Linden Homes

Proposed Housing Scheme, Sandrock, Exeter

Discharge of Condition 15

Noise Assessment

August 2014

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Document Control

Project:	Proposed Residential Development, Discharge of Condition, Sandrock, Exeter
Client:	Linden Homes
Job Number:	A086991
File Origin:	O:\Acoustics Air Quality and Noise\Active Projects\A086991

Document Checking:

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Issue	Date	Status
1	13th August 2014	First Issue
2		
3		
4		

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1.0 Introduction

1.1 Purpose of this Report

This report presents the findings of a noise assessment for the discharge of condition 15 of planning permission ref 12/0854/01 which states

> 15. "*Details of noise mitigation measures (to protect future residents from noise from surrounding land uses) shall be submitted and approved in writing prior to commencement of the development. The approved measures shall be implemented in full prior to occupation of the development.*"

A description of the existing noise environment in and around the site is provided. Noise surveys have been undertaken and the results used to verify predictions of the short-term and long-term effects of noise. The noise levels from the proposed development have been predicted at local representative receptors using CADNA noise modelling software which incorporates ISO 9613 and CRTN methodologies and calculations.

A list of acoustic terminology and abbreviations used in this report is provided in Appendix A and a set of location plans and noise contour plots relevant to the assessment are presented in Appendix B.

2.0 Assessment Criteria

2.1 Internal Noise Assessment Criteria

BS 8233:2014 '*Guidance on sound insulation and noise reduction for buildings'* and World Health Organisation Recommendations in their 'Guidelines for Community Noise' (1999) have been chosen as a suitable method for determining an adequate level of noise control to ensure that noise levels within existing and proposed properties, as a result of the proposed development and existing environment, meet the following noise guideline values specified in the above documents:

		Daytime	Night-time	
Living rooms	L_{Aeq} =	35 dB		
Bedrooms	L_{Aeq} =	35 dB	30 dB,	L_{Amax}, night-time = 45 dB
Gardens	L_{Aeq} =	55 dB		

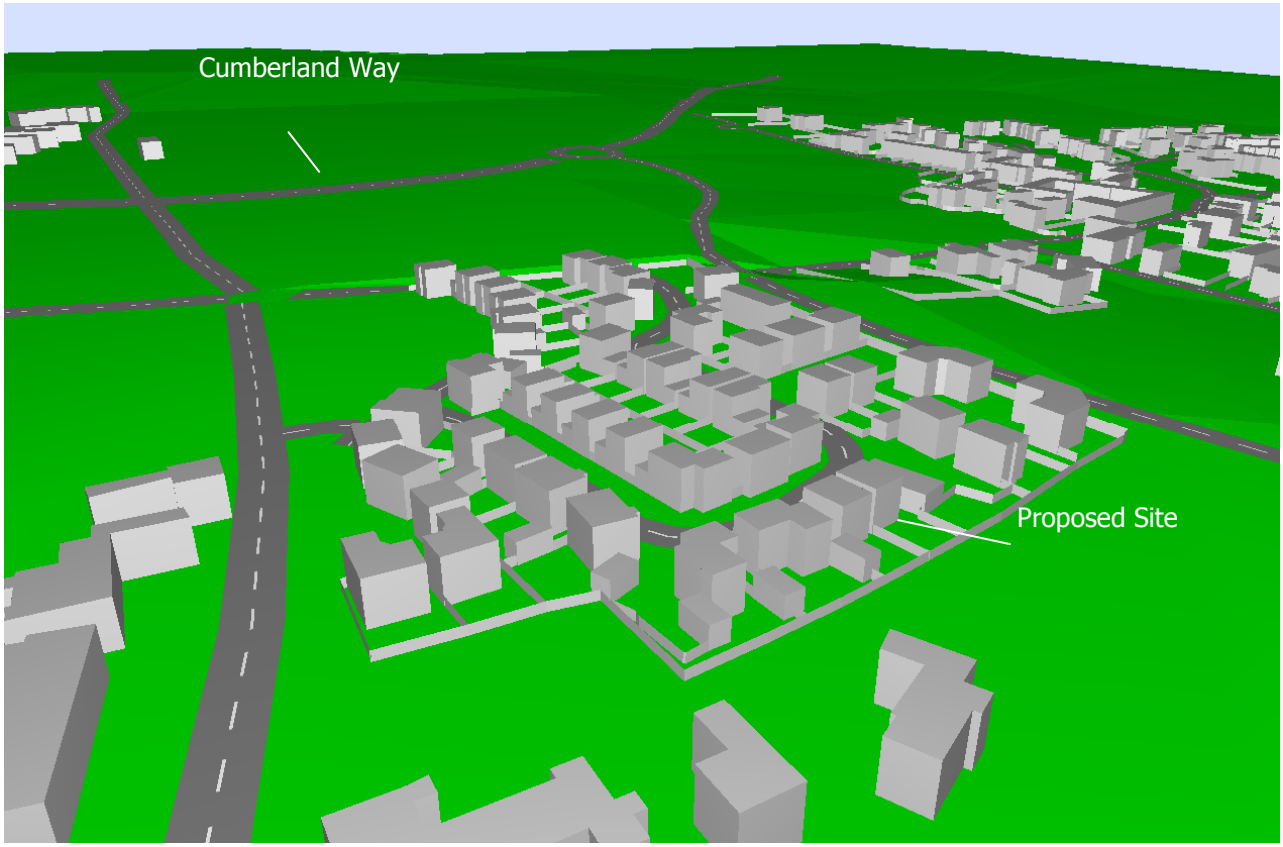
BS 8233:2014 suggests that a typical façade, regardless of construction, will offer a minimum of 10 dB sound insulation when windows are open. For the purposes of this assessment, the maximum external noise level from the source under consideration will be 45 dB(A) during the daytime, and 40 dB(A) during the night-time to ensure a maximum daytime L_{Aeq} of 35 dB, and a maximum night-time L_{Aeq} of 30 dB within habitable rooms are achieved.

3.0 Assessment Methodology

3.1 Noise Modelling Methodology

Three dimensional noise modelling has been undertaken based on the monitoring data to predict L_{Aeq} and L_{Amax} noise levels at a large number of locations both horizontally and vertically. CADNA noise modelling software has been used (as shown in Figure 3.1). This model is based on the Department of Transport Calculation of Road Traffic Noise (CRTN) and ISO 9613 noise propagation methodology and allows for detailed prediction of noise levels to be undertaken for large numbers of receptor points and different noise emission scenarios both horizontally and vertically.

Figure 3.1 CADNA Noise Model



The modelling software calculates noise levels based on the emission parameters and spatial settings that are entered. Input data, assumptions and model settings as given in the table below have been used.

