



Gatefold Development - Measurements and Analysis toward Discharging Noise-Related Planning Conditions

Report ref.

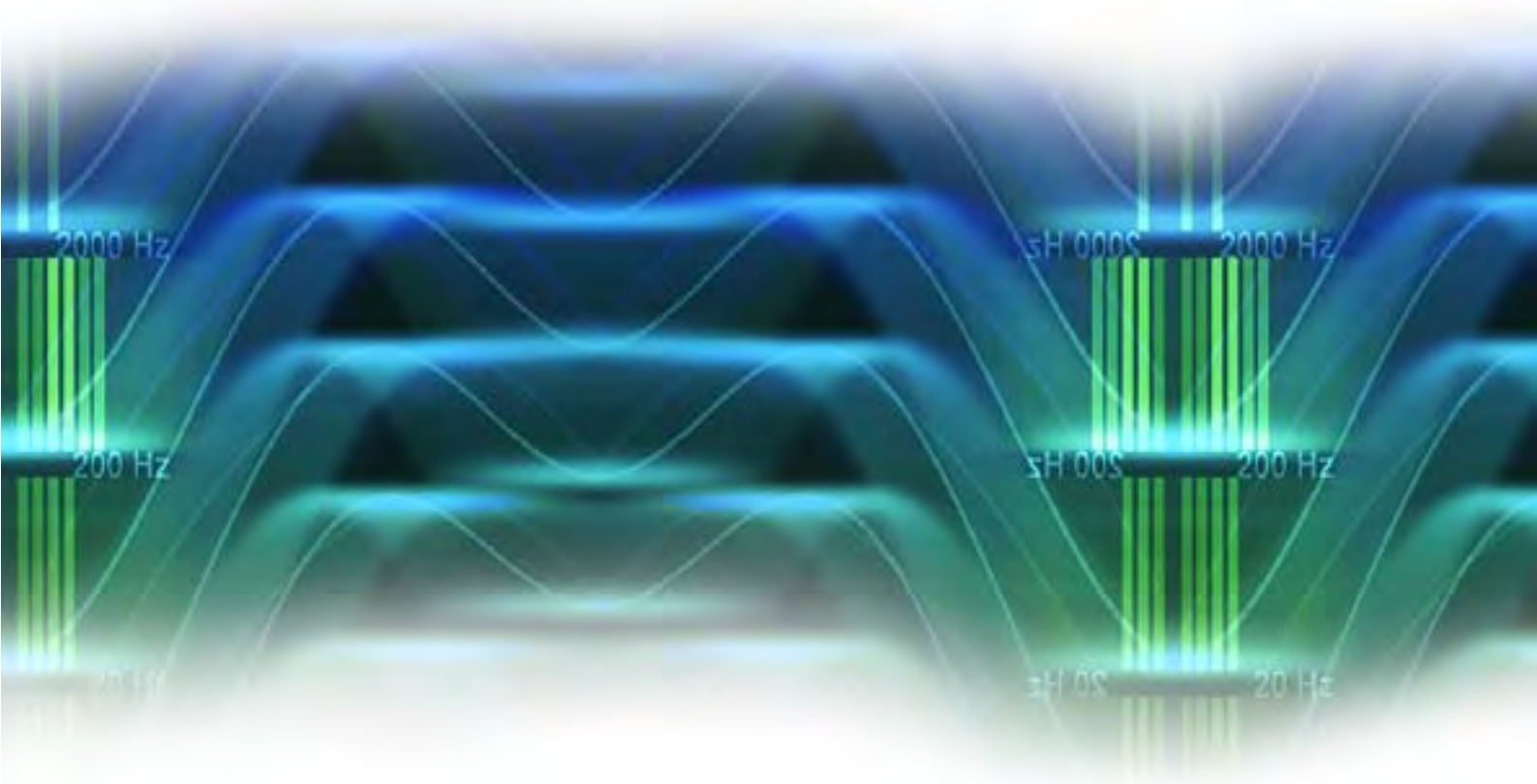
PJB7200/13172

Date

June, 2014

Issued to

Willmott Dixon Housing Ltd



Issued by

Phill Banks B Eng MIOA
Principal Consultant

Spectrum
ACOUSTIC CONSULTANTS



SECTION	TITLE	PAGE
1.	SUMMARY	4
2.	INTRODUCTION.....	5
3.	SITE DESCRIPTION.....	5
4.	HILLINGDON COUNCIL'S STANDARDS FOR ACCEPTABILITY.....	5
5.	CONDITION 39 – ENVIRONMENTAL NOISE EXPOSURE OF THE SITE.....	6
5.1	LONG-TERM NOISE MEASUREMENTS OF RAILWAY AND ROAD TRAFFIC NOISE	7
5.2	RESULTS OF LONG-TERM, UNATTENDED NOISE MONITORING	8
5.3	NOISE EXPOSURE ACROSS THE SITE GENERALLY	8
5.4	NUMERICAL NOISE MODEL PREDICTION OF NOISE EXPOSURE FOR THE PROPOSED DEVELOPMENT	9
5.5	CALCULATION OF INTRUSIVE NOISE LEVELS.....	10
5.6	VENTILATION	11
5.7	FAÇADE GLAZING SPECIFICATION.....	11
5.8	OUTDOOR NOISE LEVELS.....	12
5.9	DISCUSSION ON OUTDOOR NOISE LEVELS.....	12
6.	CONDITION 40 – VIBRATION.....	14
6.1	BS 6472-1:2008 GUIDE TO EVALUATION OF HUMAN EXPOSURE TO VIBRATION IN BUILDINGS – PART 1: VIBRATION SOURCES OTHER THAN BLASTING	14
6.2	VIBRATION SURVEY	15
6.3	RESULTS OF VIBRATION MONITORING	15
6.4	ASSESSMENT OF VIBRATION AFFECTING THE PROPOSED DEVELOPMENT.....	16
6.5	SUMMARY OF FINDINGS ON SITE VIBRATION.....	17
7.	CONDITION 42 – SOUND INSULATION BETWEEN RESIDENTIAL AND NON- RESIDENTIAL PARTS OF THE DEVELOPMENT	17
7.1	PROPOSED GUIDELINES FOR ACCEPTABILITY.....	17
7.2	PROPOSED CONSTRUCTIONS AND EXPECTED SOUND INSULATION PERFORMANCE	18
7.3	LIMITING SOUND LEVELS IN NON-RESIDENTIAL SPACES	20
8.	CONCLUSION	21



Appendix A: Site location showing noise and vibration monitoring positions.

Appendix B: Selected plans and elevations of the development

Appendix C: Results of long-term noise monitoring

Appendix D: Figures showing 'Predictor' noise model

Appendix E: Prediction results for daytime and night-time LAeq

Appendix F: Sample intrusive noise calculations

Appendix G: Mark-up of floor plans showing recommended glazing specification

Appendix H: Figures showing predicted noise level contours in outdoor amenity spaces.



1. SUMMARY

- The planning permission for the mixed use development in Blyth Road in the London Borough of Hillingdon, includes conditions which require demonstration that acceptable levels of protection from noise and vibration are achieved for residents.
- Noise measurements of the existing ambient noise environment were taken at a number of locations during October, 2013. Vibration measurements nearby the railway to the south of the site were taken at the same time.
- Using the results of the noise measurements, the site noise exposure of the proposed development has been predicted using a numerical noise model. These predictions have been used to predict internal noise levels for residences and specify façade sound insulation measures in order to comply with the technical requirements of London Borough of Hillingdon's Noise Supplementary Planning Document.
- Mark-up plans of the development are provided which show the requisite façade sound insulation.
- The greatest possible degree of protection for outdoor amenity spaces has been provided, within other constraints. The Council's recommended outdoor amenity noise levels will be met in the majority of spaces, although it will not be met throughout.
- Vibration levels are expected to be well below the threshold of possibility of adverse comment, as set out in standard BS6427-1, and are likely to be imperceptible.
- The sound insulation between residential and non-residential spaces will be sufficient to ensure protection for residences from internally-generated noise in adjoining non-residential uses



2. INTRODUCTION

Willmott Dixon are constructing a mixed use development in Blyth Road in the London Borough of Hillingdon, comprising two multi-storey residential flat blocks with commercial and ancillary uses, landscaping and parking. The planning permission for the development includes conditions which require demonstration that acceptable levels of protection from noise and vibration are achieved for residents.

This report describes the measurements and analysis undertaken to compare the predicted noise and vibration parameters with the Council's standards for acceptability.

3. SITE DESCRIPTION

The application site is located off Blyth Road in Hayes, Hillingdon. The site is roughly triangular shaped approximately and covers 0.71 hectares. The Paddington to Reading mainline railway runs along the southern boundary of the site, with Blyth Road running along the northern boundary. The western boundary adjoins the remainder of the former EMI site. The site is located in a mixed-use area, with industrial, commercial and office uses to the north, east and part of the west. The main residential area is located to the south of the site, off Keith Road, on the opposite side of the railway line. Additional residential properties are also located on Blyth Road north east of the site.

The existing noise environment is dominated by road traffic noise toward the northern side of the site and railway noise towards the southern part of the site.

The planning permission for the development, 51588/APP/2011/2253, described the proposed development as follows:

Demolition of warehouse extension to Apollo House and erection of a part 4, part 5, part 6 and part 7 storey building comprising 132 residential units, cafe (Class A3), community room (Class D2), 5 x workshop units (Class B1, B8 or A2 uses), and associated car parking and landscaping.

A site location plan is included at Appendix A. A number of layout and elevation drawings are shown in Appendix B.

4. HILLINGDON COUNCIL'S STANDARDS FOR ACCEPTABILITY

In general, the standards that are applied to new developments are set out in London Borough of Hillingdon's Noise Supplementary Planning Document. These are as follows:



5.0 Environmental Protection Unit Advice

- 5.1 To ensure an acceptable environment for all, the Council applies the following standards for judging noise levels for various types of development. They should be used in conjunction with the detailed advice set out in the preceding sections.

TABLE 2: RESIDENTIAL NOISE CRITERIA

		Recommended Noise Level (dB)
Daytime Noise (07:00 - 23:00)	Outdoor living areas	As low as practicable, and < 50 $L_{Aeq,T}$ *(free field)
	Indoor living areas	< 35 $L_{Aeq,T}$ *
Night-time Noise (23:00 - 07:00)	Outside bedroom windows	< 45 $L_{Aeq,T}$ *(façade) < 60 $L_{Amax, Fast}$ (façade)
	Inside bedrooms	< 30 $L_{Aeq,T}$ * < 45 $L_{Amax, Fast}$

Source: Derived from BS8233:1999 and "Guidelines for Community Noise", World Health Organisation, 1999

* Time base T should be appropriate for the circumstances, typically 1 hour day and 5 minutes night

Planning conditions attached to the permission that relate to noise and vibration also contain specific requirements. Finally, Spectrum have confirmed the particular requirements of some parameters directly with the Environmental Health department at Hillingdon Council. The relevant requirements are as described in the sections below that deal individual conditions.

5. CONDITION 39 – ENVIRONMENTAL NOISE EXPOSURE OF THE SITE

Condition 39 (as amended) states the following:

Works above ground other than demolition shall not begin until a scheme for protecting the proposed residential development from road and rail traffic noise has been submitted to and approved by the Local Planning Authority (LPA). The scheme shall meet acceptable noise design criteria both indoors and outdoors and provide adequate ventilation to indoor areas. The scheme shall include such combination of sound insulation, acoustic ventilation and other measures as may be approved by the LPA. The scheme shall include provision of acoustic mitigation as recommended in Noise and Vibration Report ref: JAL6459 dated 7th September 2011. The scheme shall thereafter be retained and operated in its approved form for so long as the use hereby permitted remains on the site.

The Noise and Vibration Report referred to above was prepared by RPS Planning and Development Ltd in 2011 to accompany the planning application for the development. The acoustic mitigation described within that report was based on achieving the SPG standards (set out in the previous section) taking into account the design of the building proposed at that time.

More detail about the building and internal layouts, construction type, glazing and ventilation, etc. are now known about the development. Therefore, the mitigation measures described here, particularly in relation to indoor noise levels, are based on achieving the SPG standards with the current building



design. This approach was discussed and agreed with an environmental health officer at Hillingdon Council, Mohammed Islam, prior to commencing our analysis.

5.1 LONG-TERM NOISE MEASUREMENTS OF RAILWAY AND ROAD TRAFFIC NOISE

Ambient noise measurements were carried out during a site survey between 4 and 7 October, 2013. This survey consisted of long-term, unattended noise measurements at three locations on the subject site, prior to any demolition work taking place. These positions were as follows:

- Location 1:** On the southern boundary of the site opposite the loading dock at 4m height in free field conditions with clear line of sight to trains on the railway and fully screened from Blyth Road by the existing buildings.
- Location 2:** Within the yard of the existing site approximately 40m from Blyth Road and 30m from the railway at 1.5m height in free field conditions with partially obstructed line of sight to Blyth Road and fully screened from the railway by the existing 2.4m fence.
- Location 3:** Extended 1m in front of the 1st floor office windows near the north west corner of the site in façade reflected conditions with clear line of sight to Blyth Road and fully screened from the railway by the existing buildings.

The long-term monitoring locations are shown in the site location plan in Appendix A.

The following equipment was used during the survey:

Location 1

- Bruel & Kjaer Type 2250 Sound Level Meter s/n 2739650
- Bruel & Kjaer Type 4189 Microphone s/n 2726320
- Bruel & Kjaer Type 4231 Acoustic Calibrator s/n 2730221
- Bruel & Kjaer Type UA 1404 Outdoor microphone attachment, and
- Bruel & Kjaer Type AO 0441 10m microphone extension cable

Location 2

- Bruel & Kjaer Type 2260 Sound Level Meter s/n 1772229
- Bruel & Kjaer Type 4189 Microphone s/n 2199530
- Bruel & Kjaer Type 4231 Acoustic Calibrator s/n 2229957
- Bruel & Kjaer Type UA 1404 Outdoor microphone attachment, and
- Bruel & Kjaer Type AO 0441 10m microphone extension cable

Location 3

- Bruel & Kjaer Type 2260 Sound Level Meter s/n 2290597
- Bruel & Kjaer Type 4189 Microphone s/n 2529662
- Bruel & Kjaer Type 4231 Acoustic Calibrator s/n 2291483
- Bruel & Kjaer Type UA 1404 Outdoor microphone attachment, and
- Bruel & Kjaer Type AO 0441 10m microphone extension cable

Before and after the survey, the sound level meters were field-calibrated in accordance with the manufacturer's guidelines. In all cases, drift was less than 0.2 dB and therefore acceptable. The meter, microphone and field calibrator are laboratory calibrated biennially in accordance with UKAS procedures or to traceable National Standards.



5.2 RESULTS OF LONG-TERM, UNATTENDED NOISE MONITORING

Measurements have been summarised into contiguous 5 minute periods to present the noise profile throughout the monitoring period. Noise metrics consisted of equivalent continuous (L_{Aeq}) noise levels and maximum (L_{Amax}) noise levels as well as statistical noise levels (termed L_n, where n is the percentage of time the level is exceeded during the measurement period) including LA90 levels (the noise level exceeded for 90% of the individual measurement period) which is taken to be the background noise level. Overall A-weighted and octave band measurements (where available) were stored for later analysis.

The results of the measurements are shown graphically in Appendix C.

Overall daytime, night-time L_{Aeq} & LA90 levels and design L_{Amax} levels are shown in the following table.

Noise parameter	Location 1	Location 2	Location 3
Daytime L _{Aeq}	73	63	67
Night-time L _{Aeq}	66	56	61
Daytime LA90	41	41	42
Night-time LA90	39	36	36
Night-time L _{Amax} ¹	91	73	79

Table 1: Aggregated summary results of noise monitoring

Note 1: The numerical L_{Amax} levels for each 8 hour night-time period have been sorted by value from highest to lowest. From this, it is possible to read off the 10-15th highest L_{Amax} level for each night. This highest of these values is then taken as the representative L_{Amax} at the monitoring location for subsequent use in assessing L_{Amax} levels inside residences on the site. This is in full accordance with the guidance in the WHO "Guidelines for community noise" document, which states that, for a good nights' sleep, the L_{Amax} level should not exceed 45 dB more than 10 to 15 times.

At locations 1 and 2, the variation in L_{Aeq} and L_{Amax} levels show the significant effect of railway noise on environmental noise levels while long-term typical minimum (LA90) noise levels indicate the usual noise environment characteristics of a rise during the daytime and a fall overnight. L_{Aeq} and L_{Amax} on Blyth Road (Location 3) show the characteristics of a road with regularly traffic with only a few 5 minute periods overnight when vehicles did not pass the site.

5.3 NOISE EXPOSURE ACROSS THE SITE GENERALLY

It should be noted that the noise exposure levels in Table 1, above relate only to the specific locations at which measurements were taken. As one moves toward the centre of the subject site, the effect of distance attenuation and screening means that noise levels will reduce.

This is exemplified by the measurements at Location 2, where the general noise levels are well below those at around the perimeter of the site, next to the road and railway.

Therefore, in order to assess noise exposure and to derive a scheme of noise mitigation for the dwellings on the site, it is necessary to know how the noise exposure varies across the whole site. The results of the measurements described above can be used to establish the 'at source' noise levels of the significant sources of noise surrounding the site. In effect, these comprise road traffic and railway noise.



