

Approved and Issued by?

Date: 14<sup>TH</sup> JULY 2014

# Acoustic Report.

Noise assessment for proposed residential development at  
Greenhill Road/ Nursery Lane, Liverpool

Dates of Survey: 11th and 12th June 2014



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**A Member of The Association of Noise Consultants**

## Environmental Noise Assessment.

Site: Residential development  
Greenhill Road  
Liverpool

Client: Morris Homes Limited  
Morland House  
Altrincham Road  
Wilmslow  
SK9 5NW

Dates of Survey: 11th and 12th June 2014

Acoustic Consultant: *Iain Critchley MIOA MInstSCE for Peninsular Acoustics Ltd*

### **1. Introduction.**

This report describes a noise survey at the proposed development site, at the request of Morris Homes Ltd, in order to determine typical daytime and ambient noise levels appropriate to residential development.

This report and supporting data and recommendations will be used in support of a planning application for 85 new, two-storey dwellings.

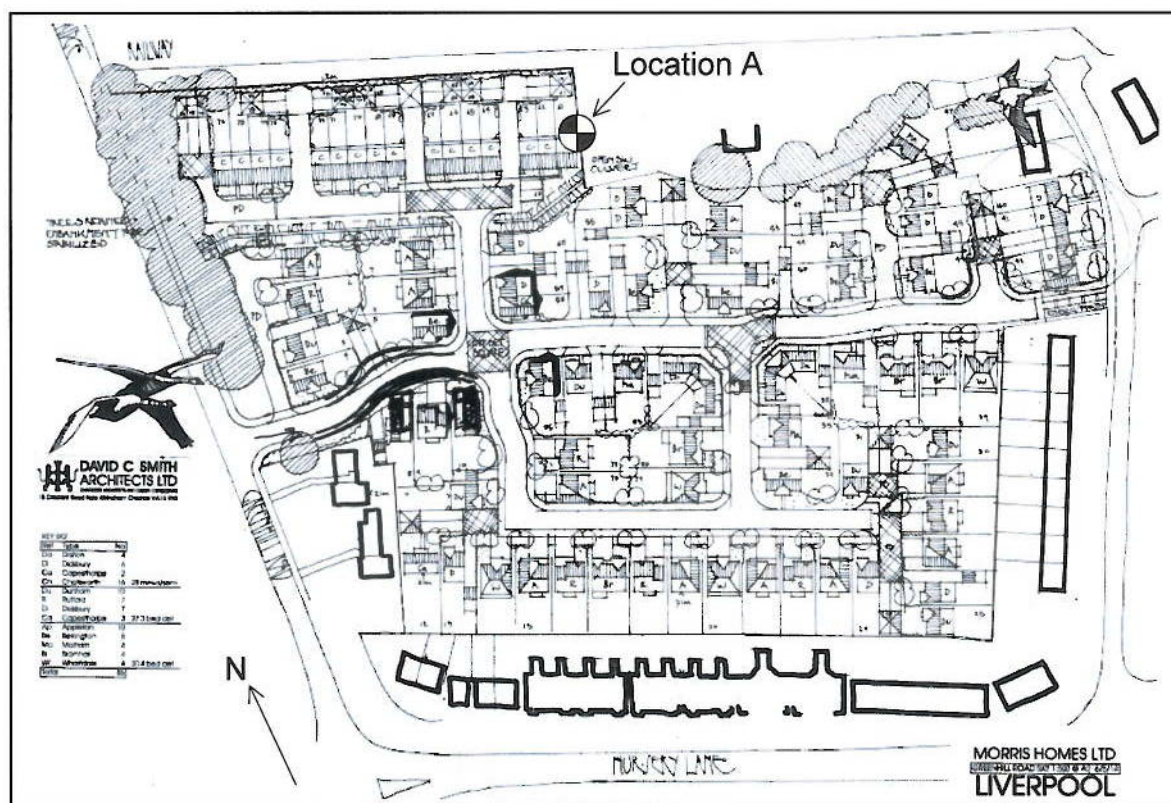
The site will be assessed in accordance with the National Planning Policy Framework with the aim of achieving 'good' levels of internal noise according to BS8233:2014.

### **2. Site Description.**

The site plan of Figure 1 shows the proposed development site which is a former garden centre/nursery located between Nursery Lane on the south-eastern boundary and Greenhill Road on the north-western boundary. To the north-east of the site lies the main Liverpool to London rail line which carries frequent freight traffic, day and night, as well as the timetabled passenger services.

The site is located in a primarily residential area and there are existing dwellings surrounding the development site and in similar proximity to the railway lines

**Figure 1** - plan of proposed development site showing monitoring location A.



### 3. Site noise survey commencing 3rd March 2014.

Noise monitoring at the site was for a continuous period of 24 hours commencing at 10.00 a.m. on the 11th June and ending at 10.00 a.m. on the 12th June 2014. This was to take account of typical rail traffic, both timetabled passenger trains and the irregular movements of freight trains.