Table 3.1 Modelling Parameters Sources and Assumptions

Parameter	Source	Details
Horizontal distances – around site	Ordnance Survey	Ordnance Survey
Ground levels – around site	Ordnance Survey	Ordnance Survey
Ground levels – other areas	Site Observations and Ordnance Survey	OS 1:25,000 contours and OS 1:10,000 spot heights.
Traffic data, main surrounding roads	WYGE	Traffic flows for local roads based on WYGE observations and experience.
Traffic data – local roads	WYGE	Traffic flows for local roads based on WYGE observations and experience.
Building heights – around site	WYGE Observations	8 m height for two storey residential properties, and 4 m for Bungalows
Barrier heights	WYGE Observations	All existing barriers at 1.0 m with the exception of hedges and trees which are assumed to offer no noise protection.1.8m for proposed garden fences.
Receptor positions	WYGE	1 m from façade, height of 1.5 m for ground floor, 4 m for first floor properties with ground floor or bungalow dormer windows. 7 m for dormer windows on two storey properties. 1.5 m height for model grid and monitoring locations for validation.
Reflections	WYGE	First order reflections have been applied based on mirror image sources
Absorbent Ground	CADNA	Frequency dependant ground absorption has been applied based on values specified in VDI 2714/16 clause 6.3.
Façade Correction	CADNA	Façade corrections have been incorporated into the modelling
Gradient	CADNA	Gradient for each road has been calculated from the height information using the 'calc slope of roads' tool
Site Master plan	Linden Homes	Drawing No. AL (0)02

It is acknowledged that a number of these assumptions will affect the overall noise levels presented in this report. However it should be noted that certain assumptions made, as identified above, are worst case.

3.2 Model Input Data

3.2.1 Traffic Noise Data

All roads expected to make a significant contribution have been included within this assessment. Traffic flows and HGV percentages for the proposed Tithe Barn link road have been based on traffic data provided by Devon County Council. Estimates of the vehicle speeds have been made based upon the speed restrictions currently in force in the area.

Table 3.2 Tithe Barn Link Road Traffic Data

Road	18hr AAWT	HGV %	Speed (kmph)
Tithebarn Link Road	8740	05	48

A correction has been made to correct the predicted 18 hour L_{A10} traffic noise levels to 16 hour L_{Aeq} noise levels using the following formula, as provided within PPG 24:

$$L_{Aeq\ (16hour)} = L_{A10(18hour)} - 2dB$$

3.2.2 Model Verification

The model was verified by modelling the monitoring locations for the 'existing' weekday scenario. Daytime and night-time L_{Aeq} and night-time L_{Amax} scenarios have been verified. The comparison between the monitoring and modelling results are shown in the tables below.

Table 3.3 Modelled vs. Monitored Results $L_{Aeq;\ daytime\ 07:00 - 23:00}$

Location	Monitored L_{Aeq}	Modelled L_{Aeq}	Difference between Monitored and Modelled Results
LT1	58.6	58.6	0.0
LT2	56.4	56.4	0.0
LT3	78.4	78.4	0.0
ST1	79.4	81.6	2.2
ST2	62.7	62.5	-0.2
ST3	59.8	61.5	1.7
ST4	68.2	68.2	0.0
ST5	52.8	53.9	1.1
ST6	59.8	59.8	0.0
ST7	56.5	57.0	0.5

All values are sound pressure levels in dB re: $2x\ 10^{-5}$ Pa

Table 3.4 Modelled vs. Monitored Results $L_{Aeq;\ night-time\ 23:00 - 07:00}$

Location	Monitored L_{Aeq}	Modelled L_{Aeq}	Difference between Monitored and Modelled Results
LT1	51.1	51.1	0.0

Location	Monitored L_{Aeq}	Modelled L_{Aeq}	Difference between Monitored and Modelled Results
LT2	52.1	52.1	0.0
LT3	73.2	73.2	0.0
ST1	68.7	76.4	7.7
ST2	51.4	57.9	6.5
ST3	45.4	55.5	10.1
ST4	55.7	55.7	0.0
ST5	45.1	46.8	1.7
ST6	44.7	53.6	8.9

All values are sound pressure levels in dB re: 2x 10^{-5} Pa

Table 3.5 Modelled vs. Monitored Results $L_{Amax;\ night\text{-}time\ 23:00–07:00}$

Location	Monitored L_{Amax}	Modelled L_{Amax}	Difference between Monitored and Modelled Results
LT1	79.2	79.2	0.0
LT2	71.7	68.8	-2.9
LT3	84.0	83.7	-0.3
ST1	84.0	86.1	2.1
ST2	71.2	71.2	0.0
ST3	75.2	75.6	0.4
ST4	79.6	79.5	-0.1
ST5	73.2	73.2	0.0
ST6	74.1	73.7	-0.4
ST7	64.5	61.5	-3.0

All values are sound pressure levels in dB re: 2x 10^{-5} Pa

The verification points show a divergence between monitored and modelled results of no more than 3 dB with exception of locations ST1 - 3 and ST6 during the daytime and night-time L_{Aeq} scenarios where the model is predicting a higher level than was recorded during short term measurements, probably due to the low frequency of cars passing during the short-term 15 minute measurements.

3.2.3 Sensitive Receptors

Existing noise levels have been assessed at properties to the north, centre and south of the site with respect to direct noise from the existing ambient noise climate surrounding the site. The locations of the proposed receptors are shown of SK02 of Appendix B.

Table 3.5 Residential Receptor Locations

Ref.	Description	Closest Source	Approximate Distance To Source (m)	Height (m)
R1	West of the Site	Pinn Lane	27.1	4.0
R2	Centre of the Site	Gypsy Hill Lane	46.2	4.0
R3	South of the Site	Gypsy Hill Lane	11.5	4.0
R4	South of the Site	Gypsy Hill Lane	9.7	4.0
R5	East of the Site	M5	208.6	4.0
R6	East of the Site	M5	225.2	4.0
R7	North East of the Site	M5	236.3	4.0
R8	North of the Site	Tithe Barn Link Road	8.5	4.0
R9	North of the Site	Tithe Barn Link Road	15.9	4.0
R10	North of the Site	Pinn Lane	3.75	4.0

Table 3.6 Private External Amenity Area Receptor Locations

Ref.	Description	Co-ordinates		
		X	Y	Height (m)
G1	West of the Site	296540.4	93614.0	1.5
G2	Centre of the Site	296583.3	93610.9	1.5
G3	South of the Site	296628.8	93576.4	1.5
G4	South of the Site	296679.1	93566.9	1.5
G5	East of the Site	296693.0	93608.4	1.5
G6	East of the Site	296680.2	93642.3	1.5
G7	North East of the Site	296661.7	93676.1	1.5
G8	North of the Site	296616.1	93684.4	1.5
G9	North of the Site	296559.98	93663.1	1.5
G10	North of the Site	296526.9	93622.6	1.5

4.0 Noise Survey

4.1 Noise Survey Methodology

A monitoring survey was undertaken to characterise baseline ambient noise levels currently experienced on the site and to establish the relative local background and traffic noise levels.