The noise level affecting the site will be subject to differing levels of distance attenuation, screening and angle of view to the surrounding noise sources. Therefore, analysis has been undertaken to predict the noise level across the site, based on the measurement results and taking these effects into account.

The procedure that has been followed is as summarised below:

1. Generate a three dimensional numerical noise model of the site conditions at the time of the noise survey using Bruel and Kjaer's 7810 'Predictor' software. This acoustic model implements the procedures set out in ISO 9613-2:1996 "Acoustics – Attenuation of sound during propagation outdoors Part 2: General method of calculation to determine noise levels". This is as shown in Appendix D.
2. Validate the noise prediction model against actual noise measurement data taken at the site. This validation is carried out in respect of night-time L_{Amax} noise levels as well as daytime and night-time L_{Aeq} levels for both road traffic and railway noise sources.
3. Predict noise levels at numerous locations across the site.
4. Use these noise level predictions as the starting point for examining noise impact at a range of locations on the development, such as for intrusive noise calculations.
5. In the case of residential development, compare predicted indoor noise levels against the guideline noise levels in terms of:
 - L_{Aeq} noise levels in living rooms during the daytime
 - L_{Aeq} noise levels in bedrooms during the night-time, and
 - Typical maximum (L_{Amax}) noise levels in bedrooms during the night-time

Within the noise model, the roads and railway are modelled as line sources. However, noise levels for L_{Amax} sources are not modelled in this way as the 'instantaneous' L_{Amax} measured is mainly due to a particular source at a single location, rather than the aggregate of noise components from all parts of the road and railway. Accordingly, L_{Amax} levels have been calculated using a series of point sources along the road and railway alignments, using the maximum level from an individual point noise source, rather than the sum the noise from of all the point sources. Then, the L_{Amax} level for design purposes is the single highest individual component L_{Amax} level. This procedure has been found to agree well with measured data at previously completed sites.

5.4 NUMERICAL NOISE MODEL PREDICTION OF NOISE EXPOSURE FOR THE PROPOSED DEVELOPMENT

Following validation of the noise model and the determination of the 'at source' noise levels from the transportation sources in the area, the noise model was then modified to include the completed development with buildings in their proposed forms, locations and heights.

A '3D' rendering of the proposed development is shown in Appendix D, along with a layout drawing of the model. This shows the relationship of the buildings to the surrounding noise sources, along with the individual receptor locations at which noise levels have been calculated.

Detailed results of daytime and night-time L_{Aeq} levels are shown in Appendix E corresponding to the calculation positions shown in Appendix D. The suffix, A, B, etc. correspond to different prediction heights at the same location, as detailed in the results output.



5.5 CALCULATION OF INTRUSIVE NOISE LEVELS

BS 8233:1999 *Sound insulation and noise reduction for buildings. Code of practice* describes a 'more rigorous calculation' method for determining internal noise levels, using octave band data. This is calculated from external noise levels, given the size and sound insulation properties of the building façade elements including glazing and ventilation, as well as acoustic properties of the receiving room, such as the volume and reverberation time. Usually, it is the glazing and, depending upon the particular strategy, the ventilation apertures that admit most noise into residences. It is then a matter of providing façade elements with appropriate acoustic performance to achieve sufficient noise reduction to meet the internal noise target.

The analysis carried out for this development assumes typical internal finishes for habitable rooms, based on reverberation times that Spectrum have measured in a range of occupied dwellings. The general construction of the building envelope is as follows:-

- External walls, typically comprising 95mm Splitface Block, 130mm cavity including 80mm closed cell insulation, 100mm Metsec inner leaf frame, fully filled with Rockwool insulation and 2 layers of 15mm Plasterboard inner linings.
- Window glazing having a specification as described later within this document.
- Ventilation to meet the requirements of Part F of the Building Regulations as discussed in the following section.
- Roof comprising in-situ concrete with insulation and weatherproof membrane above with 1 layer of plasterboard forming the ceiling.

Sound insulation data for the façade elements have been taken from sources such as standard data provided by BRE and DETR, Spectrum library of measurement data, calculations using Marshall Day's *Insul* software as well as manufacturer's data and the BRE/CIRIA publication 'Sound Control for Homes'.

The proposed external wall type construction has been reviewed and the minimum sound reduction index for the façade is predicted to be as shown in Table 2. This is the sound reduction index performance that has been used in the calculations of intrusive noise throughout this analysis.

Octave Band Centre Frequency (Hz)							
63	125	250	500	1k	2k	4k	8k
30	38	52	61	67	65	65	68

Table 2: Minimum sound reduction index requirement for solid facades of dwellings.

Appendix F shows sample intrusive noise calculations following the method in Section 6.7.2.1 of BS8233 for living rooms and bedrooms having the highest predicted external noise levels.

Similar calculations have been carried out at a range of locations across the development in order to establish the necessary façade glazing specification necessary to achieve guideline internal noise levels.

When there are external walls of a room on more than one façade, separate calculations for each wall have been undertaken and the component noise levels logarithmically summed to determine compliance with the internal noise level requirement.



5.6 VENTILATION

Approved Document F of the Building Regulations (ADF) is the document which describes methods of providing adequate ventilation for people in a building. It focuses on performance-based guidance, suggesting what level of ventilation should be sufficient, rather than how it should be achieved. It recognises that in noisy locations, it may be appropriate to use either sound attenuating background ventilators or mechanical ventilation solutions, depending on the noise level and any planning conditions.

In habitable rooms, there is a requirement for background ventilation, based on the number of bedrooms or total internal floor area, and purge (formerly rapid) ventilation of 4 air changes per hour. ADF provides 4 methods of achieving this ventilation, namely:

1. Background ventilators and intermittent extract fans
2. Passive stack ventilation
3. Continuous mechanical extract
4. Continuous mechanical supply and extract with heat recovery

Of these systems, method 4 is to be used for all of the dwellings in all of the buildings throughout the development. This is described in more detail below.

5.6.1 Mechanical ventilation heat recovery (method 4)

External air is drawn into the dwelling through an external louvre, via ductwork into a mechanical ventilation heat recovery unit located within an internal void space, such as above a storage cupboard. This is then distributed via silenced ductwork to the habitable rooms. Therefore, no air is supplied directly to the habitable rooms via the external façade. Air in habitable rooms is extracted through wet rooms (kitchens & bathrooms) and discharged via a duct to an external louvre, either in the external façade or at roof level. The external noise entering habitable rooms via this duct work arrangement is negligible compared to the contribution of ambient noise entering through the room's external façade. Accordingly, no component of external intrusive noise through ventilation elements is included in the predictions in Appendix F.

The roomside noise level in habitable rooms from the 'self-noise' of the fan unit is significantly below L_{Aeq} 35 dB. Accordingly mechanical ventilation noise does not contribute to the total noise levels within habitable rooms to any appreciable extent.

5.7 FAÇADE GLAZING SPECIFICATION

Using the procedure described above, the predicted external façade noise levels have been used to calculate intrusive noise inside a representative sample of apartments, taking into account, façade element sizes and sound insulation, room volume and typical absorption.

Appendix G includes layout drawings of all floors of the development which indicate the façade sound insulation specification for glazing in living rooms and bedrooms.

The glazing acoustic specifications referred to within these mark-ups are specified as the R_w and $R_w + C_{tr}$ performance standards. Both the R_w and the $R_w + C_{tr}$ performance shown in the mark-ups is required to be met or exceeded by the selected glazing system.



In summary, glazing having the specification described above in the locations shown in Appendix G, installed to a good standard, will ensure acceptable intrusive noise levels are provided for residents of the proposed scheme.

5.8 OUTDOOR NOISE LEVELS

Noise levels in the first floor amenity areas including private gardens, the Level 5 amenity area and the Level 6 private gardens have been calculated for a range of locations using the numerical noise model described previously and are shown graphically as noise contours in Appendix H. In addition, noise levels for balconies are included in the noise model output in Appendix E.

The figures in Appendix G show noise levels in some parts of these areas comply with the L_{Aeq} 50 dB guideline in the SPG. When the guideline level of 55 dB taken from BS8233 is included, the area of the amenity area that complies is even larger.

However, there are areas in amenity spaces and on balconies where both L_{Aeq} 50 and 55 dB will be exceeded.

5.9 DISCUSSION ON OUTDOOR NOISE LEVELS

The amenity spaces on the first floor level are acoustically screened by the proposed buildings themselves and by a combined concrete block / continuous glazed screen that is a total of 3m in height. This is shown in the figure below:



In addition, the Level 5 and Level 6 amenity spaces are protected by 1.1m high continuous glazed screens. Further, the private amenity spaces benefit from the 2.8m tall privacy screens between gardens.

Therefore, the outdoor amenity spaces are already protected to a significant extent by these barriers. However, it needs to be recognised that there are some areas within the amenity spaces, where the attenuation that can be provided is limited by practical constraints on barrier heights. That is, it would



not be possible to reduce garden or balcony area noise levels in these areas to comply with the SPG's guideline of L_{Aeq} 50 dB, without installing barriers that are excessively tall and visually intrusive. Accordingly, there has to be a trade-off between limiting amenity area noise levels with other constraints, such as sufficient sunlight and a visually acceptable development. It should also be noted that residents have the choice of using the amenity space within the development that does have noise levels that comply with the SPG's guidelines.

Condition 39 states, in part:

The scheme shall include provision of acoustic mitigation as recommended in Noise and Vibration Report ref: JAL6459 dated 7th September 2011.

That report states the following

The outdoor living area criteria [in the Hillingdon Noise SPG] during the daytime period is in line with the WHO [i.e. the Guidelines for Community Noise -World Health Organization, 1999. This states:]. In order to protect the majority of people from being seriously annoyed during the daytime period, the outdoor sound level from steady, continuous noise should not exceed 55 dB L_{Aeq} on balconies, terraces and outdoor living areas. To protect the majority of people from being moderately annoyed during the daytime, where practical and feasible, the outdoor sound level should not exceed 50 dB L_{Aeq} . The lower outdoor sound level should be considered the maximum desirable sound level for new development. However, these guidance levels are more aspirational than immediately attainable

The acoustic mitigation section in the RPS report states:

Amenity areas have been positioned within the centre of the proposed residential block. Where possible, the design has ensured that the majority of amenity areas are positioned away from the dominant noise sources and orientated in such a manner as to gain maximum screening. With screening provided by the structure of the proposed building, some areas of the semi-private gardens will achieve the 55 dB L_{Aeq} target of WHO Guidelines for Community Noise.

That is, it was recognised at the planning stage that there would be a limit to the protection of noise levels in amenity areas. Even so, permission was granted for the current layout in the knowledge that some areas would not achieve the Noise SPG's amenity area requirements, in recognition of the trade-off between this and other aspects of the development's design.

The WHO Guidelines states in respect of noise impact in outdoor areas that "few people are seriously annoyed by activities with L_{Aeq} levels below 55 dB; or moderately annoyed with L_{Aeq} levels below 50 dB."

This statement is generally taken to reflect the social survey data which have found a broad range of responses to the same noise level. For example, at a given noise level, some people will be seriously annoyed, some moderately annoyed, some slightly annoyed, some not at all. As the noise level increases, so does the proportion of people who identify greater annoyance responses. However, there is always a range of responses in the population.



Therefore, if noise levels in an amenity space exceed 55dB LAeq,16hr this does not mean all people would find it intolerable. One UK study of exposure / response effects for traffic noise indicates that 20% of people would be moderately annoyed at this noise level. This means that 80% of people would be 'no more than moderately annoyed' by road traffic noise. In the case of railway noise, annoyance responses are known to be less marked than road traffic, so the proportion of people annoyed by railway noise of this level is likely to be even lower.

As a result, the WHO Guidelines are more conservative and potentially overstate the impact of outdoor noise.

While some amenity areas aren't expected to achieve the Noise SPG standards, there are many areas that do comply and all residents will have access to these areas. A good degree of protection of these areas is provided by acoustic screening, albeit that this is limited by other necessary design considerations.

6. CONDITION 40 – VIBRATION

Condition 40 (as amended) states the following:

Works above ground other than demolition shall not begin until a scheme for protecting the proposed development from vibration has been submitted to and approved in writing by the Local Planning Authority. The scheme shall include such combination of land separation, vibration control techniques and other measures, as are agreed by the Local Planning Authority. Thereafter, the scheme shall be implemented and maintained in full compliance with the approved measures.

The Hillingdon Noise SPG does not have a technical requirement in relation to vibration. In discussion with Mohammed Islam, he indicated that the standards that should be achieved in the completed development are the 'low probability of adverse comment' levels in BS6472 as described below.

6.1 BS 6472-1:2008 GUIDE TO EVALUATION OF HUMAN EXPOSURE TO VIBRATION IN BUILDINGS – PART 1: VIBRATION SOURCES OTHER THAN BLASTING

The guideline used to assess human response to vibration has been taken from British Standard 6472. BS6472 includes the following guidance on the likelihood of adverse comment from vibration within dwellings. This guidance has been used to assess the potential impact of railway vibration at the future development.

This standard uses the measurement parameter Vibration Dose Value (VDV) to classify exposure to vibration in terms of likelihood of adverse comment. VDV takes into account both vibration level and the duration of vibration, thereby giving additional weight to vibration levels that are frequent or continuous or of high level.

Table 3, below, provides the vibration dose values at which various degrees of adverse comment may be expected in residential dwellings, taken from this Standard.



Vibration dose value ranges ($\text{m/s}^{1.75}$) in which various degrees of adverse comment may be expected in office buildings			
Place and time	Low probability of adverse comment $\text{m/s}^{1.75}$ – note 1)	Adverse comment possible $\text{m/s}^{1.75}$	Adverse comment probable $\text{m/s}^{1.75}$ – note 2)
Residential buildings 16 hr day	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Residential buildings 8 hr night	0.1 to 0.2	0.2 to 0.4	0.4 to 0.8

Table 3: Rating of VDV values in accordance with table 1 of BS6472-1 2008

note 1) Below these ranges adverse comment is not expected

note 2) Above these ranges adverse comment is very likely

6.2 VIBRATION SURVEY

The following instrumentation was used to measure vibration levels at the site during the survey:

Survey Dates	Equipment	Serial Number
4-7 October, 2013	SVAN 958 vibration meter	15173
	Dytran triaxial accelerometer type 3233A	646

Table 4: Vibration monitoring equipment used

The meter and accelerometer are laboratory calibrated biennially in accordance with UKAS procedures or to traceable National Standards.

Vibration measurements of all ambient sources of vibration, including the adjoining national rail lines and any other source were taken at the location shown in Attachment 1. The accelerometer was located on the plinth of the existing gantry crane which was well keyed into the ground. This was slightly below the ground level as the national rail line to the south.

Vibration was measured in terms of RMS acceleration between 0.5-80 Hz and in three orthogonal planes as detailed in BS 6472-1. The vibration monitor records the vibration data in the three axes simultaneously and stores them over contiguous 5 minute periods. The measured acceleration data is weighted according to the standard to produce Vibration Dose Values directly. The data has been processed to determine the day-time and night-time VDV values for comparison with the guidelines for acceptability shown in Table 3.

6.3 RESULTS OF VIBRATION MONITORING

The measured Vibration Dose Values at the monitoring location are shown in Table 5 below. The highest daytime and night-time levels in any of the ordinate directions are shown in bold.



Period	Duration	Measured VDV m/s ^{-1.75}		
		x	y	z
Daytime VDV	11.5 hour period to 11pm on 24/2/14 ^{note 1.}	0.020	0.020	0.032
Night-time VDV	8 hour period from 11pm on 24/2/14	0.007	0.007	0.027
Daytime VDV	16 hour period from 7am on 25/2/14	0.013	0.008	0.031
Night-time VDV	8 hour period from 11pm on 25/2/14	0.006	0.005	0.017
Daytime VDV	16 hour period from 7am on 26/2/14	0.016	0.015	0.042
Night-time VDV	8 hour period from 11pm on 26/2/14	0.008	0.010	0.031
Daytime VDV	3 hour period from 7am on 27/2/14 ^{note 2.}	0.008	0.010	0.028

Table 5: Summary of measured vibration levels

Note 1: The Z-axis result extrapolated to an 18 hour period is .037 m/s^{-1.75}

Note 2: The Z-axis result extrapolated to an 18 hour period is .042 m/s^{-1.75}

Subjectively vibration on the site itself due to passing trains was imperceptible.

It should be noted that VDV is a cumulative measurement parameter which increases the longer the measurement continues. Therefore, the VDV measurements from partial periods at the beginning and end of the measurement may underestimate the true 16 hour VDV on those days. Accordingly, these measurements have been extrapolated to the full 16 hour period, assuming that the same level of vibration occurs for the remainder of the period. The resultant is shown in the notes to Table 5.

6.4 ASSESSMENT OF VIBRATION AFFECTING THE PROPOSED DEVELOPMENT

Table 5 above indicates that measured vibration levels near the railway line are approximately one fifth of the lower range for low probability of adverse comment from residents during the daytime. At night-time the results are one third of the lower range of possible adverse comment from residents.

It should be noted, however, that the guidelines for acceptability in BS6472 relate to the locations inside proposed habitable rooms where people may be disturbed by this vibration.