The noise data from this location was used to calibrate a CadnaA noise model to predict noise levels at the locations of the proposed dwellings at other locations on the site.

#### 3.1 Weather conditions.

The weather conditions were fine, dry and calm throughout the survey period with a daytime temperature of 17°C and a night time temperature of 13°C. Wind speeds did not exceed 1.0 m/sec from the north-west during the attended (daytime) part of the survey period and were reported to be similar through the night.

#### 3.2 Equipment and procedures.

Noise monitoring was carried out using a Norsonic 118 Class 1 sound level meter (Ser.No. 31512) and a GRAS Type 41AL environmental microphone (Ser.No.16215) with the microphone at a height of 2.0 metres above ground level, in accordance with BS7445, and 20 metres from the railway boundary fence.



All equipment was calibrated before and after each survey period and no drift in calibration was noted.

All of the equipment carries current, traceable calibration and certificates will be provided on request.

The instruments were set to record continuously in 5 minute periods, the parameters of LAeq, LA90 and Laf,max.

**Figure 2** - photo showing monitoring location A, 20 metres from boundary fence.3.3



#### Survey results.

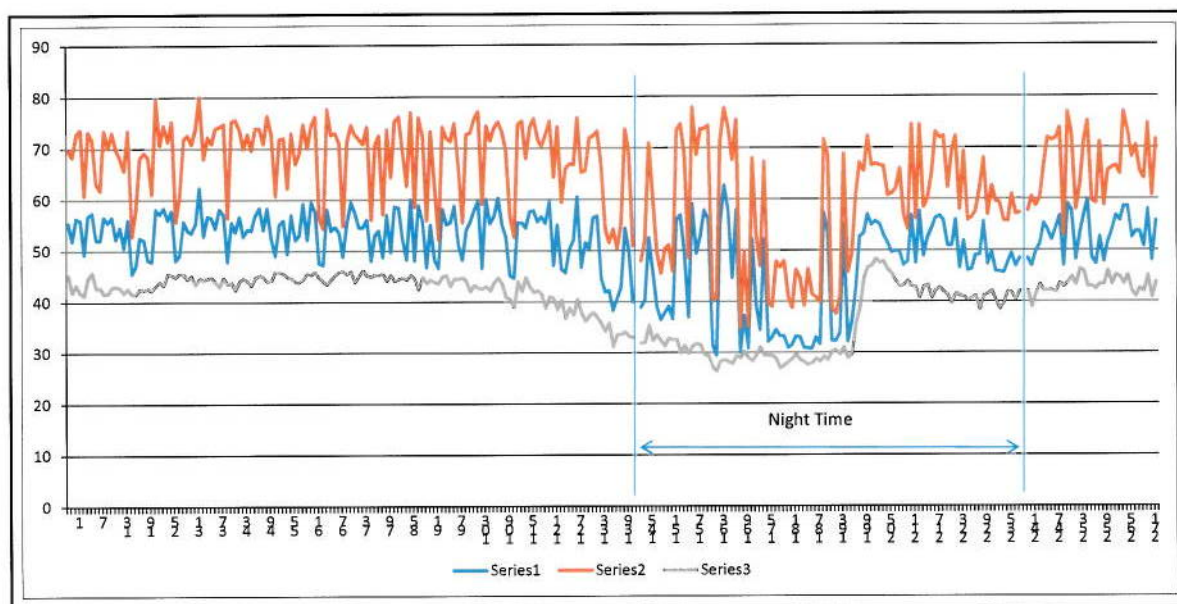
The results of the noise survey are as summarised in Table 1 and graphically in Figure 1.

**Table 1** - summary of survey results at Location A

Survey Period	Typical LAeq,1 hour	Night time LAmax.
10.00 a.m. to 11.00 p.m.	55.2 dBA	n/a
11.00 p.m. to 7.00 a.m.	52.1 dBA	77.8*
7.00 a.m. to 10.00 a.m.	54.7 dBA	n/a