Equipment used during the survey included:

B&K 2260	Environmental Noise Analyser (WYG5)	s/n	2180560
B&K 4231	Calibrator	s/n	2176211
Norsonic 131	Environmental Noise Analyser (WYG4)	s/n	1312722
Rion NL-32	Environmental Noise Analyser (WYG11)	s/n	123729
Rion NL-52	Environmental Noise Analyser (WYG14)	s/n	610212

The measurement equipment was checked against the appropriate calibrator at the beginning and end of the measurements, in accordance with recommended practice and no drift was observed. The accuracy of the calibrators can be traced to National Physical Laboratory Standards, calibration certificates for which are available on request.

A baseline monitoring survey was undertaken at ten locations (as specified in the following table and shown in SK01 of Appendix B) from Friday 27th June 2014 to Tuesday 1st July 2014. Attended short term measurements were undertaken at seven locations during the day, evening, peak and night-time periods with three additional locations being measured unattended over a 92 hour period. The raw data collected from the long term monitoring is available upon request.

Measurements were taken in general accordance with BS 7445-1:2003 *The Description and Measurement of Environmental Noise: Guide to quantities and procedures*. Weather conditions during the survey period were observed as being dry with scattered showers. Anemometer readings confirmed that wind speeds were less than 5 ms^{-1} at all times during the survey with a predominant westerly wind direction.

Table 4.1 Noise Monitoring Locations

Ref	Description	Grid Reference	
		X	Y
LT1	On embankment of Pinn Lane South of Orchard Lea	296522.9	93654.0
LT2	In northwest corner of Gipsy Hill Hotel overspill car park	296680.1	93591.1
LT3	On the embankment of M5, to the east of Gipsy Hill Hotel	296875.3	93549.0
ST1	On Redhayes Bridge over M5	296905.3	93538.2
ST2	Adjacent to 1 Gipsy Hill Mews	296705.2	93536.6
ST3	At crossroads of Pinn Lane, Gipsy Hill Lane and Hollow Lane	296522.3	93527.2
ST4	Adjacent to Higher Furlong, Hollow Lane	296356.9	93493.5
ST5	Tithebarn Lane, level with 6 Tithebarn Copse	296628.8	93818.3
ST6	Entrance to car park of Swallowtail House, Grenadier Way, Exeter Business Park	296618.9	93407.7

Ref	Description	Grid Reference	
		X	Y
ST7	In field west of Gipsy Hill Hotel overspill car park, north of Pinhoe House	296617.1	93589.4

4.2 Noise Survey Results

Existing ambient noise levels around the site are dominated by vehicles using the M5 and Pinn Lane. Noise from occasional aircraft movements using Exeter International Airport was also observed.

Ambient and background noise levels are usually described using the L_{Aeq} index (a form of energy average) and the L_{A90} index (i.e. the level exceeded for 90% of the measurement period) respectively. Road traffic noise is generally described using the L_{A10} index (i.e. the level exceeded for 10% of the measurement period).

The results of the statistical measurements and frequency measurements conducted during the survey are summarised in the following table. All values are sound pressure levels in dB (re: 2 x 10^{-5} Pa)

Table 4.2 Results of Baseline Noise Monitoring Survey (Average Levels)

Period	Duration (T)	Monitoring Date and Times	Location	$L_{Aeq,T}$ (dB)	$L_{Amax,T}$ (dB)	$L_{Amin,T}$ (dB)	$L_{A10,T}$ (dB)	$L_{A90,T}$ (dB)
Weekday Day 07:00 - 23:00	8 hours	27/06/2014 – 01/07/2014 07:00 - 23:00	LT1	58.6	85.1	35.6	57.8	45.8
Weekday Night 23:00 – 07:00	5 hours	27/06/2014 – 01/07/2014 23:00 - 07:00		47.5	78.1	28.4	46.4	37.2
Weekend Day 07:00 – 23:00	32 hours	27/06/2014 – 01/07/2014 07:00 - 23:00		58.4	86.8	36.2	57.1	45.7
Weekend Night 23:00 – 07:00	16 hours	27/06/2014 – 01/07/2014 23:00 - 07:00		51.1	83.6	27.8	47.6	39.9
Weekday Day 07:00 - 23:00	28 hours	27/06/2014 – 01/07/2014 07:00 - 23:00	LT2	56.4	90.4	41.9	56.3	52.2
Weekday Night 23:00 – 07:00	16 hours	27/06/2014 – 01/07/2014 23:00 - 07:00		50.0	71.7	31.8	50.4	44.5
Weekend Day 07:00 – 23:00	32 hours	27/06/2014 – 01/07/2014 07:00 - 23:00		55.4	93.0	40.9	55.0	50.6
Weekend Night 23:00 – 07:00	16 hours	27/06/2014 – 01/07/2014 23:00 - 07:00		49.2	71.7	28.5	49.9	43.7
Weekday Day 07:00 - 23:00	28 hours	27/06/2014 – 01/07/2014 07:00 - 23:00	LT3	78.4	86.9	53.6	80.1	74.4
Weekday Night 23:00 – 07:00	16 hours	27/06/2014 – 01/07/2014 23:00 - 07:00		72.3	87.5	35.9	74.8	58.0
Weekend Day 07:00 – 23:00	32 hours	27/06/2014 – 01/07/2014 07:00 - 23:00		78.2	98.7	50.1	79.9	73.5