The Association of Noise Consultant's Guidelines on the measurement and assessment of groundborne noise and vibration shows that there are a variety of factors which can increase and reduce ground vibration levels transferred to buildings, depending upon site and building specific factors. It is not possible to know, at this stage, the significance or level of these individual factors at the subject site.

However, for information, the ANC Guidelines indicate that there is a 10 dB reduction in vibration level from the ground to the foundations of a 2-4 storey masonry building or 13 dB on a 'large' masonry building on spread footings. In addition, there is a further 2 dB reduction for each floor up to 5th floor level. Therefore, as a minimum, there is likely to be a further 12 dB reduction of vibration inside the proposed building, relative to the measured levels. The reduction will be greater at upper floor levels. This reduction significantly outweighs any effect of floor resonance that may occur inside dwellings.

Accordingly, vibration levels inside the proposed residences would still be below the lower bound of the 'Low probability of Adverse Comment' according to BS6472.



6.5 SUMMARY OF FINDINGS ON SITE VIBRATION

The findings of our survey and assessment is that no unacceptable adverse vibration impact is expected at this development and no vibration mitigation measures are considered necessary for the building.

7. CONDITION 42 – SOUND INSULATION BETWEEN RESIDENTIAL AND NON-RESIDENTIAL PARTS OF THE DEVELOPMENT

Condition 42 (as amended) states the following:

Works above ground other than demolition all not begin until a sound insulation scheme for the control of noise transmission to the adjoining residential premises has been submitted to and approved in writing by the Local Planning Authority. The scheme shall include such combination of sound insulation and other measures as may be approved by the LPA. Thereafter, the scheme shall be implemented and maintained in full compliance with the approved measures.

The Hillingdon Noise SPG does not have a technical requirement in relation to sound insulation between residential and non-residential uses. In discussion with Mohammed Islam, the approach described within this section was proposed.

The proposals include for the following adjacencies:

1. Level 0 Plant room next to Plot 004
2. Level 0 Plant room below Plots 104, 105, 106 and 107
3. Level 0 Work Units 01 to 04 below Plots 118 to 126
4. 1st floor Café area next to Plot 118
5. 1st floor communal area next to Plot 118
6. 1st floor communal area next to Plot 117
7. 1st floor Café area below Plots 217 and 216
8. 1st floor communal area below Plot 216

7.1 PROPOSED GUIDELINES FOR ACCEPTABILITY

No information is available at this stage (including likely noise levels of their activity) on prospective uses in the ground and first floor non-residential elements the development.

Conceivable noisy activities which could occur in an A2, A3, D2, B1 or B8 encompass a broad range, however, many of the noisiest would be ruled out due to the size of the spaces, access and servicing requirements. For example, night-time entertainment from amplified music would be most unlikely, although the café could include background amplified music and kitchen activity.

In any event, it would be expected that noise levels in these spaces will be higher than normal domestic activities. Occupants of the adjacent residences should therefore be protected from undue impact as a result of this activity.

The Building Regulations Approved Document E (ADE) provides numerical sound insulation values that must be achieved between residences and between common areas and residences to prevent disturbance from the noise of normal domestic activities. However, it also states that a higher standard of sound insulation may be required between spaces used for normal domestic purposes and communal



or non-domestic purposes. In these situations the appropriate level of sound insulation will depend on the noise generated in the communal or non-domestic space. ADE states that specialist advice may be needed to establish whether a higher standard of sound insulation is required, and if so, to determine the appropriate level.

The level of intrusive noise inside residences which arises from the activity in the non-residential units should be low, in particular, relative to the ambient / background noise within the flats such as from external road traffic or railway noise ingress.

Taking, as a worst case, the adjacent bedrooms in the proposed buildings which would have an ambient noise levels from road traffic / ventilation noise no more than L_{Aeq} 30 dB. In order that there should be no increase in this noise level when activity is occurring in the non-residential unit, the intrusive noise must be at least 10 dB below this 'ambient' noise level. This is equivalent to L_{Aeq} 20 dB or about NR15.

Therefore, an appropriate design guideline for noise from the ground floor/basement use propagating through the building structure into residences above would be NR15.

7.2 PROPOSED CONSTRUCTIONS AND EXPECTED SOUND INSULATION PERFORMANCE

The initially proposed build-ups of the wall and floors between residential and non-residential uses described above are set out below, along with the expected sound insulation performance of the 'as-built' construction, taken from measurement results of previous constructions and design tools such as Marshall Day's *Insul* software

7.2.1 Level 0 Plant room next to Plot 004

- 1 x 15mm dab + 1 x 15mm Soundbloc +
- 100mm Medium dense blockwork +
- 50mm cavity + 50mm Kingspan Kooltherm K8 +
- 100mm Medium dense blockwork

The expected sound insulation of this construction is of the order of $D_{nT,w} + C_{tr}$ 48-50 dB, or 3-5 dB above the minimum requirements of ADE. Design development is on-going and it is likely that the design of this wall will be modified as follows:

- 1 x 15mm dab + 1 x 15mm Soundbloc +
- 100mm Medium dense blockwork +
- 50mm cavity + 50mm Kingspan Kooltherm K8 +
- 100mm Medium dense blockwork
- Gyplyner IWL with min 50mm cavity and 25mm fiberglass insulation faced with 1 layer of 15mm Duraline

The expected sound insulation of this construction is of the order of $D_{nT,w} + C_{tr}$ 55 dB, or 10 dB above the minimum requirements of ADE.

7.2.2 1st fl. Café and communal area next to Plot 118; 1st fl. Café and communal area next to Plot 117

- 2 x 15mm Soundbloc +
- 60mm British Gypsum I Stud (fully filled with mineral wool) + 160mm cavity (filled with 160mm Mineral Wool 10kg/m³ insulation) + 60mm metal I stud (fully filled with mineral wool) +



- 2 x 15mm Soundbloc +

The expected sound insulation of this construction is of the order of $D_{nT,w} + C_{tr}$ 55 dB, or 10 dB above the minimum requirements of ADE

7.2.3 Level 0 Plant room below Plots 104, 105, 106 and 107

- 65mm Tilcon Fibre screed + 10mm Isorubber (Yelfon Celecta HD+) +
- RC in-situ slab (thickness varies) +
- 65mm Kingspan Kooltherm K3 (on soffit of slab within the plant room/car-park)

The expected sound insulation of this construction is of the order of $D_{nT,w} + C_{tr}$ 50 - 52 dB, or 5-7 dB above the minimum requirements of ADE. Design development is on-going and it is likely that the design of this floor will be modified as follows:

- 65mm Tilcon Fibre screed + 10mm Isorubber (Yelfon Celecta HD+) +
- RC in-situ slab (250mm) +
- 65mm Kingspan Kooltherm K3 (on soffit of slab within the plant room/car-park)
- MF ceiling to approx. 200mm ceiling void
- 15mm cementitious board ceiling.

The expected sound insulation of this construction is in excess of $D_{nT,w} + C_{tr}$ 55 dB, or 10 dB above the minimum requirements of ADE.

7.2.4 Level 0 Work Units 01 to 04 below Plots 118 to 126

- 75mm Tilcon Fibre screed + 65mm Kingspan Kooltherm K3 + 10mm Isorubber (Yelfon Celecta HD+) +
- RC insitu slab (thickness varies)

Design development is on-going and it is likely that the design of this floor will be modified as follows:

- 65mm Tilcon Fibre screed + 10mm Isorubber (Yelfon Celecta HD+) +
- RC in-situ slab (550mm) +
- 65mm Kingspan Kooltherm K3 (on soffit of slab within the plant room/car-park)
- MF ceiling to approx. 200mm ceiling void
- 15mm building board ceiling.

The expected sound insulation of this construction, even without the ceiling is in excess of $D_{nT,w} + C_{tr}$ 70 dB, or 25 dB above the minimum requirements of ADE.

7.2.5 1st floor Café and communal area below Plots 217 and 216

- 65mm screed + 10mm Isorubber (Yelfon Celecta HD+) +
- Insitu RC Slab (thickness varies)

Design development is on-going and it is likely that the design of this floor will be modified as follows:

- 65mm screed + 10mm Isorubber (Yelfon Celecta HD+) +
- Insitu RC Slab (250mm below Plot 215/ 450mm below Plot 216)



- MF ceiling to 185mm ceiling void
- 15mm plasterboard ceiling.

The expected sound insulation of this construction, is in excess of $D_{nT,w} + C_{tr}$ 55 dB below plot 215 and $D_{nT,w} + C_{tr}$ 60 below Plot 216. This is at least 10 dB above the minimum requirements of ADE.

7.2.6 General comments on detailing and flanking sound transmission

The above estimates of sound insulation performance take into account the various flanking sound paths that can diminish the performance of the underlying partition construction as described above. Spectrum have a role within the overall design development process to ensure that flanking and junction details properly minimise any such effects to the greatest degree.

7.3 LIMITING SOUND LEVELS IN NON-RESIDENTIAL SPACES

Even considering the very good sound insulation between residential and non-residential spaces described above, there would be a limit to what sound insulation could be provided by the building itself and the use classes specified for some non-residential spaces could technically allow high noise levels. In this case, the tenant would be required to provide measures within their fit-out to enhance the sound insulation between their unit and residences above, in order to allow higher levels of noise to occur in the commercial / retail unit.

As regards sound level limits within the non-residential units themselves, this is based on achieving continuous noise levels below NR15 within the adjoining flats, given a sound insulation between the spaces of $D_{nT,w} + C_{tr}$ 55 dB. NR15 is approximately equivalent to 20 dB, which is 10 dB lower than the 'good' indoor ambient noise level recommended in BS 8233:1999 Sound insulation and noise reduction for buildings. Code of practice, Table 5.

Accordingly, this is likely to be considered acceptable by most people, and in the context of other noise in the flats above (such as from road traffic and internal ventilation noise), would probably be close to inaudible. The sound level limit inside premises to achieve this level is as shown in the table below:

dB(A)	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
75	74	71	71	71	70	68	65	63

Table 5: Limiting sound level in non-residential units in order to comply with NR15 in adjoining residences.

This level is a typical level for a table service restaurant having background music, a commercial kitchen or a plant room. Accordingly, there is little risk of disturbance occurring from transmitted sound between retail / commercial / ancillary uses and adjoining residences. Therefore, the above analysis indicates that the proposed building structure is likely to provide sufficient sound insulation to avoid complaints in compliance with Condition 42.

If, however, any non-residential uses included noisy machinery or amplified music as an entertainment, this would potentially generate noise levels higher than these. It would therefore be for the occupiers of these units to include further sound insulation measures within their fit-out works to enable them to have higher levels of internal noise levels without causing disturbance to residents above. The above internal



noise limits should be included in the tenants manual conditions for the leases of the ground / basement units.

8. CONCLUSION

The above analysis indicates that Hillingdon Council's technical requirements as set out in their SPG are generally met by the proposed development.

The glazing sound insulation requirements for residences has been specified in order to comply with their recommended indoor noise level guidelines.

The greatest possible degree of protection for outdoor amenity spaces has been provided, within other constraints. The Council's recommended outdoor amenity are noise levels will be met in the majority of spaces, although it will not be met throughout.

Vibration levels are expected to be well below the threshold of possibility of adverse comment and are likely to be imperceptible.

The sound insulation between residential and non-residential spaces will be sufficient to ensure protection for residences from internally-generated noise in adjoining non-residential uses.



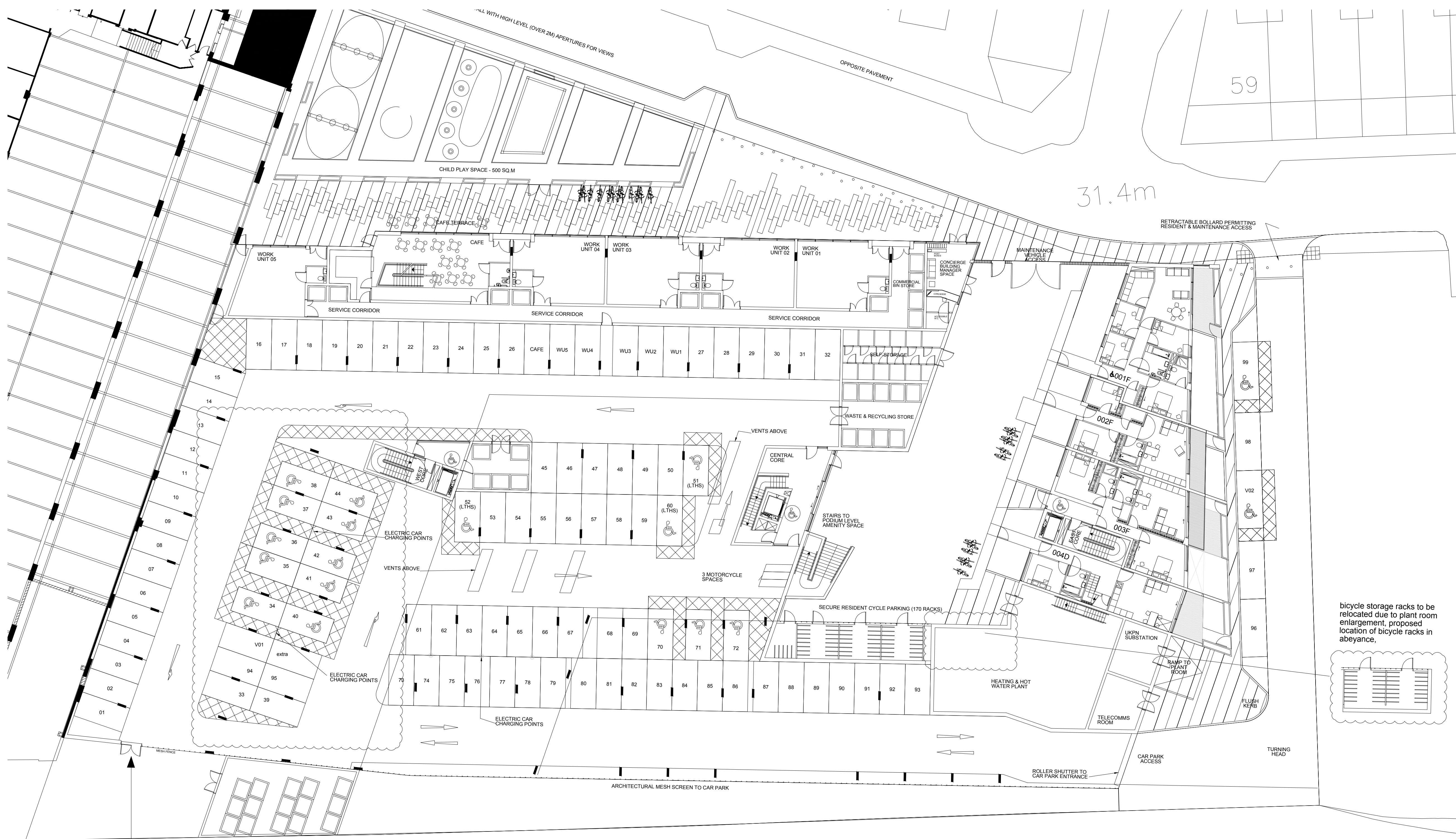
A P P E N D I X A

Site location showing noise and vibration monitoring positions.



A P P E N D I X B

Selected plans and elevations of the development



Double doors to provide access for servicing



11.10.13 Preliminary Issue

REVISION DATE DESCRIPTION

FRANK REYNOLDS ARCHITECTS

14 Clerkenwell Green
Islington
London
EC1R 0DP
www.frankreynoldsarchitects.com

CLIENT

WILLMOTT DIXON HOUSING LTD

ISIS WATERSIDE REGENERATION

PROJECT

THE GATEFOLD BUILDING

DRAWING NAME

LEVEL 01

STATUS

PRELIMINARY

DATE

OCT 2013

DRAWN BY

GF

CHECK BY

MH

SCALE

1:200 (1:400@A3)

SIZE

A1

JOB NO.

1114

DRAWING NO.

L (00) - 0110

REVISION

-

GENERAL NOTES
1. DO NOT SCALE FROM THIS DRAWING
2. ALL DIMENSIONS TO BE CHECKED ON SITE
3. ANY DISCREPANCIES SHOULD BE REPORTED TO THE ARCHITECT / CONTRACT ADMINISTRATOR



11.10.13 Preliminary Issue

REVISION DATE DESCRIPTION

FRANK REYNOLDS ARCHITECTS

14 Clerkenwell Green
Islington
London
EC1R 0DP

www.frankreynoldsarchitects.com

CLIENT

WILLMOTT DIXON HOUSING LTD

ISIS WATERSIDE REGENERATION

PROJECT

THE GATEFOLD BUILDING

DRAWING NAME

LEVEL 02

STATUS

PRELIMINARY

DATE

OCT 2013

DRAWN BY

GF

CHECK BY

MH

SCALE

1:200 (1:400@A3)

SIZE

A1

JOB NO.

1114

DRAWING NO.