\* Highest value recorded

**Figure 1** - graph of 24 hour noise data at Location A.



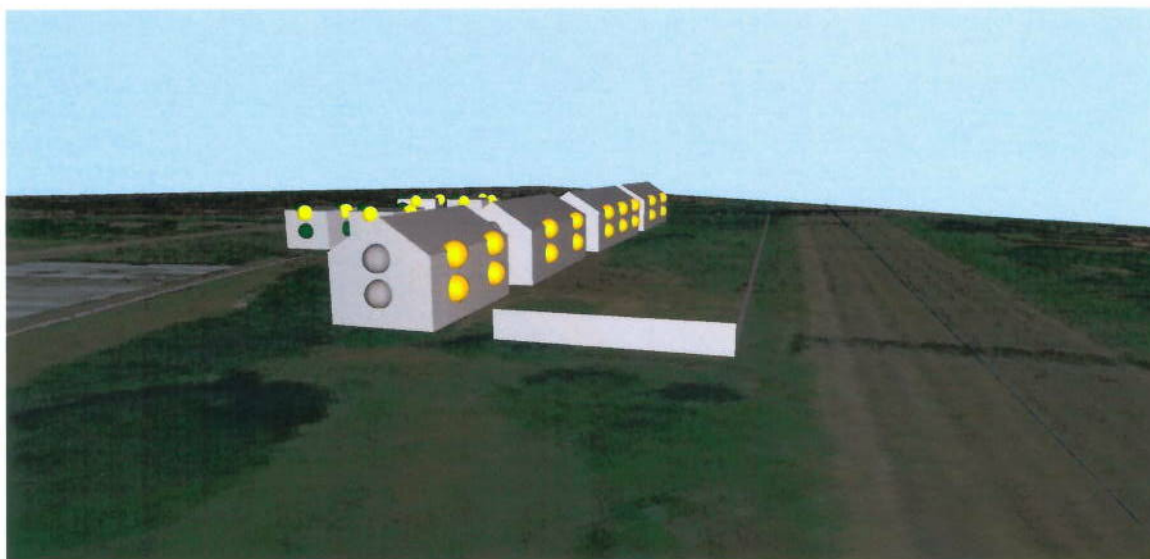
#### 4. Calculation of noise levels at the proposed development.

##### 4.1 CadnaA noise model.

A Cadna A acoustic model of the site was used to predict noise levels at the facades of the houses on the site, with particular attention to the four rows of 'Type C' terraced houses at the north-eastern boundary i.e. closest to the railway line.

Example graphics from the Cadna A noise model are included in Annex C with a 3-D view shown in Figure 3. Note that the model shows a fence alongside the railway which will be discussed later in this report.

The Cadna model was calibrated to show the 16 hour daytime levels and the 8 hour night time levels, based upon the measurements recorded at Location A. This was achieved by adjusting the sound power level of the railway line, represented as a line source, in the model until the plotted value at the reference location was an exact match, day and night, for the measured values. The model takes account of ground absorption, monitoring height and reflections from buildings.

**Figure 3** - 3D view of CADNA noise model, looking north-east.

#### 4.2 Results of calculations.

The CADNA noise model shows that noise levels at the proposed development will be as summarised in Table 2. The tabled values are shown in the 'building evaluation' symbols in the Cadna graphics included in Annex C.

The noise levels shown in Table 2 assume that a 1.8 metre high perimeter fence is erected around the gardens of Plots 61 to 67, mainly to provide shelter to the gardens to give a zone which is less than 55 dBA.

All of the noise levels in the table take account of the relevant source height, receiver heights, ground reflection/absorption and reflections from buildings (2nd order) and are 'worst case'.

**Table 2** - predicted facade noise levels at dwellings.

Description	LAeq,16 hrs (day)	LAeq,8 hrs (night)
Plots 61 to 76	57 dBA	53 dBA
Plots 1 to 7	48 dBA	45 dBA
Plots 51 to 60	54 dBA	51 dBA
Plots 47	56 dBA	53 dBA
Plot 40 to 43	53 dBA	50 dBA
Plots 8 to 35 and 77 to 85	48 dBA	45 dBA

The noise model also shows that there are large areas of private outdoor amenity space, across the site, where noise levels are below 50 dBA (shown as green and yellow in the noise model), and below 55 dBA (shown as grey in the noise model).



## **5. Estimation of internal noise levels in habitable rooms and recommendations for glazing.**

### **5.1 Typical living room (Plot 61)**

The noise model predicts that the noisiest elevation, of Plot 61, is exposed to a 'facade' noise level of up to 57 dBA, which is equivalent to a 'free-field' noise level of 55 dBA

A typical ground floor living room is assumed to be approximately 45 m<sup>3</sup> in volume, a window area of up to 3.5 m<sup>2</sup> and furnished to give a mid-frequency RT of 0.5 seconds.

Calculations show that internal noise levels of 31 dBA can be achieved using tightly closed, 'standard' thermal double glazing, e.g. 4/16/4 with up to 4 'acoustic' trickle vents.

Note: With windows, patio doors etc left open, the internal noise level will be approximately 41 dBA, which is higher than the 'good' level for living rooms recommended in BS8233:2014.

### **5.2 Typical bedroom (Plot 61).**

The noise model shows that the noisiest elevation, of Plot 61, is exposed to a free-field night time noise level of up to 52 dBA but also a night time maximum level of up to 78 dB LAf,max, due to the several freight trains which pass through the night.

A typical first floor bedroom is assumed to be approximately 25 m<sup>3</sup> in volume, a window area of up to 1.5 m<sup>2</sup> and furnished to give a mid-frequency RT of 0.5 seconds.

Calculations show that internal noise levels of 44 dB LAf,max can be achieved using tightly closed 'acoustic' double glazing, e.g. 10/12/6 with no trickle vents but with a Passivent 'Fresh 80' wall vent, or similar, fitted to each bedroom.

