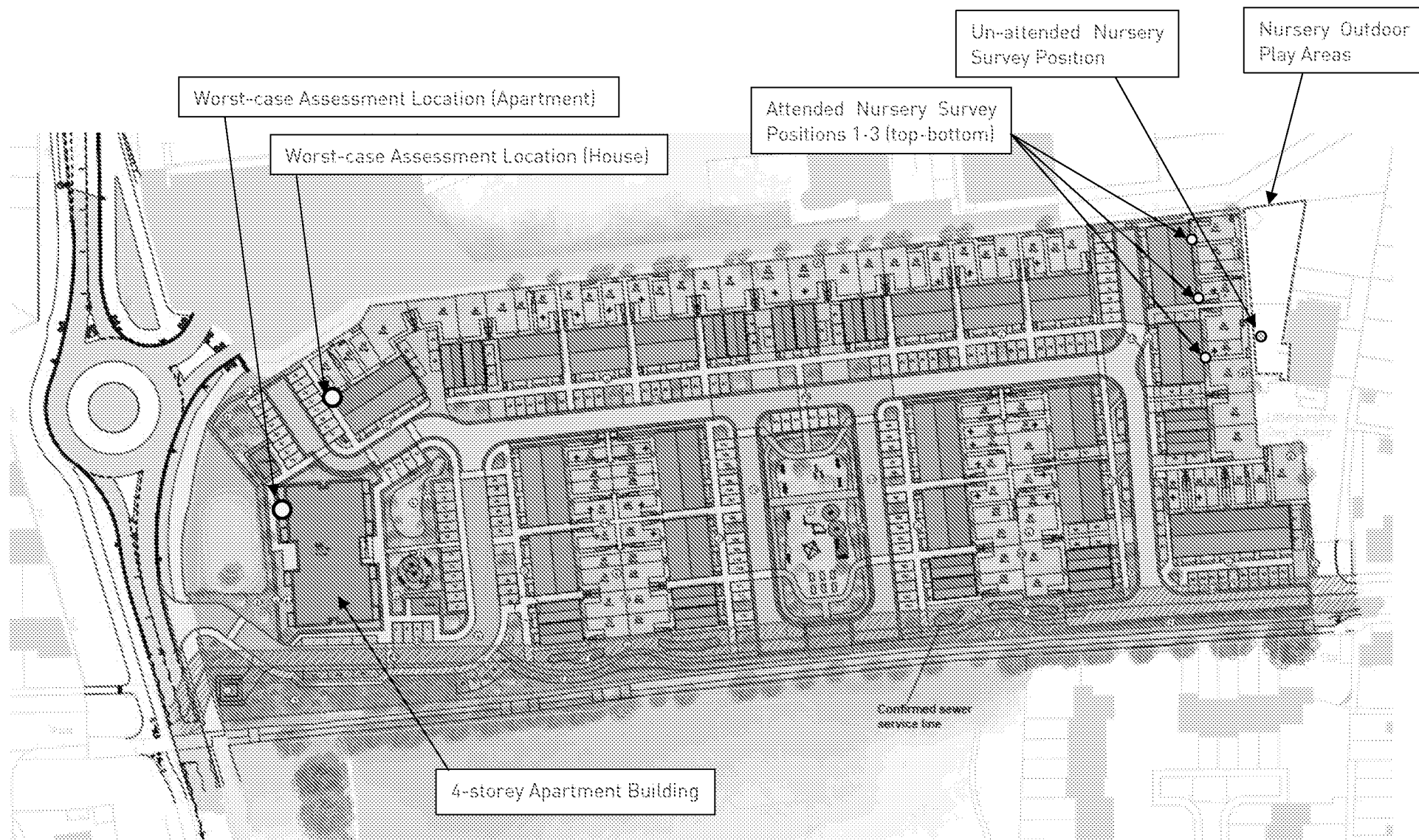




Land South of Littlehampton Academy, Littlehampton  
 PBA Noise Survey Locations [& RBA Spot Measurement Location]  
 Project 10383