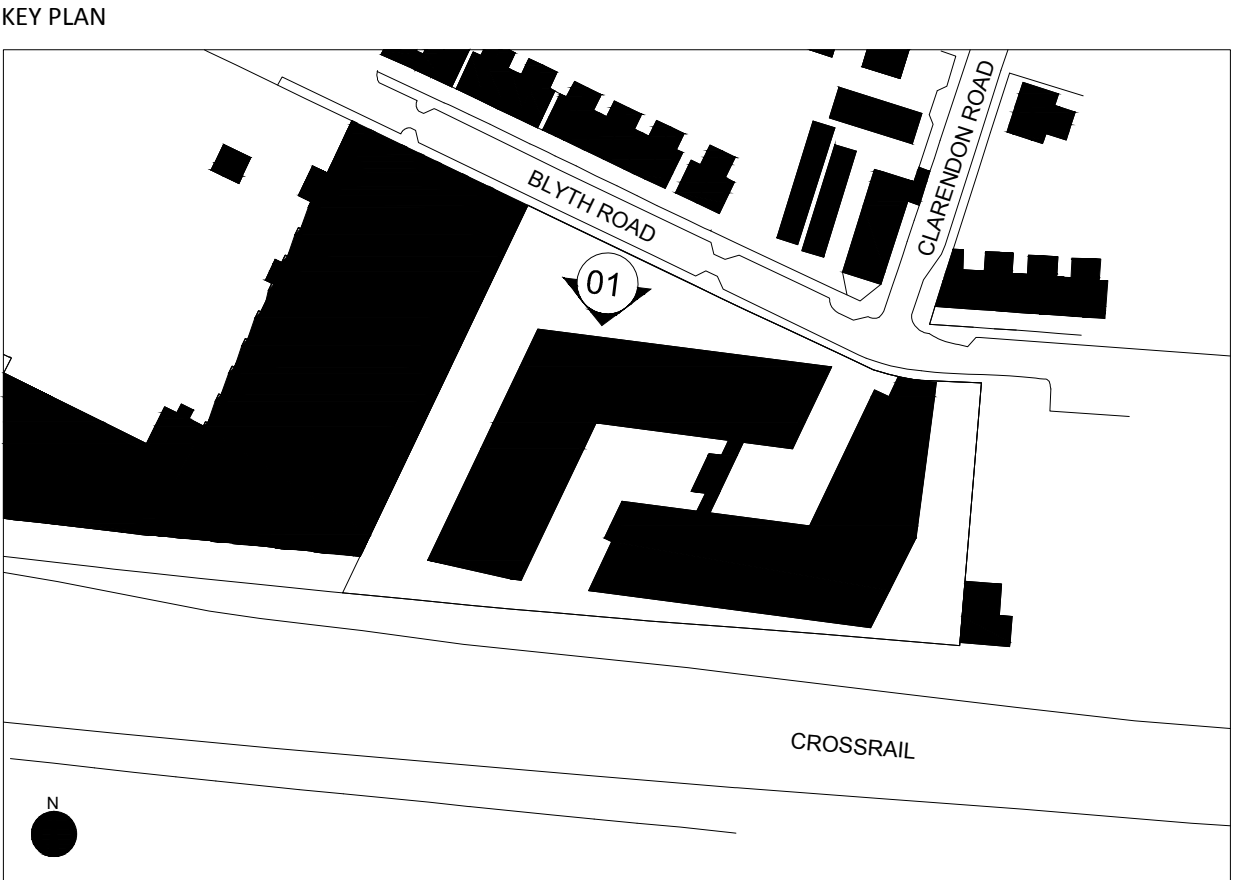
L (00) - 0120

REVISION

-



01 North Elevation
Proposed



B	07.11.13	Window amended in accordance with layout
A	01.11.13	Window fenestration amended
-	18.10.13	Preliminary issue

REVISION	DATE	DESCRIPTION	©
FRANK REYNOLDS ARCHITECTS			
14 Clerkenwell Green Islington London EC1R 6DP www.frankreynoldsarchitects.com			
CLIENT			
WILMOTT DIXON HOUSING LTD ISIS WATERSIDE REGENERATION			
PROJECT			
THE GATEFOLD BUILDING			
DRAWING NAME			
NORTH ELEVATION			
STATUS		DATE	
PRELIMINARY		AUG 2013	
DRAWN BY	CHECK BY	SCALE	SIZE
GF	MH	1:200	A1
JOB NO.	DRAWING NO.	REVISION	
1114	L(00) - 301	B	

- GENERAL NOTES
- DO NOT SCALE FROM THIS DRAWING.
 - ALL DIMENSIONS TO BE CHECKED ON SITE.
 - ANY DISCREPANCIES SHOULD BE REPORTED TO THE ARCHITECT / CONTRACT ADMINISTRATOR.

Notes

Indicative material palette subject to conditions discharge:

- 01 White split-faced masonry with white mortar
- 02 Dark grey split-faced masonry with black mortar
- 03 White tile with white mortar
- 04 "Eau de Nil" coloured toughened safety glass balconies
- 05 "Eau de Nil" coloured toughened safety glass Juliette balconies
- 06 Double-glazed window with charcoal grey finish
- 07 Opaque glazed screen
- 08 Double glazed curtain walling
- 09 Timber infill panel
- 10 Transparent acoustic glazing
- 11 Hardwood door
- 12 Hardwood sliding door
- 13 Steel and timber frame
- 14 Timber decking
- 15 Steelwork balustrades
- 16 Coarse-grain multi barrette mesh
- 17 Security roller shutter
- 18 White insulated glazed panel with charcoal grey finish
- 19 White masonry with white mortar
- 20 Metal cladding



01 South Elevation
Proposed

A	07.11.13	Window amended in accordance with layout
-	18.10.13	Preliminary issue

REVISION	DATE	DESCRIPTION	©
----------	------	-------------	---

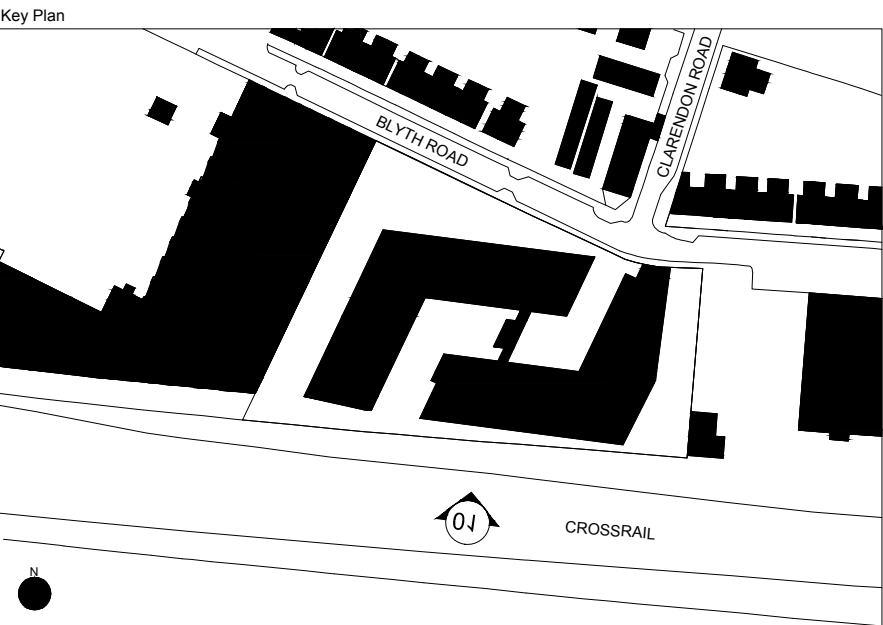
FRANK REYNOLDS ARCHITECTS
14 Clerkwell Green
Ipswich
London
EC1R 6DP
www.frankreynoldsarchitects.com

CLIENT
WILMOTT DIXON HOUSING LTD
ISIS WATERSIDE REGENERATION

PROJECT
THE GATEFOLD BUILDING

DRAWING NAME
SOUTH ELEVATION

STATUS			DATE
PRELIMINARY			AUG 2013
DRAWN BY	CHECK BY	SCALE	SIZE
GF	MH	1:200	A1
JOB NO.	DRAWING NO.	REVISION	
1114	L(00) - 303	A	



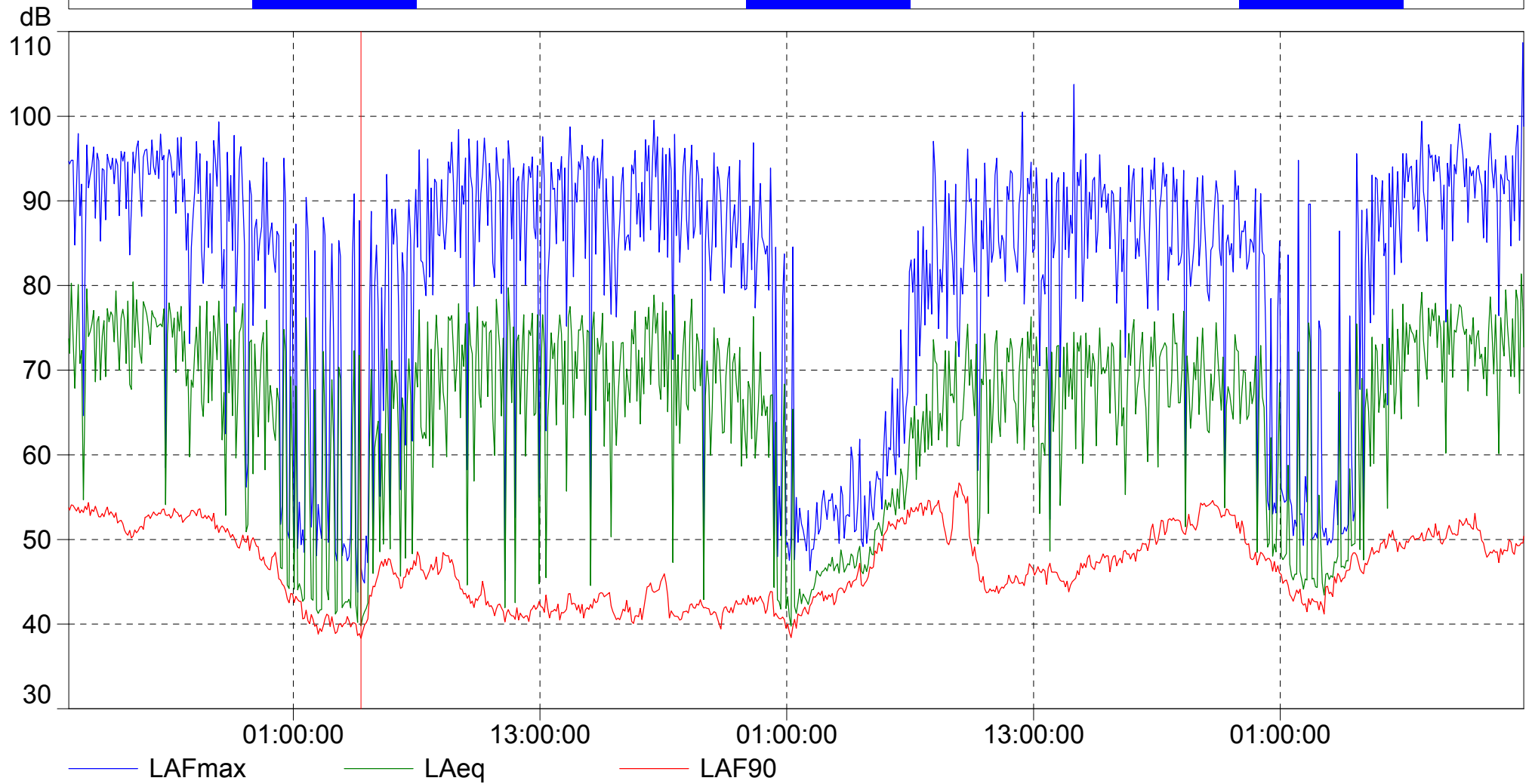


A P P E N D I X C

Results of long-term noise monitoring

Location 1

Daytime Night-time



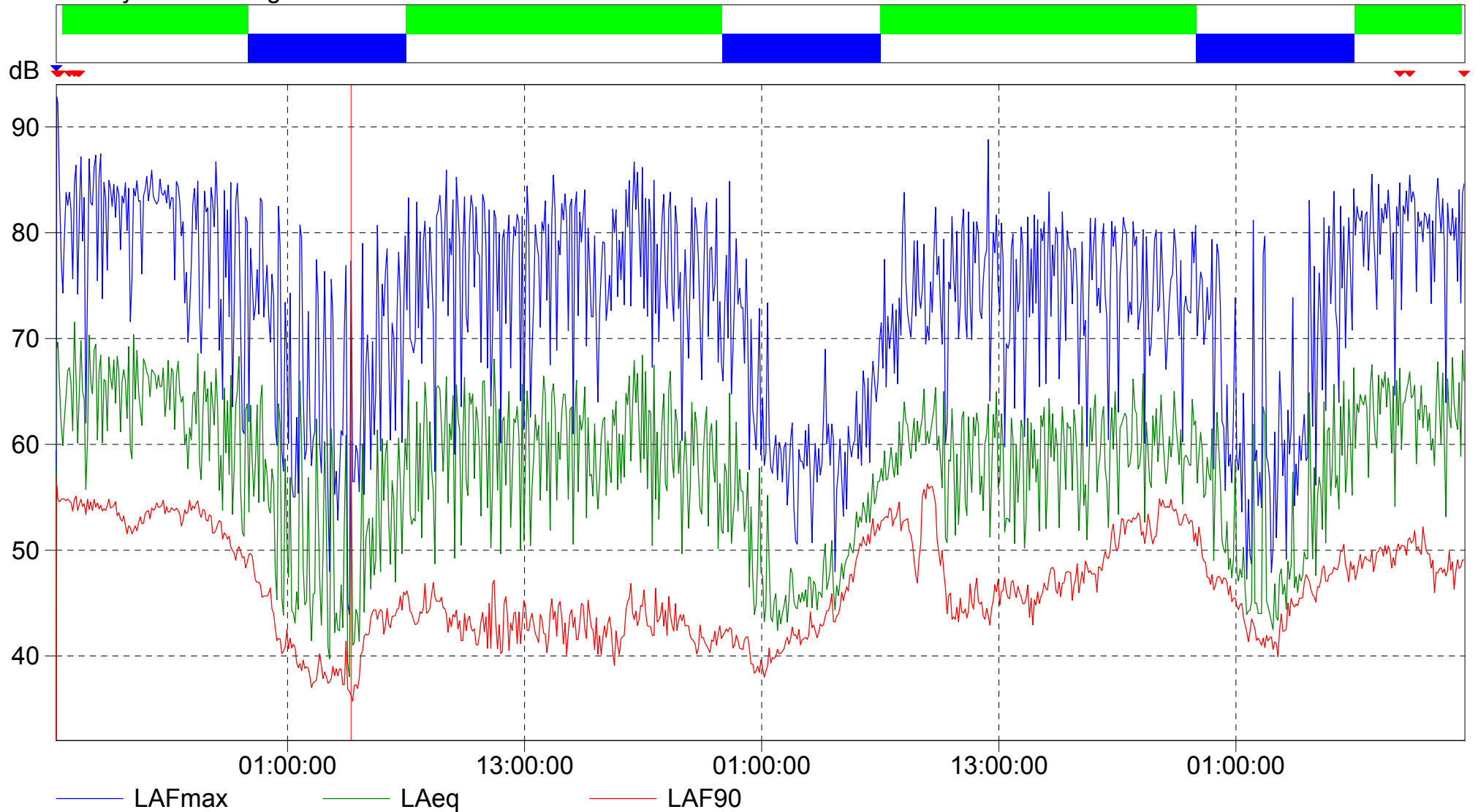
Cursor: 05/10/2013 04:15:00 - 04:20:00 LAFmax=46.7 dB LAeq=39.8 dB LAF90=38.3 dB

Location 1

Name	Start time	LAFmax [dB]	LAeq [dB]	LAF90 [dB]	LZeq 63Hz [dB]	LZeq 125Hz [dB]	LZeq 250Hz [dB]	LZeq 500Hz [dB]	LZeq 1kHz [dB]	LZeq 2kHz [dB]	LZeq 4kHz [dB]
Total	04/10/2013 13:52:40	108.7	71.0	21.8	64.8	63.4	62.8	65.8	68.1	64.2	54.5
Unmarked	04/10/2013 13:52:40	102.3	54.8	21.2	47.9	45.5	44.1	45.2	51.5	48.1	45.1
(All) Daytime	04/10/2013 13:55:00	108.7	72.9	42.9	66.5	65.2	64.5	67.7	70.2	66.3	56.2
(All) Night-time	04/10/2013 23:00:00	96.9	66.0	41.7	61.9	60.3	60.3	61.7	62.8	58.8	50.9
Daytime	04/10/2013 13:55:00	99.3	74.7	51.5	68.0	66.2	65.6	69.3	72.0	68.2	58.0
Daytime	05/10/2013 07:00:00	99.5	72.7	41.7	65.3	63.3	63.1	67.1	69.9	66.4	55.8
Daytime	06/10/2013 07:00:00	103.8	70.3	46.2	65.3	65.5	64.3	66.0	67.7	62.3	53.1
Daytime	07/10/2013 07:00:00	108.7	75.0	49.4	68.5	66.5	65.9	69.7	72.0	68.5	58.8
Night-time	04/10/2013 23:00:00	95.1	66.9	40.7	63.3	60.7	60.9	62.7	63.8	59.7	51.0
Night-time	05/10/2013 23:00:00	96.9	61.3	41.7	57.8	56.7	56.5	56.3	58.4	54.2	44.8
Night-time	06/10/2013 23:00:00	95.6	67.5	44.2	62.8	62.0	61.8	63.4	64.3	60.4	53.3