With the windows closed, the 'average' internal noise level overnight will be 18 dBA.

Note: With windows opened, the internal noise level in a typical bedroom will be 38 dBA with a Lmax of up to 64 dBA, which exceeds the 'good' level for bedrooms recommended in BS8233:2014.

### 5.3 Glazing to other plots.

It is recommended that the same glazing specification is applied to all plots where the daytime noise level exceeds 50 dBA and where the night time noise level exceeds 45 dBA (refer to Table 2). For the remaining plots, a reduced glazing specification of 4/16/4 can be used also for bedrooms.

## 6. **Ventilation of Habitable rooms.**

The room noise calculations assume that all windows are tightly closed within well-sealed frames and with the respective vents in the open position.

The night time noise levels at the site, however, are such that 'good' noise conditions (according to WHO Guidelines and BS 8233:2014) in habitable rooms of plots nearest to the railway can only be achieved with windows tightly closed.

This means that some alternative means of ventilation will be required so that adequate fresh air is available to occupants without having to open the windows. This can be achieved using a mechanical ventilation system, with heat recovery (MVHR), which has the benefit of reduced energy costs.

Mechanical ventilation is also recommended for all bedroom windows which face the railway, regardless of the plot locations on site, as the 'peak' noise level due to individual train passes is likely to exceed 45 dB LAmax, in bedrooms, with windows opened.



## 7. Conclusions.

1. A noise survey was carried out at the proposed development site on the 11th and 12th June 2014.
2. The survey data shows that noise levels at the locations of the proposed dwellings, nearest to the railway, will be up to 55 dBA during the day and up to 52 dBA at night but that 'peak' noise levels through night can be up to 78 dB Lmax due to freight trains.
3. Calculations show that good internal noise levels in all ground floor living rooms can be achieved using 'standard' thermal double glazing e.g. 4/16/4 in well-sealed frames.
4. For bedrooms of all plots where the night time external noise level exceeds 45 dBA, an 'acoustic' glazing specification e.g. 10/12/6 is required in order to insulate against individual passing trains.
5. Calculations also show that alternative means of ventilation will be required to all bedrooms which have a view towards the railway lines.
6. A 1.8 metres high, close-boarded timber fence is recommended along the railway boundary fence behind Plots 61 to 76, in order to provide an area of garden which is below 55 dBA during the day.

This concludes the report.

Signature/name of consultant.....

Date: 14/7/2014

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## 8. Definitions.

### 1. LAeq (t)

This is a measure of the 'average' noise level, in decibels, which has occurred over a given time period (t) e.g. LAeq (8 hours). The 'eq' stands for equivalent level as its proper definition is "*the equivalent steady sound level containing the same energy as the fluctuating sound level over the same time period*". The 'A' means that the quoted sound level is 'A' - weighted.

### 2. 'A' - weighting e.g. in dBA.

The sound level has been measured with an instrument whose sensitivity has been 'tailored' to match the typical frequency response of the human ear. Nearly all environmental noise measurements are expressed in dBA.

### 3. LA90.

This is the sound level, in decibels (dBA), which is exceeded for 90% of the measurement period. LA90 is used to determine the background noise level of an area.

### 4. LA10.

This is the sound level which is exceeded for 10% of the measurement period and is a traditional unit for the measurement of road traffic noise.

### 5. LAf,max.

This is the highest level or 'peak' level\*, measured with 'fast' time weighting, which is reached by the fluctuating noise level over the stated time period, even if it is only reached for a fraction of a second. Used to describe the highest sound level of short duration individual events such as a vehicle pass-by, which might cause disturbance or wake someone from sleep. It is possible to have high values of LAf,max even where the 'average' noise level, the LAeq, is relatively low.

\* Technically, the term 'peak noise level' refers to a different parameter which is not measured as part of a normal noise survey. It is occasionally used in this report as a convenient shorthand for LAf,max as it is a concept which is more easily understood by people who do not have a knowledge of acoustics theory.