Figure 2  
 16 August 2021  
 Not to Scale





Land South of Littlehampton Academy, Littlehampton  
 Site Layout Proposals  
 Project 10383

Figure 3  
 16 August 2021  
 Not to Scale





Proposed Site from north-west corner

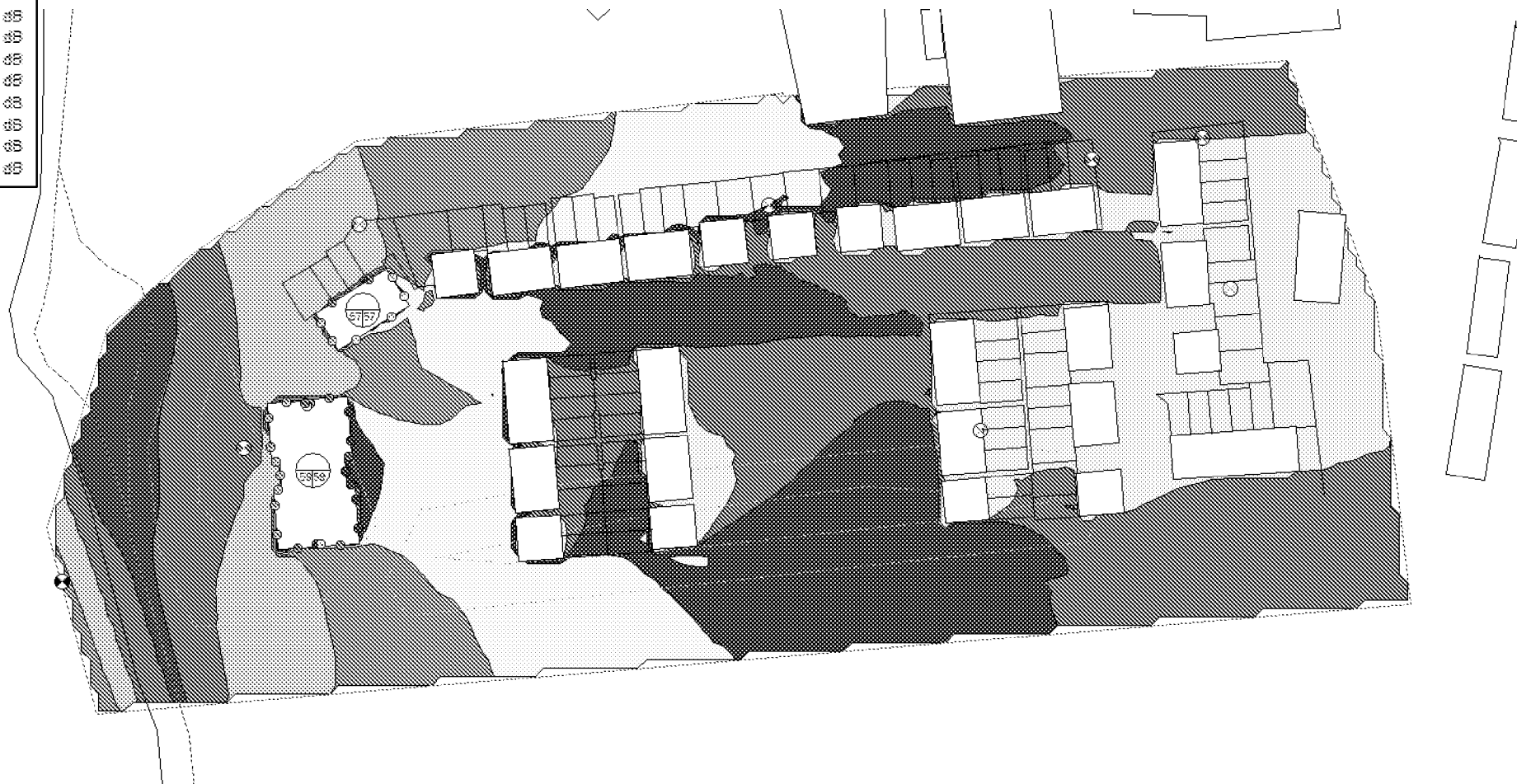
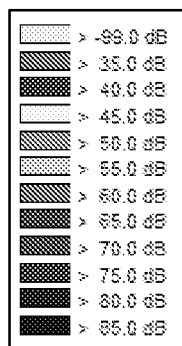