Location 2

Daytime Night-time



Cursor: 05/10/2013 04:10:00 - 04:15:00 LAFmax=77.3 dB LAeq=60.3 dB LAF90=36.3 dB

Location 2

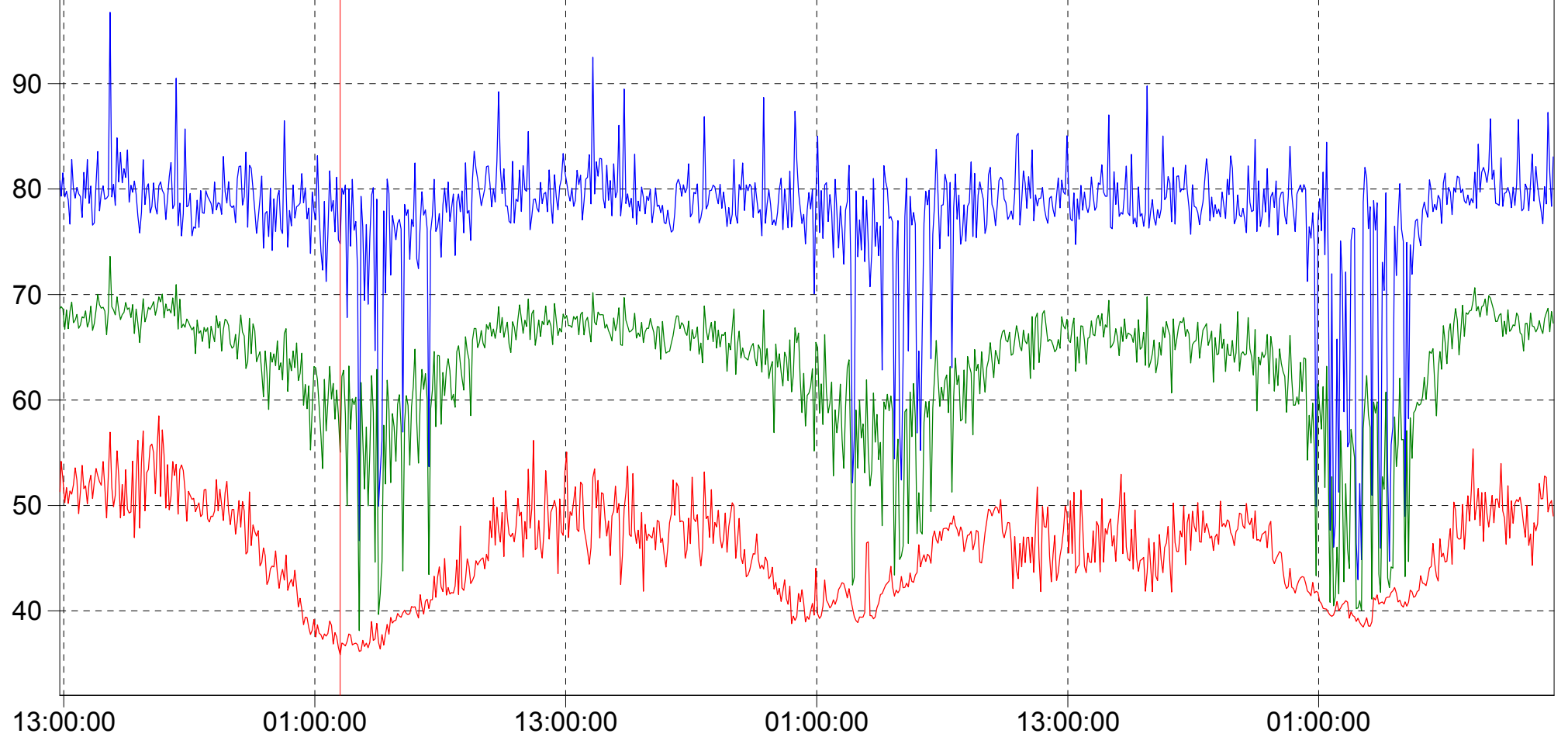
Name	Start time	LAFmax [dB]	LAeq [dB]	LAF90 [dB]	LLeq 63Hz [dB]	LLeq 125Hz [dB]	LLeq 250Hz [dB]	LLeq 500Hz [dB]	LLeq 1kHz [dB]	LLeq 2kHz [dB]	LLeq 4kHz [dB]
Total	04/10/2013 13:17:56	92.9	61.5	42.6	64.4	60.1	57.5	58.1	58.2	54.1	43.7
Unmarked	04/10/2013 13:17:56	92.9	67.5	50.9	67.7	63.5	61.3	62.7	63.8	60.8	54.0
(All) Daytime	04/10/2013 13:35:00	88.8	62.8	45.1	65.4	61.3	58.6	59.4	59.5	55.4	44.7
(All) Night-time	04/10/2013 23:00:00	84.9	56.2	40.4	60.7	55.8	53.3	53.3	52.6	48.1	39.0
Daytime	04/10/2013 13:35:00	87.5	65.4	52.4	67.2	62.8	60.6	61.7	62.1	58.2	47.5
Daytime	05/10/2013 07:00:00	86.7	61.9	42.6	64.6	60.2	57.4	58.2	58.4	55.0	44.2
Daytime	06/10/2013 07:00:00	88.8	60.6	46.8	64.1	60.9	57.6	57.8	57.6	51.1	40.9
Daytime	07/10/2013 07:00:00	85.5	64.0	48.9	67.1	62.4	60.0	60.7	60.4	57.0	46.4
Night-time	04/10/2013 23:00:00	83.3	56.9	38.7	61.6	56.3	53.8	54.2	53.2	49.0	39.9
Night-time	05/10/2013 23:00:00	84.9	52.7	40.7	57.9	52.9	50.9	49.9	49.3	43.7	33.2
Night-time	06/10/2013 23:00:00	84.1	57.6	43.1	61.5	57.2	54.4	54.5	54.1	49.6	40.9

Location 3

Daytime Night-time



dB



LAFmax LAeq LAF90

Cursor: 05/10/2013 02:10:00 - 02:15:00 LAFmax=74.8 dB LAeq=55.0 dB LAF90=35.8 dB

Location 3

Name	Start time	LAFmax [dB]	LAeq [dB]	LAF90 [dB]	LLeq 63Hz [dB]	LLeq 125Hz [dB]	LLeq 250Hz [dB]	LLeq 500Hz [dB]	LLeq 1kHz [dB]	LLeq 2kHz [dB]	LLeq 4kHz [dB]
Total	04/10/2013 12:48:26	96.7	65.3	41.5	68.4	59.9	59.4	58.9	62.6	58.5	47.8
Unmarked	04/10/2013 12:48:26	83.0	68.0	50.1	70.3	60.0	61.7	61.7	65.3	61.3	50.8
(All) Daytime	04/10/2013 12:50:00	96.7	66.6	47.0	69.7	61.2	60.7	60.2	63.9	59.8	49.1
(All) Night-time	04/10/2013 23:00:00	87.4	60.6	39.4	63.7	55.6	54.6	54.1	57.8	54.1	43.3
Daytime	04/10/2013 12:50:00	96.7	67.6	49.4	71.1	62.3	61.8	61.4	64.9	60.8	50.1
Daytime	05/10/2013 07:00:00	92.5	66.4	45.8	68.9	60.5	60.1	59.9	63.7	59.6	48.8
Daytime	06/10/2013 07:00:00	89.8	65.5	46.6	68.8	60.4	60.3	59.2	62.8	58.7	47.7
Daytime	07/10/2013 07:00:00	87.3	67.7	48.6	70.6	62.1	61.3	61.2	64.9	61.1	50.6
Night-time	04/10/2013 23:00:00	86.5	60.9	37.7	63.2	55.0	54.2	54.2	58.2	54.4	43.6
Night-time	05/10/2013 23:00:00	87.4	60.6	40.5	64.5	57.2	55.3	54.2	57.8	53.8	42.9
Night-time	06/10/2013 22:00:00	84.4	60.4	40.3	63.4	54.2	54.0	54.0	57.5	54.0	43.4

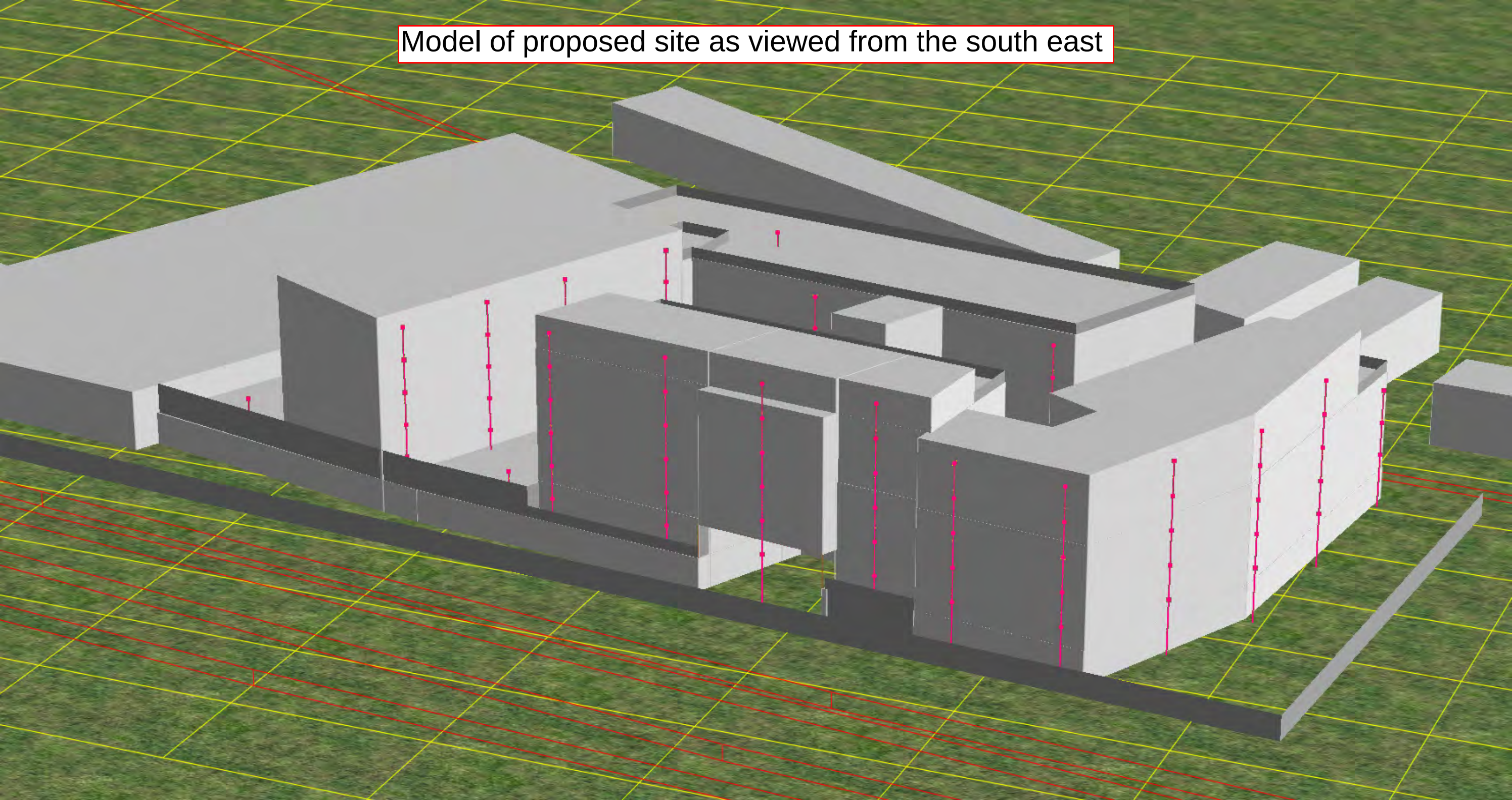


A P P E N D I X D

Figures showing 'Predictor' noise model



Model of proposed site as viewed from the south east





A P P E N D I X E

Prediction results for daytime and night-time L_{Aeq} 's

Report: Table of Results
 Model: 2014 proposal - Day
 LAeq per octave: total results for receivers
 Group: (main group)
 Group Reduction: No

Name			Day									
Receiver	Description	Height	Total	63	125	250	500	1000	2000	4000	8000	
C_Gard_A		1.50	57	33	39	44	51	54	48	35	24	
C_Gard2_A		1.50	52	28	33	38	46	49	45	33	20	
Ch_Play_A		1.50	54	32	37	42	48	51	45	32	14	
E_Amen_A		1.50	56	31	37	42	49	53	49	35	18	
E2E1_A		5.20	67	34	41	50	60	65	62	51	41	
E2E1_B		8.40	67	37	44	51	60	64	62	51	41	
E2E1_C		11.60	67	37	44	51	59	64	62	51	40	
E2E1_D		14.80	67	37	44	51	59	64	61	51	40	
E2E1_E		18.00	67	37	44	51	59	64	61	50	39	
E2E2_A		5.20	66	33	41	48	58	63	61	50	38	
E2E2_B		8.40	67	35	43	50	59	64	61	50	38	
E2E2_C		11.60	66	36	43	50	59	64	61	49	38	
E2E2_D		14.80	66	36	43	50	59	64	61	49	38	
E2E2_E		18.00	66	37	43	50	59	63	61	49	37	
E2E3_A		5.20	64	32	39	47	56	61	58	46	33	
E2E3_B		8.40	64	34	41	48	57	61	58	46	33	
E2E3_C		11.60	64	34	41	48	57	61	58	46	33	
E2E3_D		14.80	64	35	41	48	57	62	59	46	33	
E2E3_E		18.00	64	35	42	48	57	61	58	46	33	
E2E4_A		5.20	64	36	43	48	57	61	57	46	32	
E2E4_B		8.40	63	36	42	48	56	60	57	45	31	
E2E4_C		11.60	63	35	41	47	55	60	56	44	30	
E2W1_A		5.20	61	36	42	47	54	58	54	43	29	
E2W1_B		8.40	60	35	41	46	53	57	52	41	28	
E2W1_C		11.60	59	34	40	45	52	56	51	40	26	
E2W2_A		5.20	55	30	36	41	48	52	48	37	22	
E2W2_B		8.40	55	31	36	42	49	53	48	37	22	
E2W2_C		11.60	55	30	37	41	49	52	48	36	22	
E2W2_D		14.80	55	31	37	42	49	52	48	36	21	
E2W2_E		18.00	57	32	38	43	51	55	50	38	22	
E2W3_A		5.20	52	28	33	39	46	50	46	34	19	
E2W3_B		8.40	52	28	33	39	45	49	45	33	19	
E2W3_C		11.60	53	28	34	39	46	50	45	34	19	
E2W3_D		14.80	53	30	35	40	47	50	45	33	19	
E2W3_E		18.00	56	31	37	43	50	54	49	36	20	
E2W4_A		5.20	50	26	31	36	44	48	43	32	18	
E2W4_B		8.40	51	26	31	37	44	48	44	32	18	
E2W4_C		11.60	51	27	33	38	45	49	44	32	18	
E2W4_D		14.80	52	29	34	39	46	49	44	32	18	
E2W4_E		18.00	57	31	37	43	51	54	50	37	21	
E2W5_A		5.20	51	27	32	37	44	48	44	31	18	
E2W5_B		8.40	51	27	32	36	43	49	45	32	18	
E2W5_C		11.60	51	27	32	37	44	49	44	33	19	
E2W5_D		14.80	52	29	33	38	44	49	45	32	19	
E2W5_E		18.00	60	32	38	44	52	57	54	42	29	
E2W6_A		5.20	49	24	29	34	43	46	43	30	18	
E2W6_B		8.40	50	26	31	36	44	48	43	31	18	
E2W6_C		11.60	51	27	32	36	44	48	44	32	18	
E2W6_D		14.80	53	29	34	39	46	50	46	33	19	
E2W7_A		5.20	51	26	32	37	44	48	43	30	16	

All shown dB values are A-weighted

Report: Table of Results
 Model: 2014 proposal - Day
 LAeq per octave: total results for receivers
 Group: (main group)
 Group Reduction: No