## Annex A.

### Site Plans.



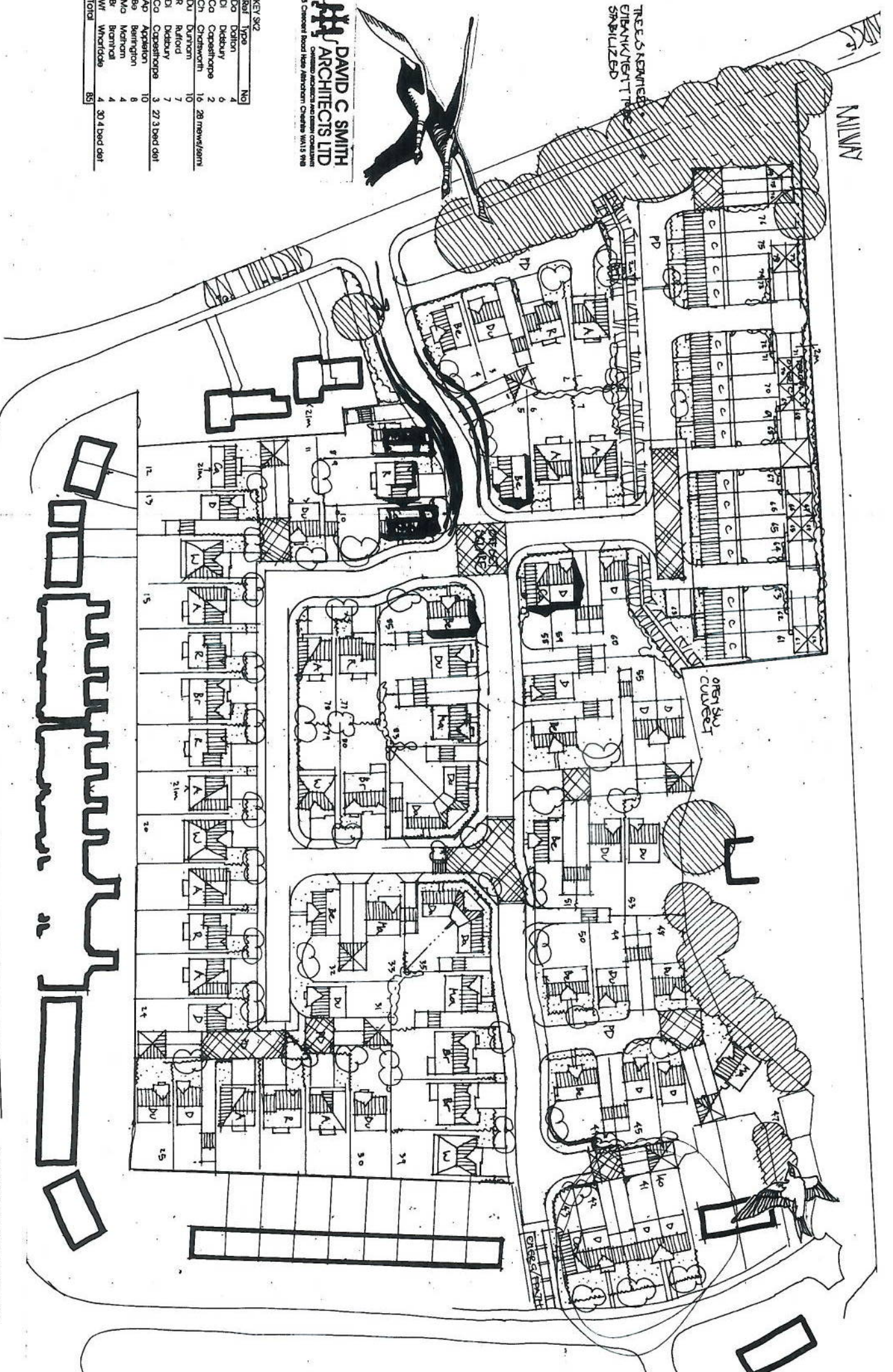
MILNAY

THREE 5 BEDDERS  
ELEVATED  
STABILIZED



**DAVID C SMITH  
ARCHITECTS LTD**  
CHARTERED ARCHITECTS AND DESIGN CONSULTANTS  
18 Campbell Road, West Abernethy, Dundee, DD11 9BB

Ref	Size	No
Do	Dormer	4
Di	Dormer	6
Ca	Capstone	2
Ch	Chimney	16
Du	Durham	28
R	Railford	7
Di	Dormer	7
Ca	Capstone	3
Ap	Apex	10
Ba	Barrington	8
Ma	Methuen	4
Br	Burton	4
Wf	Whitford	4
		30 4 Bed det
Total		85