Proposed Site from south-west corner

Land South of Littlehampton Academy, Littlehampton  
 3D Screenshot of Cadna Acoustic Model of Site (Indicative)  
 Project 10383

Figure 4  
 16 August 2021  
 Not to Scale

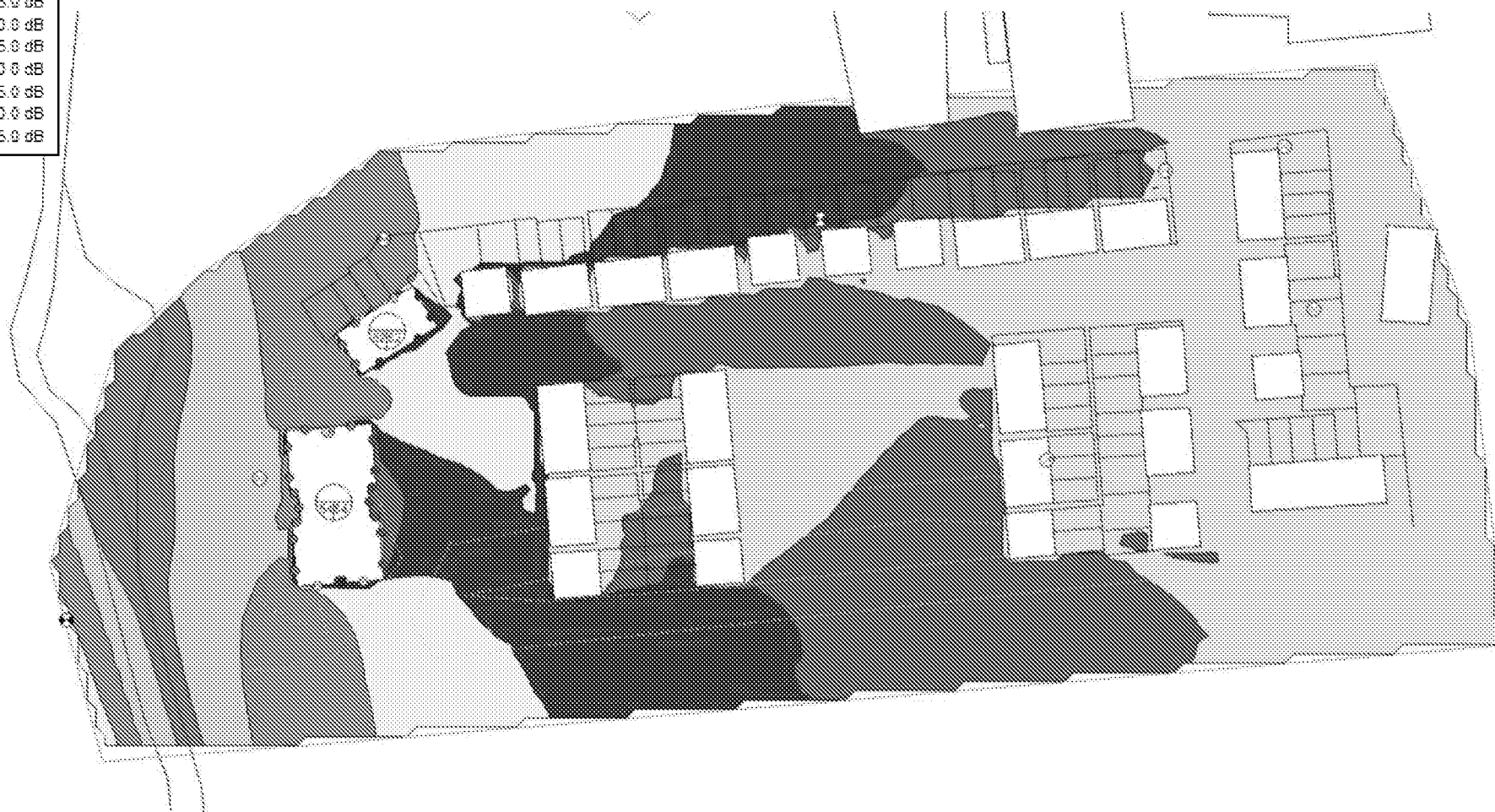
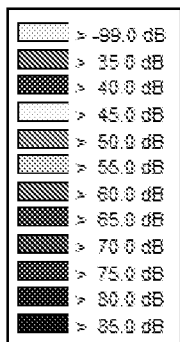