Period	Duration (T)	Monitoring Date and Times	Location	$L_{Aeq,T}$ (dB)	$L_{Amax,T}$ (dB)	$L_{Amin,T}$ (dB)	$L_{A10,T}$ (dB)	$L_{A90,T}$ (dB)
Weekend Night 23:00 – 07:00	16 hours	27/06/2014 – 01/07/2014 23:00 - 07:00		70.1	81.8	32.4	73.6	55.1
Day 07:00 - 19:00	15 Mins	30/06/2014 15:20	ST1	79.4	85.0	72.4	81.4	76.6
	15 Mins	30/06/2014 15:40	ST2	62.7	71.2	57.1	64.5	60.2
	15 Mins	30/06/2014 16:21	ST3	59.8	75.2	43.4	64.3	46.3
	15 Mins	30/06/2014 16:42	ST4	68.2	79.6	54.8	71.3	58.3
	15 Mins	01/07/2014 10:28	ST5	52.8	73.2	45.0	53.3	48.3
	15 Mins	01/07/2014 09:59	ST6	59.8	74.1	51.0	62.0	53.8
	15 Mins	30/06/2014 16:00	ST7	56.5	64.8	52.1	58.2	54.3
Evening 19:00 - 23:00	15 Mins	30/06/2014 19:31	ST1	75.7	83.2	61.8	78.2	71.3
	15 Mins	30/06/2014 19:52	ST2	57.8	66.0	49.6	60.2	54.0
	15 Mins	30/06/2014 20:11	ST3	55.5	76.1	37.6	54.3	40.5
	15 Mins	30/06/2014 20:31	ST4	63.7	80.3	47.1	68.9	51.1
	15 Mins	30/06/2014 19:08	ST5	48.0	69.7	41.4	47.3	43.4
	15 Mins	30/06/2014 20:54	ST6	58.0	64.6	51.8	59.8	55.5
Night 23:00 - 07:00	15 Mins	30/06/2014 23:34	ST1	68.7	84.0	51.3	72.4	59.7
	15 Mins	30/06/2014 23:54	ST2	51.4	67.2	41.3	54.5	44.8
	15 Mins	01/07/2014 00:13	ST3	45.4	69.7	28.9	37.5	31.7
	15 Mins	01/07/2014 00:33	ST4	55.7	75.2	37.6	50.4	41.6
	15 Mins	30/06/2014 23:08	ST5	45.1	70.4	34.0	42.9	38.0
	15 Mins	01/07/2014 01:08	ST6	44.7	54.2	36.2	47.5	40.1

All values are sound pressure levels in dB re: $2x\ 10^{-5}$ Pa

5.0 Assessment of Key Effects

5.1 Noise Intrusion Assessment

Internal noise levels within potential dwellings have been assessed both with windows open, where a reduction from a partially open window of 10 dB has been used, and with windows closed where an assumption of glazing with specification R_w 30 dB (e.g 6/12/6mm double glazing or equivalent) has been used.

The results presented in tables 5.1 – 5.3 below show the predicted noise intrusion levels at properties to the north, centre and south of the site. The recommended WHO/BS 8233 internal noise levels are generally met across the site during the daytime and night-time, assuming a windows-closed scenario however certain northern façades along the new Tithe Barn link road are predicted to exceed the relevant criteria. In order to achieve the recommended internal noise criteria, mitigation measures are outlined in Section 6.1 of this report; SK05 in Appendix B shows the glazing and ventilation requirements for bedrooms and living rooms of the proposed development.

Table 5.1 Daytime Noise Intrusion Levels $L_{Aeq\ 16\ hour}$

Location	External L_{Aeq} at 1m from facade	Internal L_{Aeq} with windows open	Internal L_{Aeq} with windows closed	Criteria Internal L_{Aeq}
R1	55.0	45.0	25.0	35
R2	55.7	45.7	25.7	35
R3	60.0	50.0	30.0	35
R4	60.4	50.4	30.4	35
R5	54.2	44.2	24.2	35
R6	56.0	46.0	26.0	35
R7	58.1	48.1	28.1	35
R8	67.0	57.0	37.0	35
R9	63.0	53.0	33.0	35
R10	59.4	49.4	29.4	35

All values are sound pressure levels in dB re: $2x\ 10^{-5}$ Pa.

Table 5.2 Night-time Noise Intrusion Levels $L_{Aeq\ 8\ hour}$

Location	External L_{Aeq} at 1m from facade	Internal L_{Aeq} with windows open	Internal L_{Aeq} with windows closed	Criteria Internal L_{Aeq}
R1	49.8	39.8	19.8	30
R2	50.2	40.2	20.2	30
R3	56.0	46.0	26.0	30
R4	56.5	46.5	26.5	30
R5	48.6	38.6	18.6	30
R6	49.5	39.5	19.5	30
R7	50.2	40.2	20.2	30
R8	56.9	46.9	26.9	30
R9	53.6	43.6	23.6	30
R10	49.4	39.4	19.4	30

All values are sound pressure levels in dB re: $2x\ 10^{-5}$ Pa.

Table 5.3 Night-time Noise Intrusion Levels L_{Amax}

Location	External L_{Amax} at 1m from facade	Internal L_{Amax} with windows open	Internal L_{Amax} with windows closed	Criteria Internal L_{Amax}
R1	62.7	52.7	32.7	45
R2	63.5	53.5	33.5	45
R3	68.2	58.2	38.2	45
R4	68.6	58.6	38.6	45
R5	60.5	50.5	30.5	45
R6	63.6	53.6	33.6	45
R7	67.0	57.0	37.0	45
R8	76.8	66.8	46.8	45
R9	72.7	62.7	42.7	45
R10	68.5	58.5	38.5	45

All values are sound pressure levels in dB re: 2x 10-5 Pa.

5.1.1 Private External Amenity Area Noise Levels

Daytime noise levels in gardens and private external spaces of the proposed development have been assessed in the table below. The location of the 'garden' receptor locations are shown on SK02 in Appendix B.

Table 5.4 Private External Amenity Area Noise Levels $L_{Aeq,16hr}$

Ref	External $L_{Aeq,16hr}$ Daytime	BS 8233 Upper Limit Criteria L_{Aeq}
G1	51.0	55.0
G2	48.9	55.0
G3	47.8	55.0
G4	53.5	55.0
G5	52.4	55.0
G6	53.9	55.0
G7	54.5	55.0
G8	50.9	55.0
G9	54.5	55.0
G10	53.1	55.0

All values are sound pressure levels in dB re: 2x 10^{-5} Pa.

The results in the table above show that daytime L_{Aeq} noise levels within private external amenity areas are predicted to be within the BS 8233 upper limit (55 dB).

6.0 Noise Mitigation

6.1 Glazing and Ventilation Strategy

In order to comply with condition 15 of planning permission ref 12/0854/01 the glazing strategy provided in SK05 has been designed to achieve internal daytime L_{Aeq} of 35 dB, an internal night-time L_{Aeq} of 30 dB and an internal night-time L_{Amax} of 45 dB in habitable rooms of the proposed development. Dwellings across the site (in the absence of any alternative mitigation such as noise barriers) require an alternative means of ventilation in order to meet both ventilation and internal ambient noise criteria within habitable rooms (bedrooms/living rooms). Alternative ventilation can be provided in several ways from acoustic trickle vents (which need to have a minimum sound reduction equal to or greater than the glazing), other passive ventilation systems or mechanical ventilations systems.