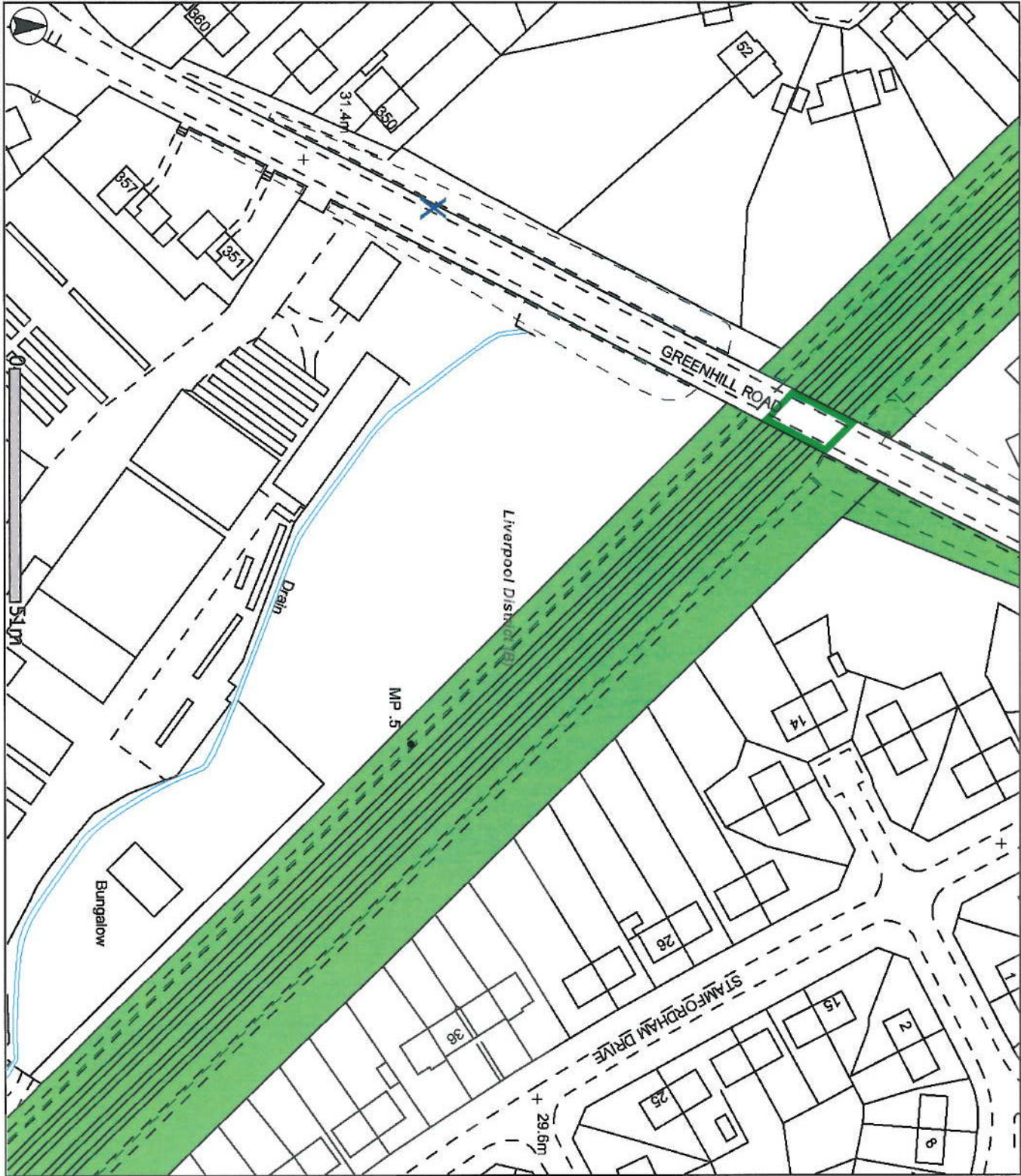
MURPHY LANE

MORRIS HOMES LTD  
GREENHILL ROAD SK2 1 300 @ A2 6/5/14  
LIVERPOOL










Centre of Map Window (E.N): 340285, 385505

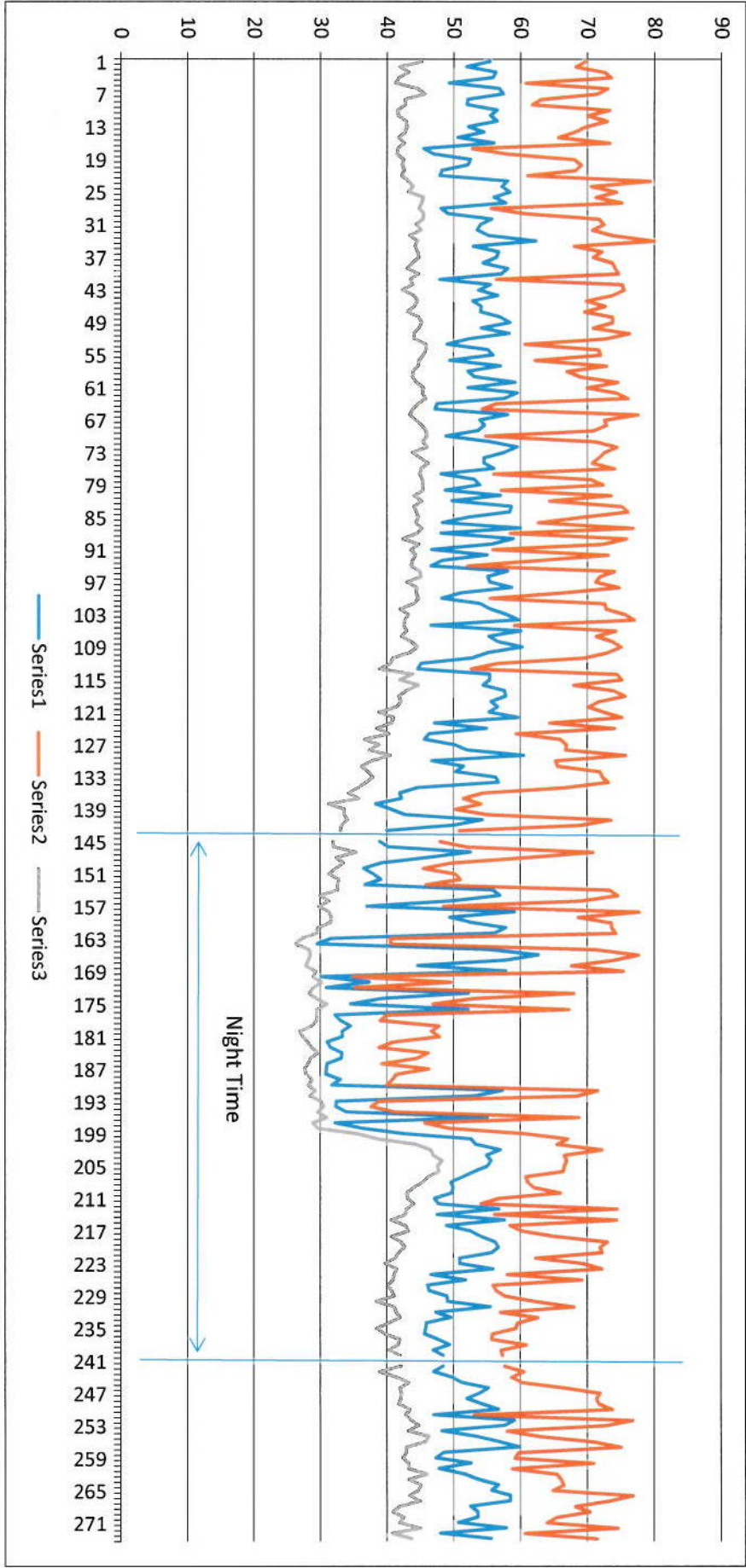
<b>GREENHILL RD</b>	
Network Rail Land	
Plot Scale	1:1250
Plot Date	16/1/2013
	