Land South of Littlehampton Academy, Littlehampton  
 Daytime Noise Level Predictions,  $L_{Aeq,16hr}$  ( $h=4m$ )  
 Project 10383

Figure 5  
 16 August 2021  
 Not to Scale





Land South of Littlehampton Academy, Littlehampton  
 Night-time Noise Level Predictions,  $L_{Aeq,8hr}$  (h=4m)  
 Project 10383

Figure 6  
 16 August 2021  
 Not to Scale



DAYTIME

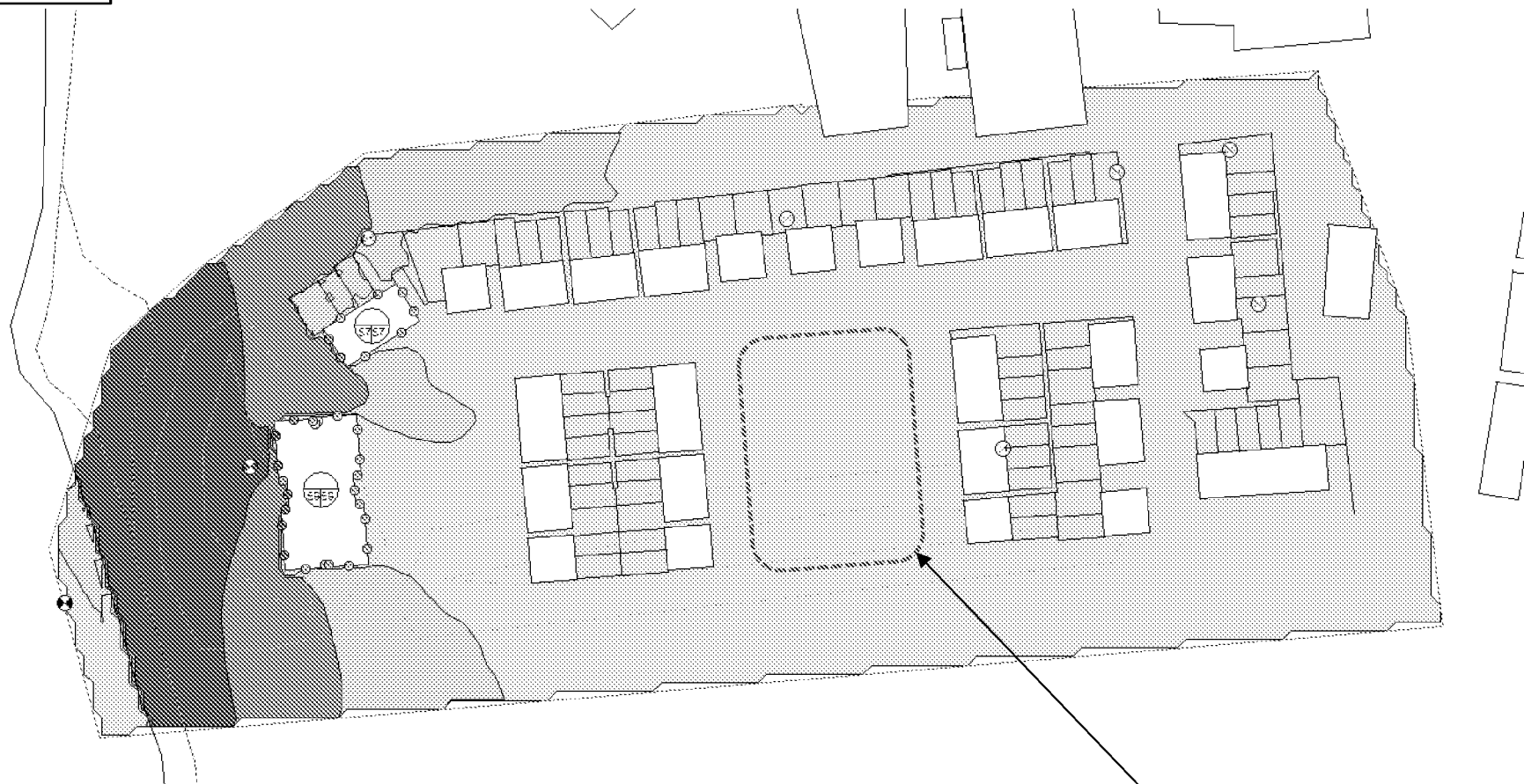
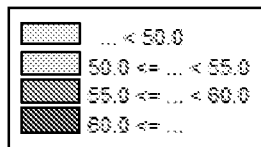
NIGHT-TIME