Name			Day									
Receiver	Description	Height	Total	63	125	250	500	1000	2000	4000	8000	
E2W7_B		8.40	54	28	34	40	47	51	48	35	22	
E2W7_C		11.60	56	28	35	40	49	53	50	37	24	
E2W7_D		14.80	57	29	36	42	50	54	51	39	25	
G_Amen_A		1.50	59	34	39	45	52	57	52	41	28	
N1_A		5.20	63	38	44	49	56	60	56	45	31	
N1_B		8.40	62	37	43	48	55	59	55	44	30	
N1_C		11.60	61	36	42	47	54	58	54	43	29	
N1_D		14.80	60	35	41	46	53	57	53	42	27	
N2_A		5.20	61	36	42	47	54	58	54	43	29	
N2_B		8.40	61	35	41	47	54	58	54	42	28	
N2_C		11.60	60	35	41	46	53	57	53	42	27	
N2_D		14.80	60	34	40	46	53	57	52	41	26	
N3_A		5.20	59	34	39	45	52	56	52	41	27	
N3_B		8.40	60	33	40	46	53	57	53	41	27	
N3_C		11.60	59	34	40	45	53	57	52	41	26	
N3_D		14.80	59	34	40	45	52	56	52	40	25	
N4_A		5.20	57	31	37	43	50	55	50	38	23	
N4_B		8.40	59	31	38	44	52	57	52	41	26	
N4_C		11.60	59	32	39	45	52	56	52	40	25	
N4_D		14.80	59	33	39	45	52	56	51	40	24	
N5_A		5.20	56	29	35	41	49	53	48	36	20	
N5_B		8.40	57	29	35	42	50	54	51	39	24	
N5_C		11.60	58	30	36	44	51	55	51	39	23	
N5_D		14.80	58	31	38	44	51	55	50	38	23	
Roof_Am_A		1.50	51	29	34	38	45	48	43	28	12	
S1_A		2.00	71	37	46	54	63	68	66	55	45	
S1_B		5.20	71	40	47	54	63	68	65	55	45	
S1_C		8.40	71	40	47	54	63	68	65	54	44	
S1_D		11.60	70	40	47	54	63	67	65	54	44	
S1_E		14.80	70	39	46	53	62	67	64	53	43	
S1_F		18.00	70	39	46	53	62	67	64	53	42	
S2_A		2.00	71	37	46	54	63	68	65	55	45	
S2_B		5.20	71	40	47	54	63	68	65	55	45	
S2_C		8.40	70	40	47	54	63	67	65	54	44	
S2_D		11.60	70	39	46	53	62	67	64	54	43	
S2_E		14.80	70	39	46	53	62	67	64	53	43	
S2_F		18.00	69	39	46	53	62	66	64	53	42	
S3_A		5.20	71	39	47	54	63	68	66	55	46	
S3_B		8.40	71	40	47	54	63	68	66	55	45	
S3_C		11.60	71	40	47	54	63	68	65	55	45	
S3_D		14.80	71	40	47	54	63	68	65	54	44	
S3_E		18.00	70	39	46	53	62	67	65	54	43	
S3_F		21.20	70	39	46	53	63	68	65	54	43	
S4_A		5.20	71	37	46	54	63	68	66	55	46	
S4_B		8.40	71	41	48	55	64	68	66	55	45	
S4_C		11.60	71	40	47	54	63	68	66	55	45	
S4_D		14.80	71	40	47	54	63	68	65	54	44	
S4_E		18.00	71	40	47	54	63	68	65	54	44	
S4_F		21.20	70	39	46	53	62	67	64	53	42	
S6_A		5.20	71	40	48	55	64	68	66	56	46	

All shown dB values are A-weighted

Report: Table of Results
 Model: 2014 proposal - Day
 LAeq per octave: total results for receivers
 Group: (main group)
 Group Reduction: No

Name			Day									
Receiver	Description	Height	Total	63	125	250	500	1000	2000	4000	8000	
S6_B		8.40	71	40	47	54	63	68	66	55	46	
S6_C		11.60	71	40	47	54	63	68	65	55	45	
S6_D		14.80	71	40	47	54	63	68	65	54	44	
S6_E		18.00	70	39	46	53	62	67	64	54	43	
S7_A		5.20	72	40	48	55	64	69	66	56	46	
S7_B		8.40	72	41	48	55	64	69	66	55	46	
S7_C		11.60	71	40	47	54	63	68	66	55	45	
S7_D		14.80	71	40	47	54	63	68	65	55	44	
S7_E		18.00	70	39	46	53	62	67	65	54	43	
W_Gard_A		1.50	58	34	40	45	52	54	49	36	24	
W1_A		2.00	56	32	38	44	51	53	48	34	22	
W1_B		5.20	66	33	40	48	58	63	61	50	39	
W1_C		8.40	66	36	43	50	59	63	61	49	39	
W1_D		11.60	66	36	43	50	59	63	60	49	38	
W1_E		14.80	66	36	43	50	58	63	60	49	38	
W2_A		2.00	54	31	36	41	49	51	46	32	19	
W2_B		5.20	59	31	37	43	52	56	53	41	28	
W2_C		8.40	63	31	38	46	55	61	58	46	34	
W2_D		11.60	64	33	40	47	56	61	58	46	34	
W2_E		14.80	64	34	41	48	56	61	58	46	34	
W2E1_A		2.00	58	34	39	45	52	55	49	36	25	
W2E1_B		5.20	70	38	46	53	62	67	64	53	44	
W2E1_C		8.40	69	39	46	53	61	66	64	53	43	
W2E1_D		11.60	69	38	45	52	61	66	63	53	42	
W2E1_E		14.80	69	38	45	52	61	66	63	52	42	
W2E2_A		2.00	54	31	36	42	49	51	46	32	20	
W2E2_B		5.20	61	32	38	45	54	58	56	45	33	
W2E2_C		8.40	66	33	41	48	58	63	60	49	39	
W2E2_D		11.60	65	35	42	49	58	63	60	49	39	
W2E2_E		14.80	65	35	42	49	58	62	60	49	38	
W2E3_A		5.20	57	29	35	42	50	54	50	38	24	
W2E3_B		8.40	62	30	37	44	53	59	56	44	32	
W2E3_C		11.60	63	31	39	46	55	60	58	46	35	
W2E3_D		14.80	63	32	40	47	56	60	57	46	35	
W2E4_A		5.20	52	27	32	38	46	49	45	31	16	
W2E4_B		8.40	56	27	33	40	49	53	51	39	25	
W2E4_C		11.60	59	28	34	42	52	57	54	42	29	
W2E4_D		14.80	60	29	36	44	53	57	55	43	31	
W2E5_A		5.20	50	26	31	36	44	47	43	29	14	
W2E5_B		8.40	53	26	32	37	46	50	47	34	20	
W2E5_C		11.60	57	28	33	39	49	54	51	39	25	
W2E6_A		5.20	49	26	30	36	43	46	41	27	11	
W2E6_B		8.40	51	26	31	37	44	48	44	31	16	
W2E6_C		11.60	54	28	32	38	47	51	48	35	20	
W2E7_A		5.20	48	27	31	35	42	45	41	28	14	
W2E7_B		8.40	48	27	31	35	41	45	40	28	13	
W2E7_C		11.60	49	28	32	37	43	46	41	28	13	
W3_A		2.00	52	29	35	40	46	49	44	30	16	
W3_B		5.20	57	30	36	42	50	54	50	36	22	
W3_C		8.40	60	30	36	43	52	58	55	43	30	

All shown dB values are A-weighted

Report: Table of Results
 Model: 2014 proposal - Day
 LAeq per octave: total results for receivers
 Group: (main group)
 Group Reduction: No

Name			Day									
Receiver	Description	Height	Total	63	125	250	500	1000	2000	4000	8000	
W3_D		11.60	62	30	38	45	55	60	56	44	32	
W3_E		14.80	63	32	39	46	55	60	57	45	32	
W4_A		2.00	52	29	34	39	46	49	43	29	14	
W4_B		5.20	56	29	35	41	49	53	48	34	18	
W4_C		8.40	58	29	35	42	50	55	52	39	26	
W4_D		11.60	61	29	36	44	53	58	55	43	29	
W4_E		14.80	62	31	38	45	54	59	56	43	30	
W5_A		2.00	50	28	33	38	44	47	42	27	12	
W5_B		5.20	54	28	34	40	48	51	47	32	15	
W5_C		8.40	56	28	35	41	49	53	50	36	21	
W5_D		11.60	59	29	35	42	51	56	53	40	25	
W5_E		14.80	60	29	36	43	52	57	54	41	26	
W6_A		2.00	53	29	34	40	47	51	45	32	15	
W6_B		5.20	55	29	35	41	49	52	48	34	20	
W6_C		8.40	57	29	35	42	50	54	50	37	20	
W6_D		11.60	58	30	36	43	51	55	52	38	22	

Report: Table of Results
 Model: As proposed - Night
 LAeq per octave: total results for receivers
 Group: (main group)
 Group Reduction: No

Name			Night								
Receiver	Description	Height	Total	63	125	250	500	1000	2000	4000	8000
C_Gard_A		1.50	50	28	34	39	45	46	41	29	19
C_Gard2_A		1.50	46	22	27	33	39	42	39	28	14
Ch_Play_A		1.50	46	28	32	35	41	43	37	25	11
E_Amen_A		1.50	49	27	32	36	43	45	41	28	12
E2E1_A		5.20	60	28	35	42	52	57	54	46	37
E2E1_B		8.40	61	31	39	46	54	57	55	46	37
E2E1_C		11.60	60	32	39	46	53	57	55	46	36
E2E1_D		14.80	60	32	39	45	53	57	54	45	36
E2E1_E		18.00	60	32	39	45	53	57	54	45	35
E2E2_A		5.20	57	27	34	41	50	54	52	43	32
E2E2_B		8.40	59	29	37	44	52	56	53	44	34
E2E2_C		11.60	59	30	38	44	52	56	53	44	33
E2E2_D		14.80	59	31	37	44	52	56	53	44	33
E2E2_E		18.00	59	31	38	44	52	56	53	43	33
E2E3_A		5.20	55	27	33	40	48	52	49	39	27
E2E3_B		8.40	56	29	35	41	49	53	50	40	29
E2E3_C		11.60	57	29	35	42	50	54	51	41	29
E2E3_D		14.80	57	29	36	42	50	54	51	40	28
E2E3_E		18.00	57	30	36	42	50	54	50	40	28
E2E4_A		5.20	56	32	37	42	49	53	49	39	28
E2E4_B		8.40	56	32	37	42	49	53	49	39	27
E2E4_C		11.60	56	31	36	42	49	52	49	39	26
E2W1_A		5.20	54	32	37	41	48	51	46	37	26
E2W1_B		8.40	53	31	36	40	47	50	45	36	25
E2W1_C		11.60	52	30	35	39	46	49	45	35	23
E2W2_A		5.20	48	26	31	35	42	45	40	30	18
E2W2_B		8.40	48	26	31	35	42	45	41	31	18
E2W2_C		11.60	49	26	31	35	42	46	42	32	19
E2W2_D		14.80	49	27	31	36	43	46	42	32	19
E2W2_E		18.00	51	27	33	38	45	48	44	33	20
E2W3_A		5.20	44	23	28	32	38	41	37	27	13
E2W3_B		8.40	45	24	28	32	39	42	38	28	13
E2W3_C		11.60	46	24	28	32	39	42	39	28	12
E2W3_D		14.80	46	25	29	34	40	43	39	28	12
E2W3_E		18.00	50	26	32	37	44	46	42	31	16
E2W4_A		5.20	42	22	26	29	36	39	35	24	--
E2W4_B		8.40	42	22	26	29	36	39	34	24	--
E2W4_C		11.60	42	23	27	30	36	38	34	24	--
E2W4_D		14.80	43	25	29	32	37	39	34	24	--
E2W4_E		18.00	49	27	32	37	43	46	41	30	10
E2W5_A		5.20	42	22	26	29	35	38	34	24	--
E2W5_B		8.40	42	23	26	30	36	38	34	24	--
E2W5_C		11.60	42	23	27	30	36	38	34	24	--
E2W5_D		14.80	43	24	28	32	37	39	34	24	--
E2W5_E		18.00	52	27	32	38	45	49	46	36	24
E2W6_A		5.20	54	26	33	39	47	51	49	40	30
E2W6_B		8.40	54	27	33	40	47	51	49	40	30
E2W6_C		11.60	54	27	33	39	47	51	48	39	29
E2W6_D		14.80	54	27	33	40	47	51	48	39	29
E2W7_A		5.20	41	22	26	30	35	37	32	22	--

All shown dB values are A-weighted

Gatefold development - Environmental Noise Model

Predicted noise exposure
All locations, Night-time LAeq

Report: Table of Results
Model: As proposed - Night
LAeq per octave: total results for receivers
Group: (main group)
Group Reduction: No

Name Receiver	Description	Height	Night Total	63	125	250	500	1000	2000	4000	8000
E2W7_B		8.40	43	24	28	33	38	40	35	23	--
E2W7_C		11.60	44	24	29	33	39	40	35	23	--
E2W7_D		14.80	44	25	30	34	39	40	35	23	--
G_Amen_A		1.50	51	30	35	38	45	48	44	34	23
N1_A		5.20	56	33	38	42	49	52	48	38	28
N1_B		8.40	55	32	37	41	48	51	47	37	27
N1_C		11.60	54	31	37	41	47	50	46	36	25
N1_D		14.80	53	31	36	40	47	49	45	35	24
N2_A		5.20	54	31	36	40	47	51	46	36	26
N2_B		8.40	53	31	36	40	47	50	46	36	25
N2_C		11.60	53	31	36	40	47	49	45	35	24
N2_D		14.80	52	30	35	39	46	49	44	34	23
N3_A		5.20	51	29	34	38	45	48	44	34	24
N3_B		8.40	52	29	34	39	46	49	45	34	23
N3_C		11.60	52	29	35	39	46	49	44	34	22
N3_D		14.80	51	29	34	38	45	48	44	33	21
N4_A		5.20	48	26	31	35	42	45	41	30	18
N4_B		8.40	51	26	32	36	45	48	43	33	22
N4_C		11.60	51	27	34	38	45	48	43	33	21
N4_D		14.80	51	28	34	38	45	47	43	32	20
N5_A		5.20	46	25	30	33	40	43	38	27	14
N5_B		8.40	48	25	30	34	42	45	42	31	19
N5_C		11.60	49	26	31	36	44	46	42	31	19
N5_D		14.80	49	27	33	37	44	46	42	30	18
Roof_Am_A		1.50	45	24	29	34	40	41	36	23	--
S1_A		2.00	64	32	41	49	57	61	59	50	41
S1_B		5.20	64	35	42	49	57	61	58	50	41
S1_C		8.40	64	35	42	49	57	60	58	49	40
S1_D		11.60	63	34	41	48	56	60	57	49	39
S1_E		14.80	63	34	41	48	56	60	57	48	39
S1_F		18.00	63	34	41	48	56	59	57	48	38
S2_A		2.00	64	32	41	49	57	61	58	50	41
S2_B		5.20	64	35	42	49	57	61	58	49	41
S2_C		8.40	64	35	42	49	57	60	58	49	40
S2_D		11.60	63	34	41	48	56	60	57	49	39
S2_E		14.80	63	34	41	48	56	60	57	48	39
S2_F		18.00	63	34	41	48	56	59	57	48	38
S3_A		5.20	64	32	41	49	57	61	59	50	42
S3_B		8.40	64	35	42	49	57	61	58	50	41
S3_C		11.60	64	35	42	49	57	61	58	49	40
S3_D		14.80	64	35	41	48	56	60	58	49	40
S3_E		18.00	63	34	41	48	56	60	57	48	39
S3_F		21.20	63	34	41	48	56	59	57	48	38
S4_A		5.20	64	32	41	49	57	61	58	50	41
S4_B		8.40	64	35	42	49	57	61	58	50	41
S4_C		11.60	64	35	42	49	57	60	58	49	40
S4_D		14.80	63	34	41	48	56	60	57	49	40
S4_E		18.00	63	34	41	48	56	60	57	48	39
S4_F		21.20	63	34	41	48	56	59	57	48	38
S6_A		5.20	65	35	42	49	57	61	59	50	42

All shown dB values are A-weighted

Report: Table of Results
 Model: As proposed - Night
 LAeq per octave: total results for receivers
 Group: (main group)
 Group Reduction: No

Name			Night								
Receiver	Description	Height	Total	63	125	250	500	1000	2000	4000	8000
S6_B		8.40	64	35	42	49	57	61	59	50	41
S6_C		11.60	64	35	42	49	57	61	58	50	41
S6_D		14.80	64	35	42	49	57	60	58	49	40
S6_E		18.00	63	34	41	48	56	60	57	48	39
S7_A		5.20	65	35	42	49	57	61	59	50	42
S7_B		8.40	64	35	42	49	57	61	59	50	41
S7_C		11.60	64	35	42	49	57	61	58	50	41
S7_D		14.80	64	35	42	49	57	60	58	49	40
S7_E		18.00	63	34	41	48	56	60	57	48	39
W_Gard_A		1.50	50	29	34	40	45	47	41	29	18
W1_A		2.00	50	28	33	39	45	46	41	29	15
W1_B		5.20	59	28	35	43	52	56	53	44	35
W1_C		8.40	59	30	38	45	52	56	53	44	35
W1_D		11.60	59	31	38	45	52	56	53	44	34
W1_E		14.80	59	31	38	44	52	56	53	44	34
W2_A		2.00	47	26	31	36	42	43	38	26	--
W2_B		5.20	53	26	32	38	46	49	46	37	25
W2_C		8.40	57	26	33	41	50	54	51	41	30
W2_D		11.60	57	28	35	42	50	54	51	41	30
W2_E		14.80	57	29	35	42	50	54	51	41	30
W2E1_A		2.00	52	29	35	40	47	48	43	32	20
W2E1_B		5.20	63	33	40	47	55	59	57	48	39
W2E1_C		8.40	62	33	40	47	55	59	56	48	39
W2E1_D		11.60	62	33	40	47	55	59	56	47	38
W2E1_E		14.80	62	33	40	47	55	58	56	47	37
W2E2_A		2.00	48	26	32	37	43	44	39	28	14
W2E2_B		5.20	55	27	33	40	48	52	49	41	31
W2E2_C		8.40	59	28	36	43	52	55	53	44	35
W2E2_D		11.60	58	30	37	44	51	55	52	44	34
W2E2_E		14.80	58	30	37	43	51	55	52	43	34
W2E3_A		5.20	49	24	30	36	43	46	43	32	21
W2E3_B		8.40	54	25	31	38	47	50	48	39	29
W2E3_C		11.60	55	26	33	40	48	52	50	41	30
W2E3_D		14.80	55	28	34	41	48	52	49	40	30
W2E4_A		5.20	45	22	27	33	39	42	38	26	--
W2E4_B		8.40	48	22	28	34	41	45	43	32	20
W2E4_C		11.60	51	24	29	36	44	48	45	35	24
W2E4_D		14.80	52	25	31	37	45	49	46	37	26
W2E5_A		5.20	47	22	27	33	40	44	40	30	18
W2E5_B		8.40	49	22	28	34	42	46	43	33	21
W2E5_C		11.60	51	23	29	36	44	48	45	35	22
W2E6_A		5.20	41	21	26	30	36	38	33	21	--
W2E6_B		8.40	43	22	26	31	37	40	36	25	--
W2E6_C		11.60	46	23	27	32	39	43	39	28	--
W2E7_A		5.20	49	23	28	33	41	46	43	33	22
W2E7_B		8.40	50	23	28	35	43	47	45	35	23
W2E7_C		11.60	51	25	30	36	44	47	44	35	23
W3_A		2.00	45	24	30	35	40	42	36	23	--
W3_B		5.20	50	25	31	37	44	47	43	32	18
W3_C		8.40	54	25	31	38	46	50	48	38	26