Dwellings within approximately 15 metres of the Tithe Barn Link Road to the north of the site would require enhanced glazing in order to meet internal target noise levels (as shown in SK05 in Appendix B and detailed below):

- 4 buildings require R_w 37 dB glazing

Care should be taken to minimise the potential impact of noise via careful design of site/building layout. Consideration should be made to the appropriate positioning of living rooms, bedrooms and gardens with respect to both Gypsy Hill Lane and the Tithe Barn Link Road. Within the buildings themselves, living rooms and bedrooms should ideally be located on shielded façades with non-sensitive spaces such as corridors, bathrooms, en-suite, utility rooms, window-less gable ends and kitchens should ideally be located on the road facing façades of residential properties.

Fences should be constructed from brick or solid timber panels with no gaps and be a minimum of 1.8 metres high to provide further protection to external private amenity spaces.

7.0 Conclusions

In accordance with condition 15 of planning permission ref 12/0854/01 a glazing and ventilation strategy has been provided which achieves both ventilation and internal ambient noise level requirements of $L_{Aeq\ daytime}$ 35 dB, $L_{Aeq\ night\text{-}time}$ of 30 dB and $L_{Amax\ night\text{-}time}$ of 45 dB in all residential bedroom and living spaces of the proposed development. The suggested glazing specifications are understood to be achievable. Standard double glazing is sufficient across the majority of the site in order to achieve the target internal noise levels when windows are closed, however alternative ventilation will be required for habitable areas (living rooms and bedrooms) of all properties across the site and enhanced glazing is required for four buildings facing the Tithe Barn Link Road in order to meet internal targets for noise levels.

All private external amenity areas receptors are below BS 8233 Upper Limit Criteria levels for L_{Aeq}; fences should be constructed from brick or solid timber panels with no gaps and be a minimum of 1.8 metres high to provide further protection to private amenity spaces.

It is considered that the noise mitigation in Section 6.0 of this report is sufficient to reduce the effects of any noticeable and disruptive noise being currently emitted from the surrounding environment by helping to prevent noise levels exceeding BS 8233 criteria for L_{Aeq} and L_{Amax} within all areas of the proposed development.

The requirements of Condition 15 of planning permission ref 12/0854/01 are met and can therefore be discharged.

Appendices

Appendix A – Acoustic Terminology and Abbreviations

Acoustic Terminology

dB — Sound levels from any source can be measured in frequency bands in order to provide detailed information about the spectral content of the noise, i.e. whether it is high-pitched, low-pitched, or with no distinct tonal character. These measurements are usually undertaken in octave or third octave frequency bands. If these values are summed logarithmically, a single dB figure is obtained. This is usually not very helpful as it simply describes the total amount of acoustic energy measured and does not take any account of the ear's ability to hear certain frequencies more readily than others.

dB(A) — Instead, the dBA figure is used, as this is found to relate better to the loudness of the sound heard. The dBA figure is obtained by subtracting an appropriate correction, which represents the variation in the ear's ability to hear different frequencies, from the individual octave or third octave band values, before summing them logarithmically. As a result the single dBA value provides a good representation of how loud a sound is.

L_{Aeq} — Since almost all sounds vary or fluctuate with time it is helpful, instead of having an instantaneous value to describe the noise event, to have an average of the total acoustic energy experienced over its duration. The $L_{Aeq,\ 07:00 - 23:00}$ for example, describes the equivalent continuous noise level over the 12 hour period between 7 am and 11 pm. During this time period the L_{pA} at any particular time is likely to have been either greater or lower that the $L_{Aeq,\ 07:00 - 23:00}$.

L_{Amin} — The L_{Amin} is the quietest instantaneous noise level. This is usually the quietest 125 milliseconds measured during any given period of time.

L_{Amax} — The L_{Amax} is the loudest instantaneous noise level. This is usually the loudest 125 milliseconds measured during any given period of time.

L_n — Another method of describing, with a single value, a noise level which varies over a given time period is, instead of considering the average amount of acoustic energy, to consider the length of time for which a particular noise level is exceeded. If a level of x dBA is exceeded for say 6 minutes within one hour, then that level can be described as being exceeded for 10% of the total measurement period. This is denoted as the $L_{A10,\ 1\ hr}$ = x dB.

The L_{A10} index is often used in the description of road traffic noise, whilst the L_{A90}, the noise level exceeded for 90% of the measurement period, is the usual descriptor for underlying background noise. L_{A1} and L_{Amax} are common descriptors of construction noise.

R_w — The *weighted sound reduction index* determined using the above *measurement* procedure, but weighted in accordance with the procedures set down in BS EN ISO 717-1. Partitioning and building board manufacturers commonly use this index to describe the inherent sound insulation performance of their products.