| BoKlok Unit Types |  |
|-------------------|--|
| Standard          |  |
| Medium            |  |
| High              |  |

Land South of Littlehampton Academy, Littlehampton  
 Boklok Unit Type Zones (indicative) based on Façade Noise Levels  
 Project 10383

Figure 7  
 16 August 2021  
 Not to Scale





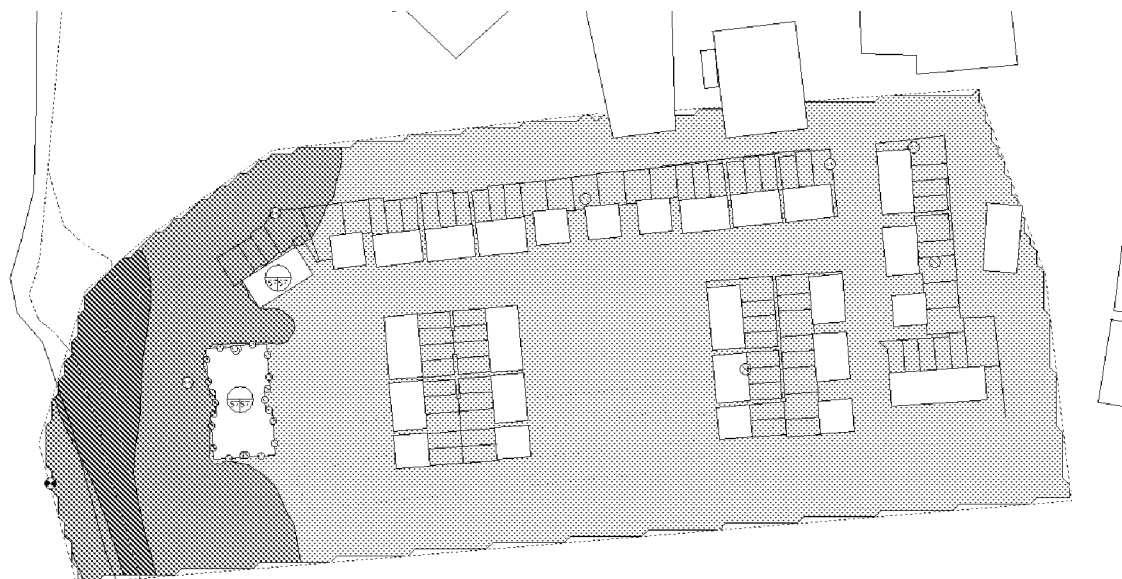
Central Amenity Area for all Residents

Land South of Littlehampton Academy, Littlehampton  
 External Amenity Areas Daytime Noise Level Prediction,  $L_{Aeq,16hr}$  ( $h=1.5m$ )  
 Project 10383