All shown dB values are A-weighted

Report: Table of Results
 Model: As proposed - Night
 LAeq per octave: total results for receivers
 Group: (main group)
 Group Reduction: No

Name			Night								
Receiver	Description	Height	Total	63	125	250	500	1000	2000	4000	8000
W3_D		11.60	56	26	33	40	49	53	50	39	28
W3_E		14.80	56	27	34	41	49	53	50	39	27
W4_A		2.00	44	24	29	34	40	41	35	22	--
W4_B		5.20	49	24	30	36	43	46	41	29	10
W4_C		8.40	51	24	30	37	44	48	45	35	22
W4_D		11.60	54	25	31	38	47	51	48	38	25
W4_E		14.80	55	26	33	40	48	52	49	38	25
W5_A		2.00	43	23	28	32	38	39	33	20	--
W5_B		5.20	47	24	29	35	41	44	39	26	--
W5_C		8.40	49	24	29	35	43	46	42	31	15
W5_D		11.60	51	24	30	36	45	48	45	34	20
W5_E		14.80	53	25	31	38	46	50	47	35	22
W6_A		2.00	44	24	29	33	39	40	34	22	--
W6_B		5.20	47	25	30	35	41	44	39	27	14
W6_C		8.40	49	25	30	36	43	46	42	30	14
W6_D		11.60	51	25	31	36	44	48	44	32	17



A P P E N D I X F

Sample intrusive noise calculations

Date: 04/07/2014

Project No: 13172

Project: Gatefold

Plot name and receiver room: 105F LR - Living Room

Estimated Indoor Ambient Noise Levels

Estimation of the indoor ambient noise level in a room based on the external noise levels and façade sound insulation taken from equations in Section 6.7.2.1 of BS8233:1999

$$L_{\text{internal}} = L_{\text{external}} - \Sigma R + 10 \log S + 10 \log T - 10 \log 0.163V + 3 + C$$

Where: - L_{internal}	- estimated indoor reverberant sound pressure level
L_{external}	- measured external sound pressure level (LAeq, 16hr) - i.e. the design external LAeq,
C	- correction factor to convert the measured external sound pressure level to 'free field' (6dB for measurements within millimetres of the façade, 3dB for measurements 2m from the façade)
ΣR	- overall sound reduction of the facade
T	- reverberation time inside the room in question
V	- volume of the room in question

External Noise Spectral Data	dB(A)	Octave Band Centre Frequency (Hz)							
		63	125	250	500	1k	2k	4k	8k
LAeq, 16hr	71	40	47	54	63	68	66	55	46
Façade Correction Factor, C		0	0	0	0	0	0	0	0

Reduction of façade elements

Glazing - Pilkington 10/12/6	Area:	13	m ²						
	R:	20	26	27	34	40	38	46	44
Wall - Brick and block external wall	Area:	12	m ²						
	R:	34	40	44	45	51	56	60	63
Doors	Area:		m ²						
	R:								
Rooflight	Area:		m ²						
	R:								
Ventilators - None	Number of:	2							
	D _{ne}	0	0	0	0	0	0	0	0

Room Data

Living Room Reverberation Time	0.6	0.6	0.5	0.5	0.4	0.4	0.4	0.3
Total Façade Area	24.8	m ²						
Room Volume	65.0	m ³						

Overall sound reduction of the facade

Combined sound reduction	23	29	30	36	42	41	49	47
--------------------------	----	----	----	----	----	----	----	----

Estimated Indoor Noise Level	dB(A)	Octave Band Centre Frequency (Hz)							
		63	125	250	500	1k	2k	4k	8k
	35	48	39	37	33	28	27	8	0

Date: 04/07/2014

Project No: 13172

Project: Gatefold

Plot name and receiver room: 105F LR - Bedroom

Estimated Indoor Ambient Noise Levels

Estimation of the indoor ambient noise level in a room based on the external noise levels and façade sound insulation taken from equations in Section 6.7.2.1 of BS8233:1999

$$L_{\text{internal}} = L_{\text{external}} - \Sigma R + 10 \log S + 10 \log T - 10 \log 0.163V + 3 + C$$

Where: - L_{internal}	- estimated indoor reverberant sound pressure level
L_{external}	- measured external sound pressure level (LAeq, 8hr) - i.e. the design external LAeq,
C	- correction factor to convert the measured external sound pressure level to 'free field' (6dB for measurements within millimetres of the façade, 3dB for measurements 2m from the façade)
ΣR	- overall sound reduction of the facade
T	- reverberation time inside the room in question
V	- volume of the room in question

External Noise Spectral Data	dB(A)	Octave Band Centre Frequency (Hz)							
		63	125	250	500	1k	2k	4k	8k
LAeq, 8hr	64	35	42	49	57	61	59	50	42
Façade Correction Factor, C		0	0	0	0	0	0	0	0

Reduction of façade elements

SG 8.8A-20-6.4A	Area:	7							
	R:	24	30	35	45	56	52	50	60
High Rw Rainscreen	Area:	7							
	R:	30	38	52	61	67	65	65	68
Doors	Area:	0							
	R:								
Rooflight	Area:	0							
	R:								
Ventilators - Greenwood 4000 SBW (Hit and miss)	Number of:	0							
	D_{ne}	0	38	37	34	30	34	37	46

Room Data

Bedroom Reverberation Time	0.4	0.5	0.4	0.4	0.3	0.3	0.3	0.2
Total Façade Area	14.3	m ²						
Room Volume	35.5	m ³						

Overall sound reduction of the facade

Combined sound reduction	26	32	38	48	59	55	53	62
--------------------------	----	----	----	----	----	----	----	----

Estimated Indoor Noise Level	dB(A)	Octave Band Centre Frequency (Hz)							
		63	125	250	500	1k	2k	4k	8k
	19	38	30	23	15	4	5	0	0

Date: 04/07/2014

Project No: 13172

Project: Gatefold

Plot name and receiver room: 105F LR - Bedroom

Estimated Indoor Ambient Noise Levels

Estimation of the indoor ambient noise level in a room based on the external noise levels and façade sound insulation taken from equations in Section 6.7.2.1 of BS8233:1999

$$L_{\text{internal}} = L_{\text{external}} - \Sigma R + 10 \log S + 10 \log T - 10 \log 0.163V + 3 + C$$

Where: - L_{internal}	- estimated indoor reverberant sound pressure level
L_{external}	- measured external sound pressure level (LAFMax) - i.e. the design external LAFMax
C	- correction factor to convert the measured external sound pressure level to 'free field' (6dB for measurements within millimetres of the façade, 3dB for measurements 2m from the façade)
ΣR	- overall sound reduction of the facade
T	- reverberation time inside the room in question
V	- volume of the room in question

External Noise Spectral Data		dB(A)	Octave Band Centre Frequency (Hz)							
			63	125	250	500	1k	2k	4k	8k
LAFMax		89	60	69	75	83	86	81	74	64
Façade Correction Factor, C			0	0	0	0	0	0	0	0
Reduction of façade elements										
SG 8.8A-20-6.4A	Area:	7	m ²							
	R:	24	30	35	45	56	52	50	60	
High Rw Rainscreen	Area:	7	m ²							
	R:	30	38	52	61	67	65	65	68	
Doors	Area:	0	m ²							
	R:									
Rooflight	Area:	0	m ²							
	R:									
Ventilators - None	Number of:	0								
	D _{ne}	0	0	0	0	0	0	0	0	
Room Data										
Bedroom Reverberation Time			0.4	0.5	0.4	0.4	0.3	0.3	0.3	0.2
Total Façade Area			14.3	m ²						
Room Volume			35.5	m ³						
Overall sound reduction of the facade										
Combined sound reduction			26	32	38	48	59	55	53	62
Estimated Indoor Noise Level		dB(A)	Octave Band Centre Frequency (Hz)							
			63	125	250	500	1k	2k	4k	8k
		45	63	57	49	41	29	27	22	3

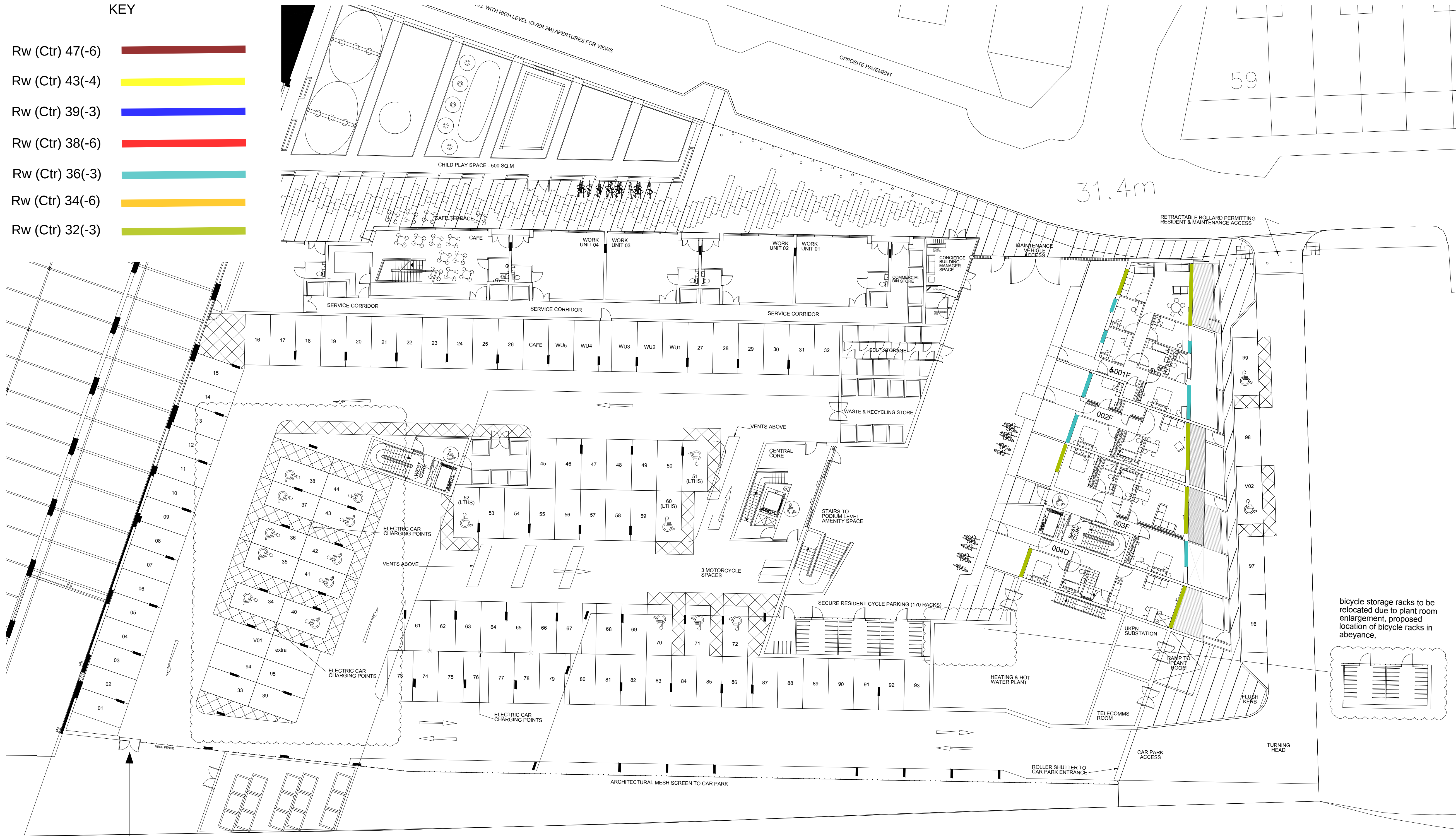


A P P E N D I X G

Mark-up of floor plans showing recommended glazing specification

KEY

- Rw (Ctr) 47(-6)
- Rw (Ctr) 43(-4)
- Rw (Ctr) 39(-3)
- Rw (Ctr) 38(-6)
- Rw (Ctr) 36(-3)
- Rw (Ctr) 34(-6)
- Rw (Ctr) 32(-3)



Spectrum Acoustic Consultants - Glazing Sound Insulation
Mark-up Rev. 1 : 09-06-2014

11.10.13 Preliminary Issue				①
REVISION	DATE	DESCRIPTION		
FRANK REYNOLDS		ARCHITECTS		
14 Clerkenwell Green Islington London EC1R 0DP				www.frankreynoldsarchitects.com
CLIENT				
WILLMOTT DIXON HOUSING LTD ISIS WATERSIDE REGENERATION				
PROJECT				
THE GATEFOLD BUILDING				
DRAWING NAME				
LEVEL 00				
STATUS				DATE
PRELIMINARY				OCT 2013
DRAWN BY	CHECK BY	SCALE	SIZE	
GF	MH	1:200 (1:400@A3)	A1	
JOB NO.	DRAWING NO.		REVISION	
1114	L (00) - 0100		-	

GENERAL NOTES
1. DO NOT SCALE FROM THIS DRAWING
2. ALL DIMENSIONS TO BE CHECKED ON SITE
3. ANY DISCREPANCIES SHOULD BE REPORTED TO THE ARCHITECT / CONTRACT ADMINISTRATOR

KEY

- Rw (Ctr) 47(-6)
- Rw (Ctr) 43(-4)
- Rw (Ctr) 39(-3)
- Rw (Ctr) 38(-6)
- Rw (Ctr) 36(-3)
- Rw (Ctr) 34(-6)
- Rw (Ctr) 32(-3)



11.10.13 Preliminary Issue

REVISION DATE DESCRIPTION

FRANK REYNOLDS ARCHITECTS

14 Clerkenwell Green
Islington
London
EC1R 0DP
www.frankreynoldsarchitects.com

CLIENT

WILLMOTT DIXON HOUSING LTD

ISIS WATERSIDE REGENERATION

PROJECT

THE GATEFOLD BUILDING

DRAWING NAME

LEVEL 01

STATUS

PRELIMINARY

DATE

OCT 2013

DRAWN BY

GF

CHECK BY

MH

SCALE

1:200 (1:400@A3)

SIZE

A1

JOB NO.

1114

DRAWING NO.

L (00) - 0110

REVISION

-

GENERAL NOTES
1. DO NOT SCALE FROM THIS DRAWING
2. ALL DIMENSIONS TO BE CHECKED ON SITE
3. ANY DISCREPANCIES SHOULD BE REPORTED TO THE ARCHITECT / CONTRACT ADMINISTRATOR

KEY

- Rw (Ctr) 47(-6)
- Rw (Ctr) 43(-4)
- Rw (Ctr) 39(-3)
- Rw (Ctr) 38(-6)
- Rw (Ctr) 36(-3)
- Rw (Ctr) 34(-6)
- Rw (Ctr) 32(-3)



11.10.13 Preliminary Issue			
REVISION	DATE	DESCRIPTION	©
FRANK REYNOLDS ARCHITECTS			
14 Clerkenwell Green Islington London EC1R 0DP www.frankreynoldsarchitects.com			
CLIENT			
WILLMOTT DIXON HOUSING LTD ISIS WATERSIDE REGENERATION			
PROJECT			
THE GATEFOLD BUILDING			
DRAWING NAME			
LEVEL 02			
STATUS		DATE	
PRELIMINARY		OCT 2013	
DRAWN BY	CHECK BY	SCALE	SIZE
GF	MH	1:200 (1:400@A3)	A1
JOB NO.	DRAWING NO.	REVISION	
1114	L (00) - 0120	-	

KEY

- Rw (Ctr) 47(-6)
- Rw (Ctr) 43(-4)
- Rw (Ctr) 39(-3)
- Rw (Ctr) 38(-6)
- Rw (Ctr) 36(-3)
- Rw (Ctr) 34(-6)
- Rw (Ctr) 32(-3)



GENERAL NOTES

1. DO NOT SCALE FROM THIS DRAWING.
2. ALL DIMENSIONS TO BE CHECKED ON SITE.
3. ANY DISCREPANCIES SHOULD BE REPORTED TO THE ARCHITECT / CONTRACT ADMINISTRATOR.