Abbreviations

CADNA – Computer Aided Noise Abatement

DMRB – Design Manual for Roads and Bridges

HGV – Heavy Goods Vehicle

PPG24 – Planning Policy Guidance

UDP – Unitary Development Plan

UKAS – United Kingdom Accreditation Service

WYGE – WYG Environment

Appendix B – Sketches

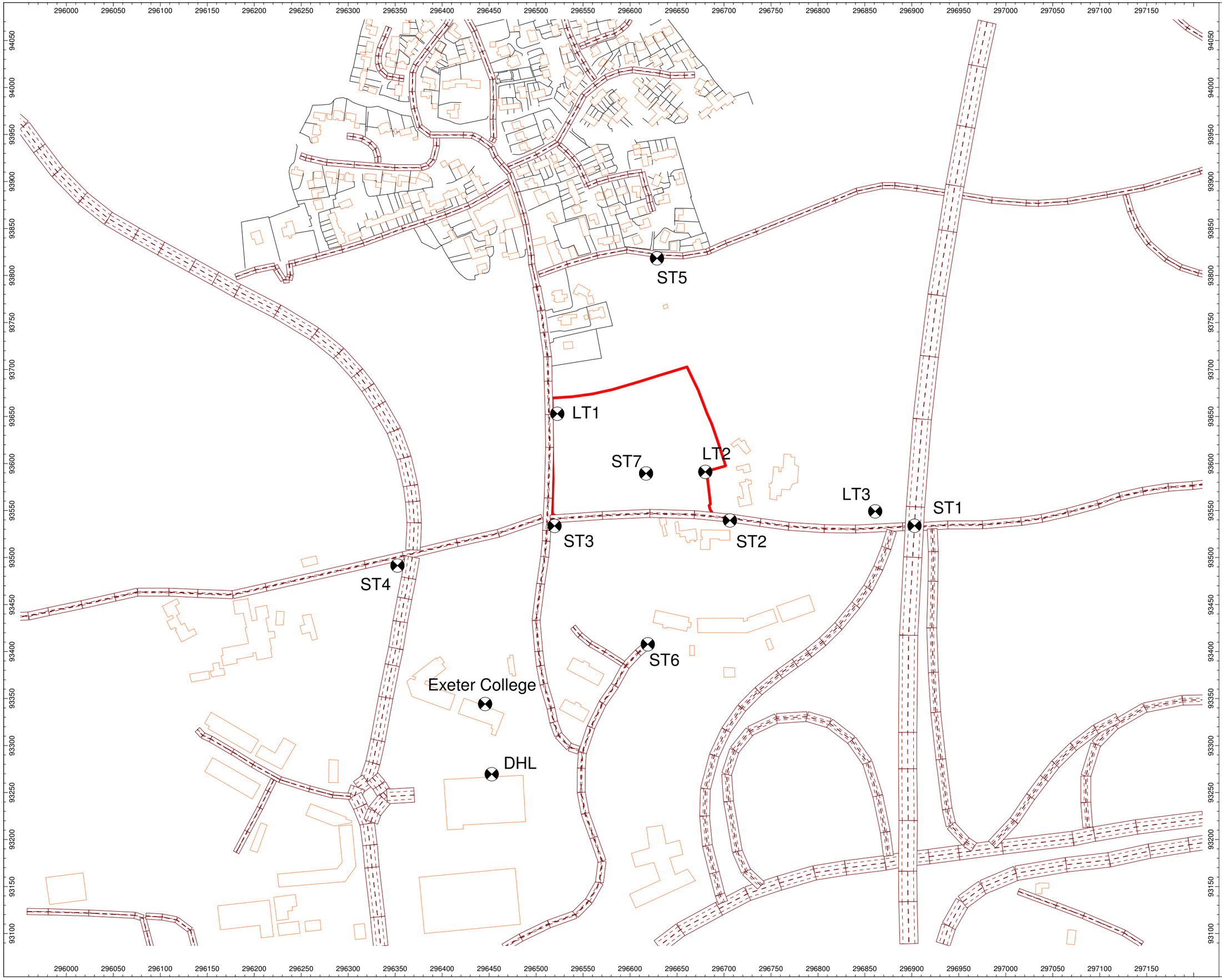
SK01 Noise Monitoring Locations

SK02 Site Layout and Receptor Locations

SK03 Daytime $L_{Aeq,16hr}$

SK04 Night-time $L_{Aeq,8hr}$

SK05 Glazing and Ventilation Strategy



Client:
Linden Homes

Project:
Sandrock
Exeter

Project Number:
A086991

Drawing Title / Scenario:
Noise Monitoring Locations

Drawing Number:
SK01

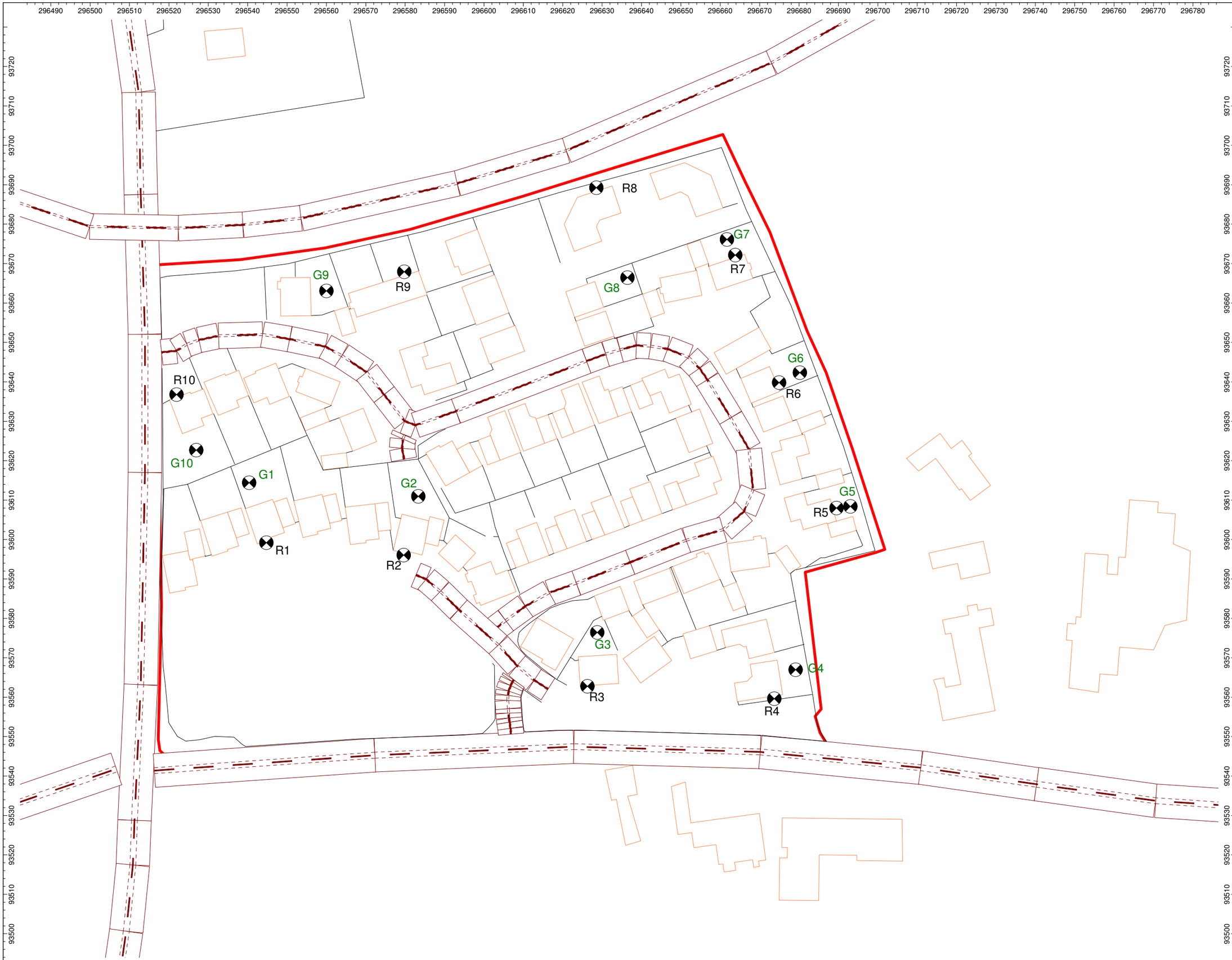
Key:

Site Boundary:

Scale : Not to scale

WYGE Leicester 13.08.14

Executive Park
Avalon Way
Anstey
Leicestershire
LE7 7GR
Tel 0116 234 8000



Client:
Linden Homes

Project:
Sandrock,
Exeter

Project Number:
A086991

Drawing Title / Scenario:
Proposed Receptor locations

Drawing Number:
SK02

Key:

Site Boundary:

Scale : Not to scale

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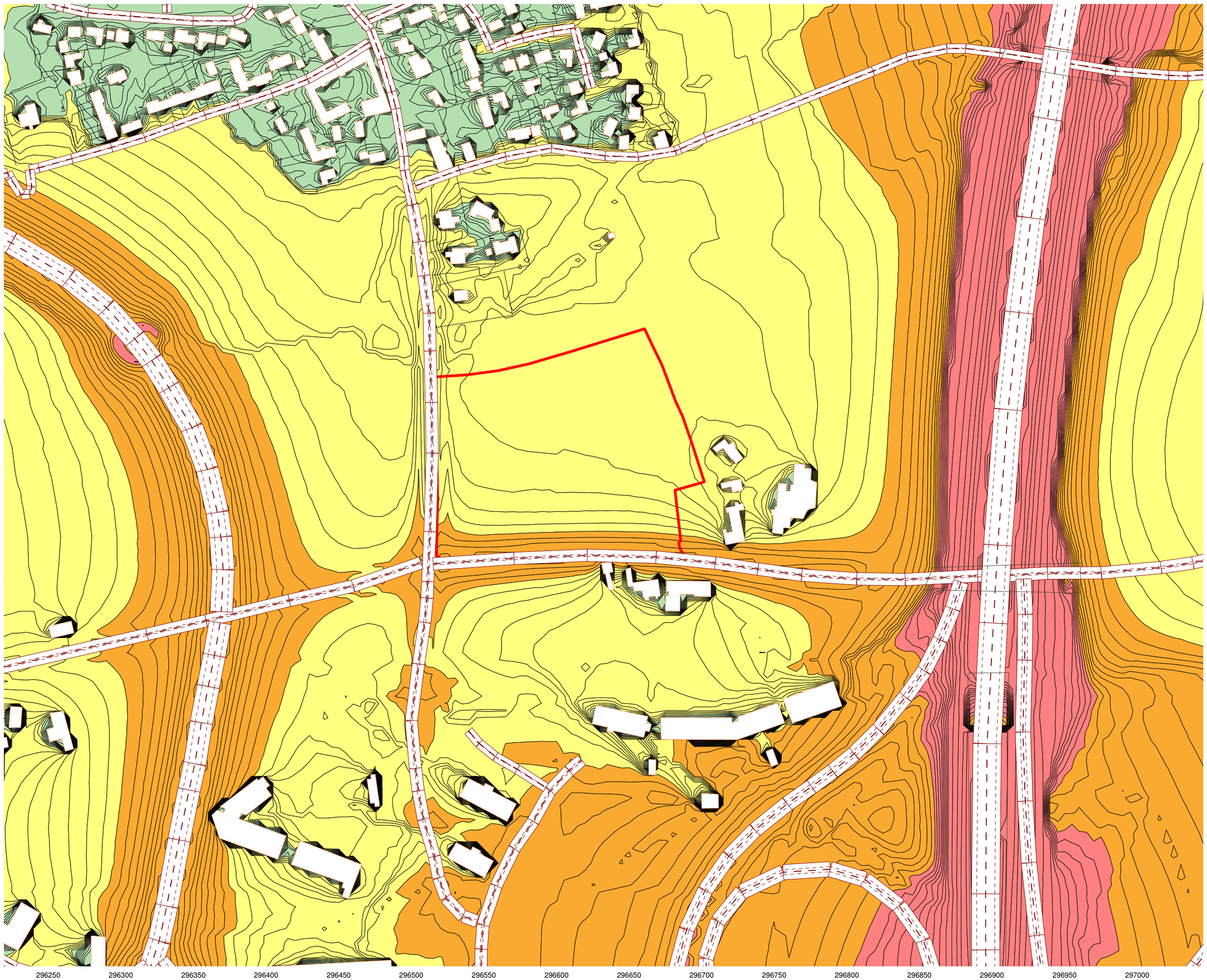
Licence Number AL 553611

Executive Park
Avalon Way
Anstey
Leicestershire
LE7 7GR
Tel 0116 234 8000



Client:
Linden Homes

Project:
Sandrock,
Exeter

Project Number:
A086991

Drawing Title / Scenario:
Existing Daytime
LAeq, 16hr Noise Levels

Drawing Number:
SK03

Key:

Site Boundary:

- 0.0 - 50.0 dB
- 50.0 - 60.0 dB
- 60.0 - 70.0 dB
- >70.0 dB

Scale : Not to scale

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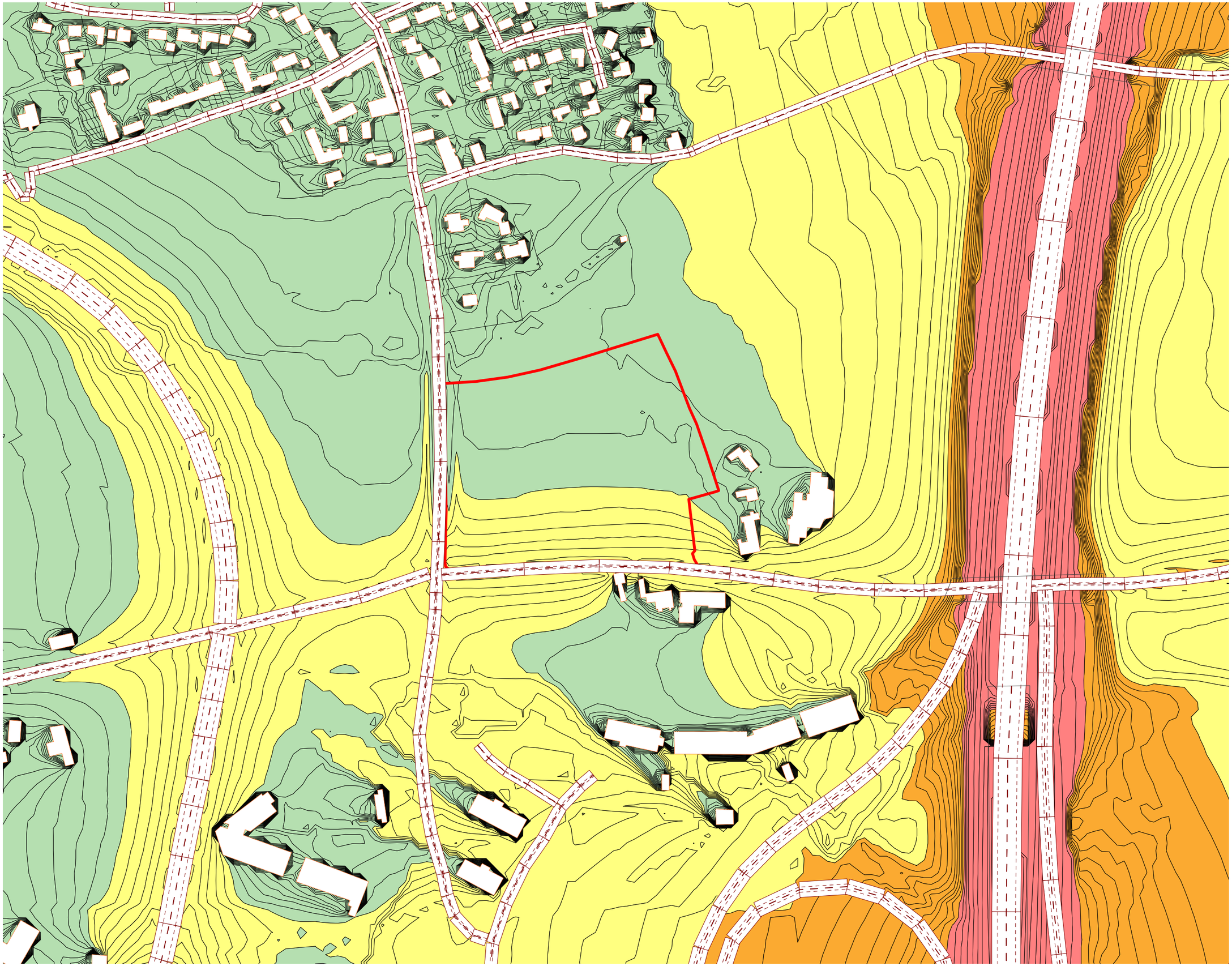
Executive Park
Avalon Way
Anstey
Leicestershire
LE7 7GR
Tel 0116 234 8000



Client:
Linden Homes

Project:
Sandrock,
Exeter

Project Number:
A086991

Drawing Title / Scenario:
Existing Night-time
LAeq, 8hr Noise Levels

Drawing Number:
SK04

Key:

Site Boundary:

- 0.0 - 50.0 dB
- 50.0 - 60.0 dB
- 60.0 - 70.0 dB
- >70.0 dB

Scale : Not to scale

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Executive Park
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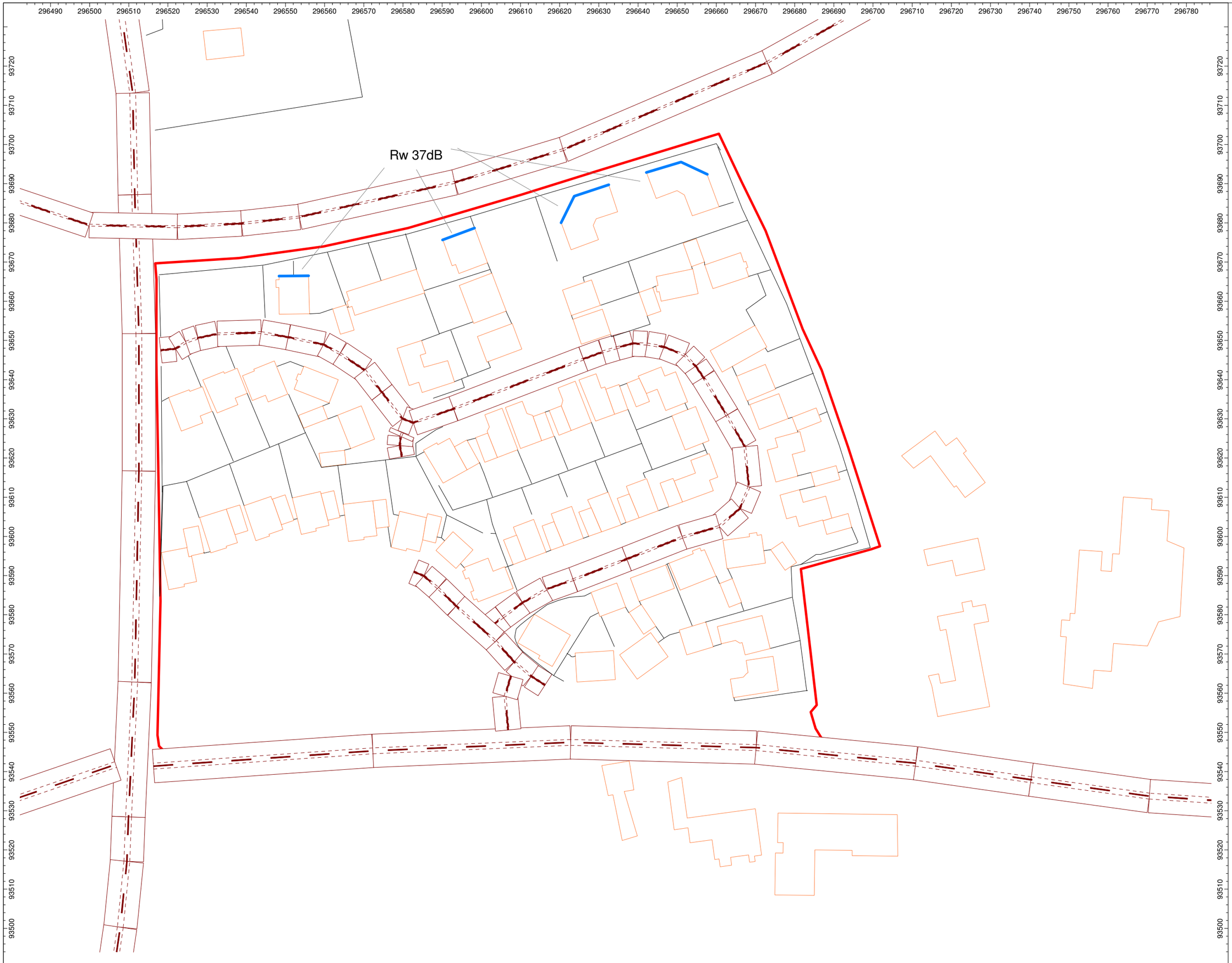
Leicestershire
LE7 7GR
Tel 0116 234 8000



Client:
Linden Homes

Project:
Sandrock,
Exeter

Project Number:
A086991

Drawing Title / Scenario:
Glazing Strategy

Drawing Number:
SK05

Key:

Enhanced Glazing Required:

Site Boundary:

Scale : Not to scale

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