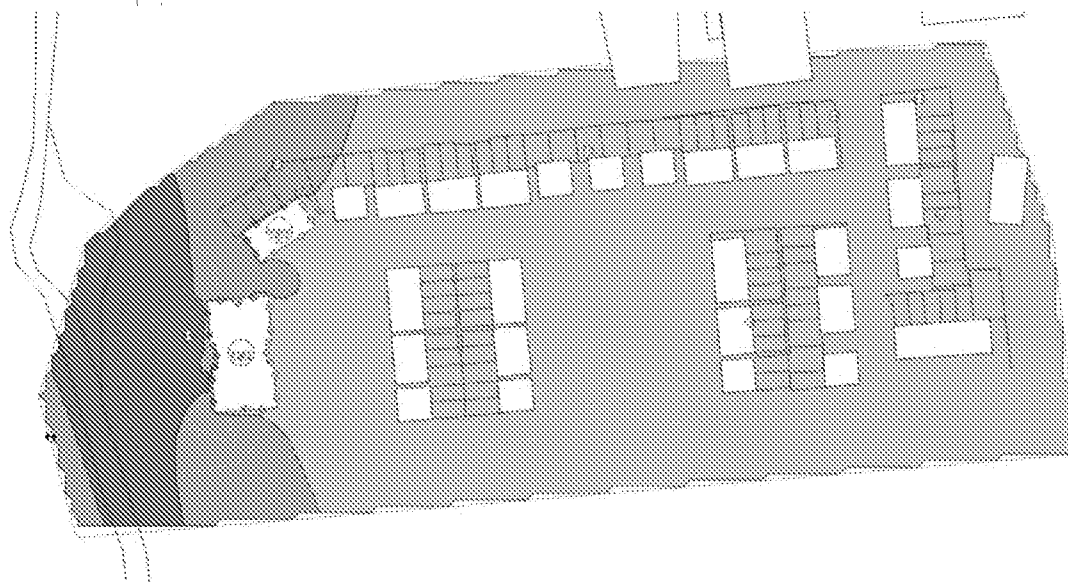
Figure 8  
 16 August 2021  
 Not to Scale



DAYTIME



NIGHT-TIME



| AVO L1 Assessment Zones |  |
|-------------------------|--|
| Negligible Risk         |  |
| Low/Medium Risk         |  |
| High Risk               |  |

Land South of Littlehampton Academy, Littlehampton

AVO Level 1 Risk Zones based on Façade Noise Levels,  $L_{Aeq,T}$  ( $h=4m$ )