## Annex B.

Measurement data and room calculations.

Results of 24-hour noise survey at Greenhill Road Nursery (Location A)



52.1397 night  
55.23795 day  
54.7276 morning

Directory:

C:\Acoustic Data Files 2014\Nor 116 data\140611

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NOR116_2862588_140611_0004.NBF	(2014/06/11 11:20:00.00)	55.9	73.6	41.8
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NOR116_2862588_140611_0091.NBF	(2014/06/11 18:35:01.00)	46.7	55.9	43.6
NOR116_2862588_140611_0092.NBF	(2014/06/11 18:40:01.00)	55	73.2	44.3
NOR116_2862588_140611_0093.NBF	(2014/06/11 18:45:01.00)	48.3	62.6	43.8
NOR116_2862588_140611_0094.NBF	(2014/06/11 18:50:01.00)	46.6	52.1	43.6
NOR116_2862588_140611_0095.NBF	(2014/06/11 18:55:01.00)	58.1	74.1	44.9
NOR116_2862588_140611_0096.NBF	(2014/06/11 19:00:01.00)	55.1	71.9	45.1
NOR116_2862588_140611_0097.NBF	(2014/06/11 19:05:01.00)	55.4	71.3	43
NOR116_2862588_140611_0098.NBF	(2014/06/11 19:10:01.00)	58.7	74.8	44.5
NOR116_2862588_140611_0099.NBF	(2014/06/11 19:15:01.00)	51.1	66.1	44.4
NOR116_2862588_140611_0100.NBF	(2014/06/11 19:20:01.00)	48.2	55.5	44.7
NOR116_2862588_140611_0101.NBF	(2014/06/11 19:25:01.00)	53.9	72.6	44
NOR116_2862588_140611_0102.NBF	(2014/06/11 19:30:01.00)	55.5	72.9	42
NOR116_2862588_140611_0103.NBF	(2014/06/11 19:35:01.00)	57.9	75.7	43.2
NOR116_2862588_140611_0104.NBF	(2014/06/11 19:40:01.00)	59.7	77.1	42.7
NOR116_2862588_140611_0105.NBF	(2014/06/11 19:45:01.00)	46.6	59.1	42.5
NOR116_2862588_140611_0106.NBF	(2014/06/11 19:50:01.00)	60.1	74.3	43
NOR116_2862588_140611_0107.NBF	(2014/06/11 19:55:01.00)	55.3	71.4	42.2
NOR116_2862588_140611_0108.NBF	(2014/06/11 20:00:01.00)	56.6	73.8	43.6
NOR116_2862588_140611_0109.NBF	(2014/06/11 20:05:01.00)	60.3	75.1	44.6