Architectural floor plan of a building, likely a residential or institutional structure, showing a central core and multiple wings. The plan includes various rooms, corridors, and a central void area. Key features and labels include:

- Central Core:** Labeled "CENTRAL CORE" in the center.
- Wings and Rooms:**
 - Top wing: Rooms 401F, 402F, 403F, 404F, 405F, 406F, 407D, 408D, 409D, 410D, 411D, 412D, 413D, 414D, 415F, 416F, 417F, 418F, 419F, 420F, 421F, 422F, 423F, 424F, 425F, 426F, 427F, 428F.
 - Bottom wing: Rooms 401F, 402F, 403F, 404F, 405F, 406F, 407D, 408D, 409D, 410D, 411D, 412D, 413D, 414D, 415F, 416F, 417F, 418F, 419F, 420F, 421F, 422F, 423F, 424F, 425F, 426F, 427F, 428F.
- Central Void:** A large open area labeled "VOID" in the center.
- Private Amenity Space:** Located on the right side of the plan.
- Access Control:** Labeled "ACCESS CONTROL OPERATED DOOR" in two locations.
- Glazing:** Labeled "OPAQUE GLAZED SCREENS" in two locations and "OPAQUE GLAZING TO EASTERN FACE" on the right wing.
- Dimensions:** A dimension line on the right side indicates a length of 31.4m.
- Other Labels:** "PRIVATE AMENITY SPACE" is labeled on the right wing.

11.10.13 Preliminary Issue		©	
REVISION	DATE	DESCRIPTION	
FRANK REYNOLDS		ARCHITECTS	
14 Cheshamwell Green Hendon London WU4 7JH T: 0181 871 0039 www.frankreynoldsarchitects.com			
CLIENT			
WILLMOTT DIXON HOUSING LTD ISIS WATERSIDE REGENERATION			
PROJECT			
THE GATEFOLD BUILDING			
DRAWING NAME		DATE	
LEVEL 04		OCT 2013	
STATUS	PRELIMINARY		
DRAWN BY	CHECKED BY	SCALE	SIZE
GF	MH	1:200 (1:400 @A3)	A1
JOB NO.	DRAWING NO.		REVISION
1114	L (00) - 0140		-

KEY

- Rw (Ctr) 47(-6)
- Rw (Ctr) 43(-4)
- Rw (Ctr) 39(-3)
- Rw (Ctr) 38(-6)
- Rw (Ctr) 36(-3)
- Rw (Ctr) 34(-6)
- Rw (Ctr) 32(-3)

GENERAL NOTES

1. DO NOT SCALE FROM THIS DRAWING

2. ALL DIMENSIONS TO BE CHECKED ON SITE

3. ANY DISCREPANCIES SHOULD BE REPORTED TO THE ARCHITECT / CONTRACT ADMINISTRATOR



11.10.13 Preliminary Issue

REVISION	DATE	DESCRIPTION

FRANK REYNOLDS ARCHITECTS

14 Clerkenwell Green
Islington
London
EC1R 0DP
www.frankreynoldsarchitects.com

CLIENT

WILLMOTT DIXON HOUSING LTD
ISIS WATERSIDE REGENERATION

PROJECT
THE GATEFOLD BUILDING

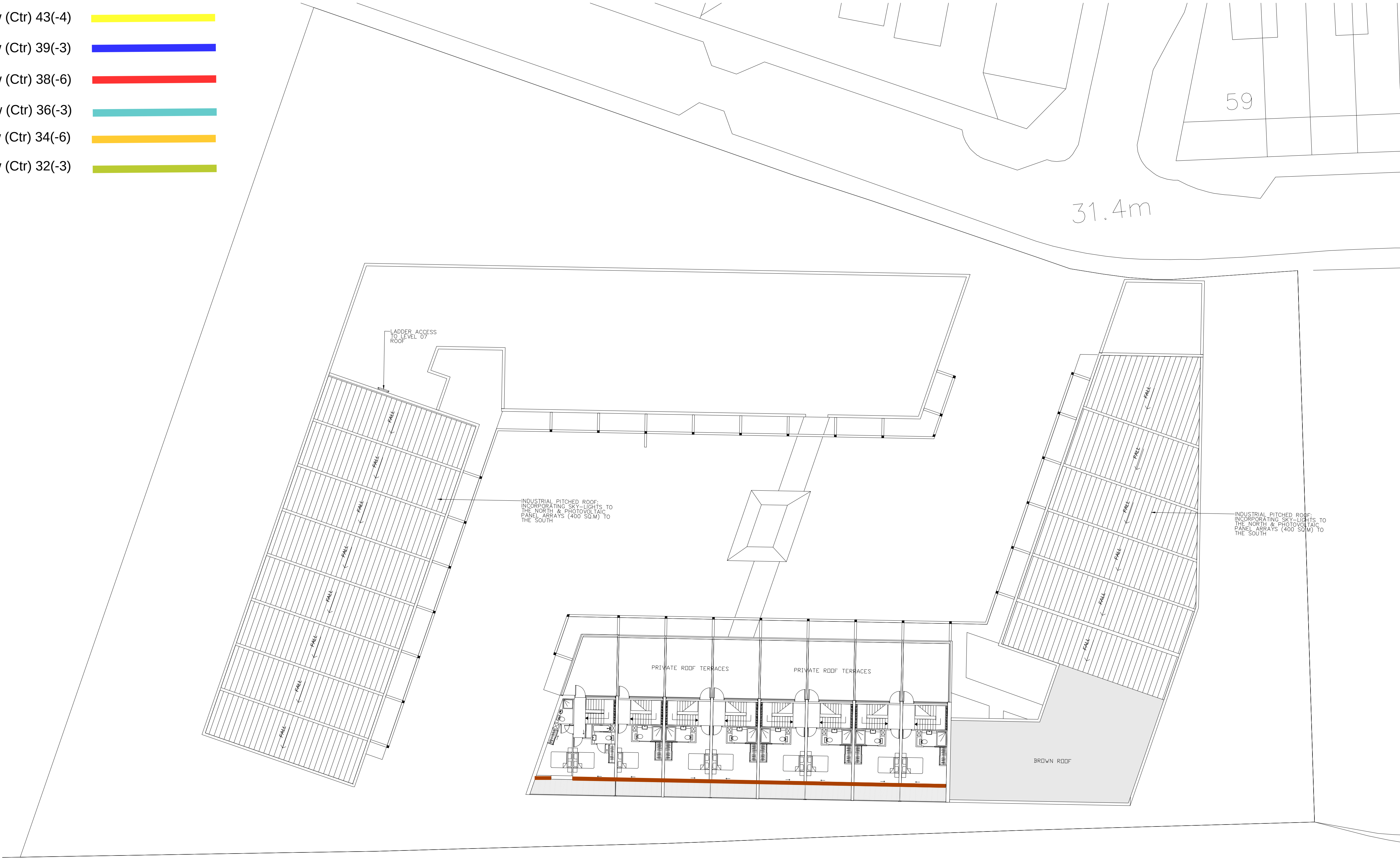
DRAWING NAME
LEVEL 05

STATUS				DATE
PRELIMINARY				OCT 2013
DRAWN BY	CHECK BY	SCALE	SIZE	
GF	MH	1:200 (1:400@A3)	A1	
JOB NO.	DRAWING NO.		REVISION	
1114	L (00) - 0150		-	

KEY

- Rw (Ctr) 47(-6)
- Rw (Ctr) 43(-4)
- Rw (Ctr) 39(-3)
- Rw (Ctr) 38(-6)
- Rw (Ctr) 36(-3)
- Rw (Ctr) 34(-6)
- Rw (Ctr) 32(-3)

- GENERAL NOTES
1. DO NOT SCALE FROM THIS DRAWING
2. ALL DIMENSIONS TO BE CHECKED ON SITE
3. ANY DISCREPANCIES SHOULD BE REPORTED TO THE ARCHITECT / CONTRACT ADMINISTRATOR



11.10.13 Preliminary Issue

REVISION	DATE	DESCRIPTION
----------	------	-------------

FRANK REYNOLDS ARCHITECTS

14 Clerkenwell Green
Islington
London
EC1R 0DP

www.frankreynoldsarchitects.com

CLIENT

WILLMOTT DIXON HOUSING LTD

ISIS WATERSIDE REGENERATION

PROJECT

THE GATEFOLD BUILDING

DRAWING NAME

LEVEL 06

STATUS			DATE
--------	--	--	------

PRELIMINARY			OCT 2013
-------------	--	--	----------

DRAWN BY	CHECK BY	SCALE	SIZE
----------	----------	-------	------

GF	MH	1:200 (1:400@A3)	A1
----	----	------------------	----

JOB NO.	DRAWING NO.	REVISION
---------	-------------	----------

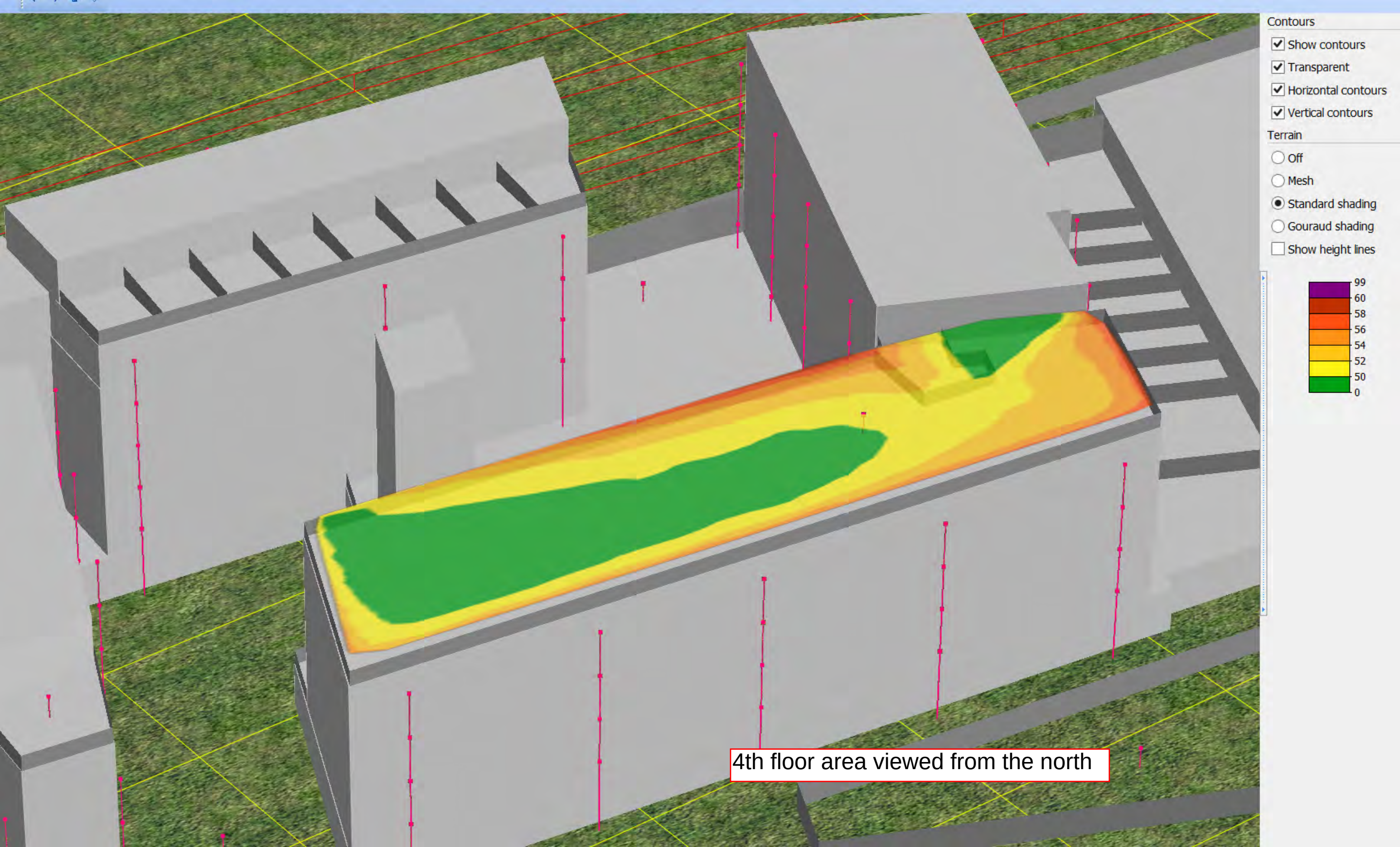
1114	L (00) - 0160	-
------	---------------	---

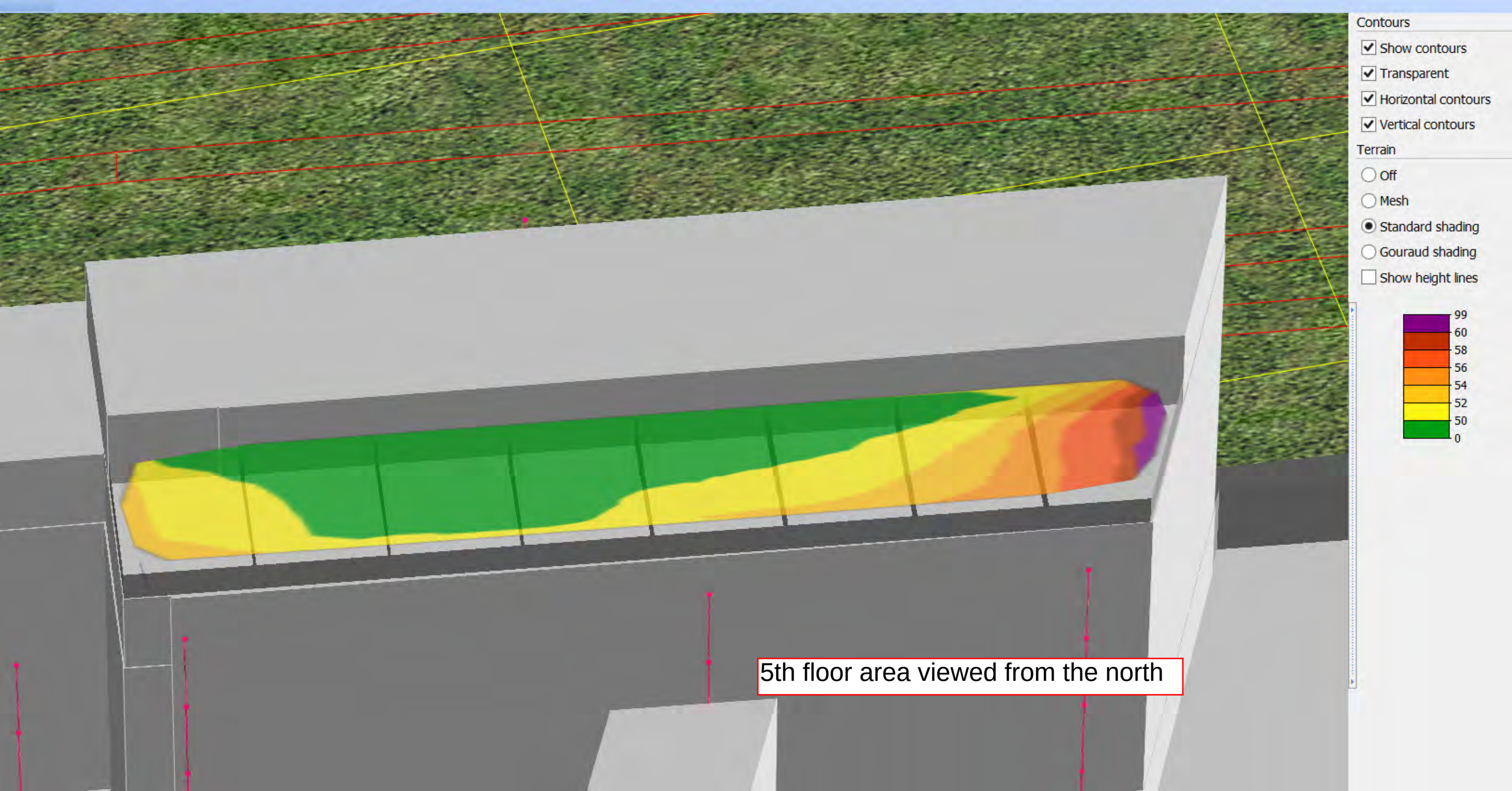


A P P E N D I X H

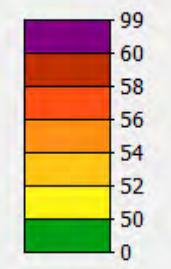
Figures showing predicted noise level contours in outdoor amenity spaces







- Contours
- ☒ Show contours
 - ☒ Transparent
 - ☒ Horizontal contours
 - ☒ Vertical contours
- Terrain
- ☐ Off
 - ☐ Mesh
 - ☒ Standard shading
 - ☐ Gouraud shading
 - ☐ Show height lines



5th floor area viewed from the north