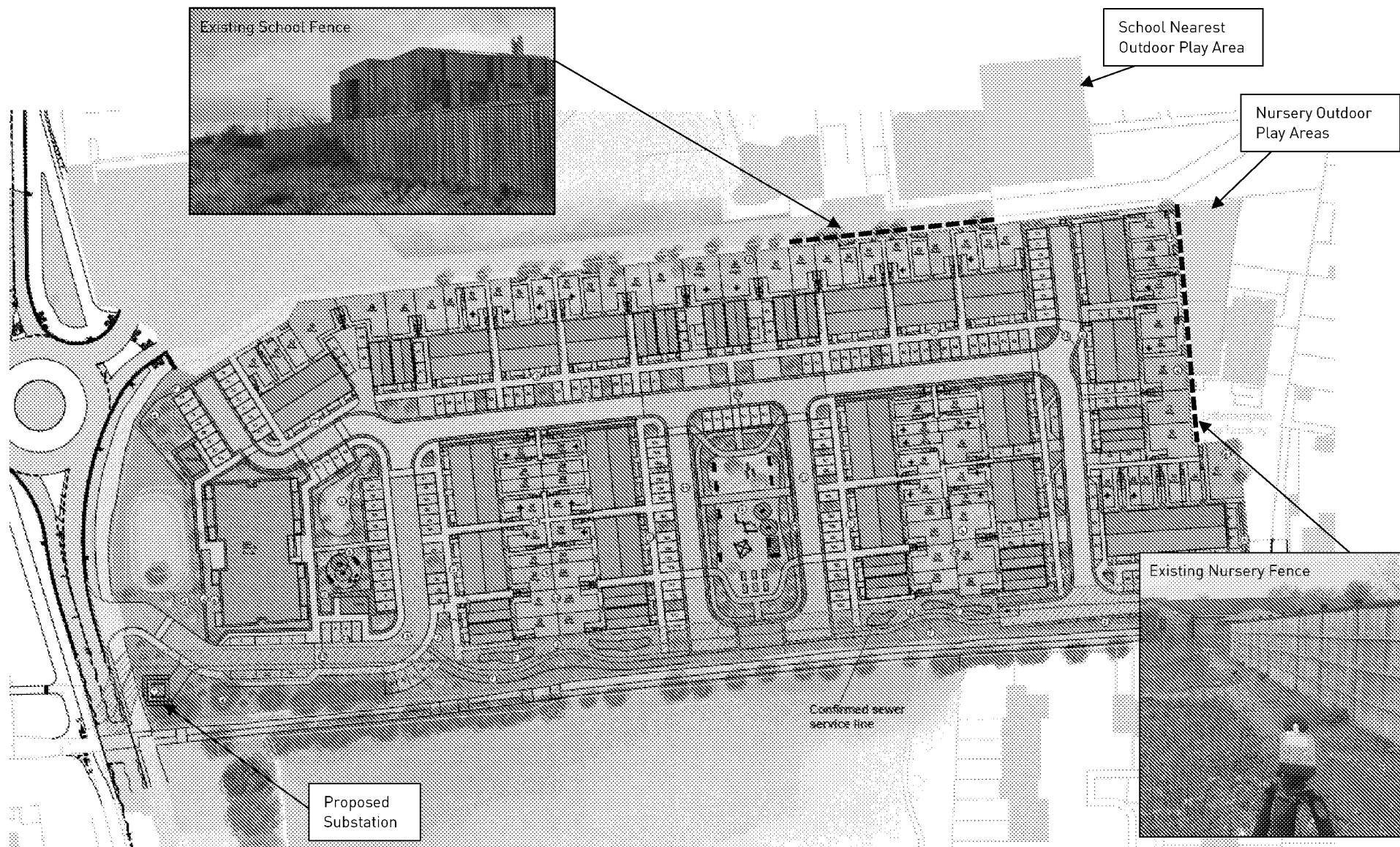
Project 10383

Figure 9

16 August 2021

Not to Scale





Land South of Littlehampton Academy, Littlehampton

Indicative locations of noise emission predictions from adjacent Nursery & School

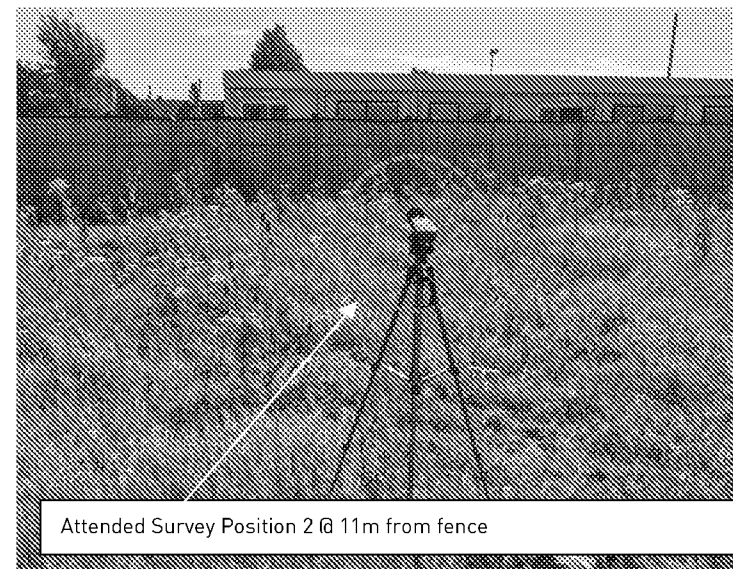
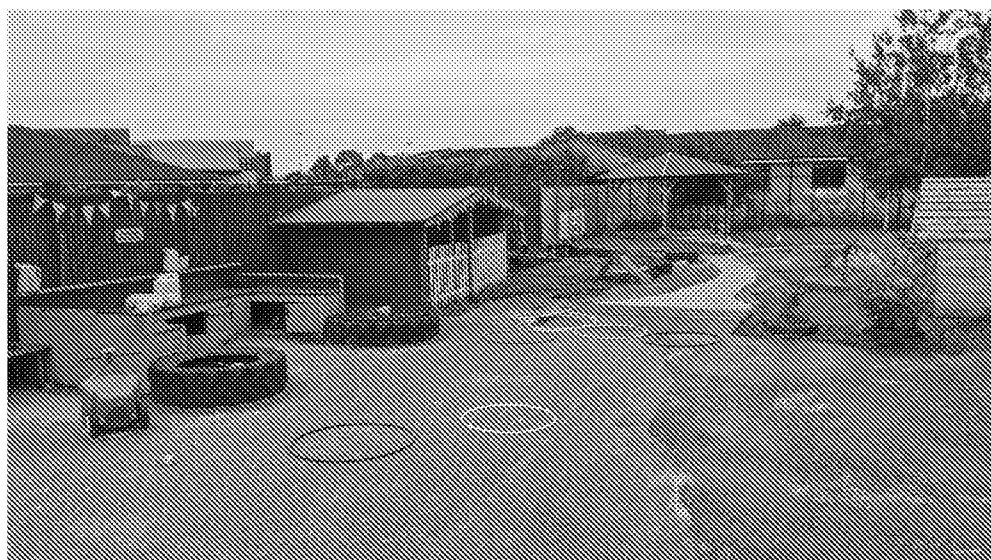
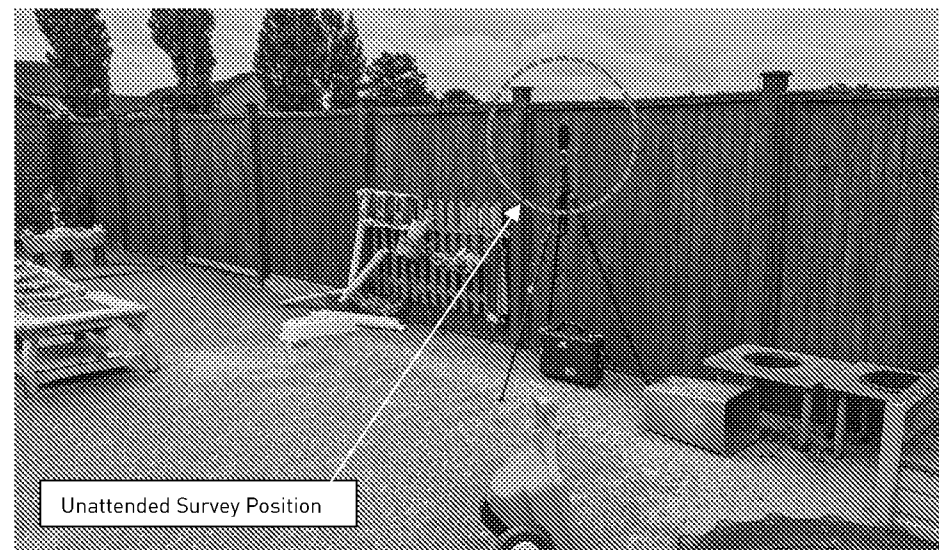
Project 10383

Figure 10

16 August 2021

Not to Scale





Land South of Littlehampton Academy, Littlehampton  
 Images of Littlehampton Day Nursery Surveys  
 Project 10383

Figure 11  
 16 August 2021  
 Not to Scale