NOR116_2862588_140611_0110.NBF	(2014/06/11 20:10:01.00)	55.2	73.2	43.5
NOR116_2862588_140611_0111.NBF	(2014/06/11 20:15:01.00)	52.8	69.6	40.9
NOR116_2862588_140611_0112.NBF	(2014/06/11 20:20:01.00)	45.1	56.6	40.5
NOR116_2862588_140611_0113.NBF	(2014/06/11 20:25:01.00)	44.6	52.7	38.9
NOR116_2862588_140611_0114.NBF	(2014/06/11 20:30:01.00)	55.4	74.5	43.9
NOR116_2862588_140611_0115.NBF	(2014/06/11 20:35:01.00)	55.4	75.2	42
NOR116_2862588_140611_0116.NBF	(2014/06/11 20:40:01.00)	54.4	68	44.7
NOR116_2862588_140611_0117.NBF	(2014/06/11 20:45:01.00)	57.6	73.9	42.9
NOR116_2862588_140611_0118.NBF	(2014/06/11 20:50:01.00)	57.8	75.7	41.8
NOR116_2862588_140611_0119.NBF	(2014/06/11 20:55:01.00)	55.6	71.8	42.1
NOR116_2862588_140611_0120.NBF	(2014/06/11 21:00:01.00)	56.6	70.2	41.5
NOR116_2862588_140611_0121.NBF	(2014/06/11 21:05:01.00)	55.3	72.5	38.8
NOR116_2862588_140611_0122.NBF	(2014/06/11 21:10:01.00)	59.7	75.2	41
NOR116_2862588_140611_0123.NBF	(2014/06/11 21:15:01.00)	47.1	64.4	40.7
NOR116_2862588_140611_0124.NBF	(2014/06/11 21:20:01.00)	54.9	74.1	38.5
NOR116_2862588_140611_0125.NBF	(2014/06/11 21:25:01.00)	46.3	59.4	40.3
NOR116_2862588_140611_0126.NBF	(2014/06/11 21:30:01.00)	45.6	66	36.7
NOR116_2862588_140611_0127.NBF	(2014/06/11 21:35:01.00)	50.1	66.9	38.8
NOR116_2862588_140611_0128.NBF	(2014/06/11 21:40:01.00)	51.9	66.8	37.4
NOR116_2862588_140611_0129.NBF	(2014/06/11 21:45:01.00)	60.5	75.8	40.5
NOR116_2862588_140611_0130.NBF	(2014/06/11 21:50:01.00)	46.7	65.3	37.8
NOR116_2862588_140611_0131.NBF	(2014/06/11 21:55:01.00)	51.5	65.6	36.2
NOR116_2862588_140611_0132.NBF	(2014/06/11 22:00:01.00)	50.3	71.9	37.2
NOR116_2862588_140611_0133.NBF	(2014/06/11 22:05:01.00)	56.3	72.3	37.9
NOR116_2862588_140611_0134.NBF	(2014/06/11 22:10:01.00)	56.7	73.2	36.9
NOR116_2862588_140611_0135.NBF	(2014/06/11 22:15:01.00)	44.6	66.7	35.7
NOR116_2862588_140611_0136.NBF	(2014/06/11 22:20:01.00)	41.9	54.3	34.2
NOR116_2862588_140611_0137.NBF	(2014/06/11 22:25:01.00)	42.2	51.5	35.8
NOR116_2862588_140611_0138.NBF	(2014/06/11 22:30:01.00)	38.3	54.1	31.2
NOR116_2862588_140611_0139.NBF	(2014/06/11 22:35:01.00)	40.6	50.3	33.6
NOR116_2862588_140611_0140.NBF	(2014/06/11 22:40:01.00)	42.7	55.2	33.6
NOR116_2862588_140611_0141.NBF	(2014/06/11 22:45:01.00)	54.3	73.6	34.1
NOR116_2862588_140611_0142.NBF	(2014/06/11 22:50:01.00)	50	68.9	33.2
NOR116_2862588_140611_0143.NBF	(2014/06/11 22:55:01.00)	40	50.9	33
NOR116_2862588_140611_0144.NBF	(2014/06/11 23:00:01.00)	38.9	48	31.9
NOR116_2862588_140611_0145.NBF	(2014/06/11 23:05:01.00)	40.2	52	32
NOR116_2862588_140611_0146.NBF	(2014/06/11 23:10:01.00)	52.5	70.9	35.4
NOR116_2862588_140611_0147.NBF	(2014/06/11 23:15:01.00)	46.1	60.8	32.4
NOR116_2862588_140611_0148.NBF	(2014/06/11 23:20:01.00)	39.1	49.6	33.5
NOR116_2862588_140611_0149.NBF	(2014/06/11 23:25:01.00)	36.5	45.5	32.3
NOR116_2862588_140611_0150.NBF	(2014/06/11 23:30:01.00)	37.9	50.3	31.3
NOR116_2862588_140611_0151.NBF	(2014/06/11 23:35:01.00)	39.1	51	32.8
NOR116_2862588_140611_0152.NBF	(2014/06/11 23:40:01.00)	36.7	45.9	32.6
NOR116_2862588_140611_0153.NBF	(2014/06/11 23:45:01.00)	55.9	73.4	32.6
NOR116_2862588_140611_0154.NBF	(2014/06/11 23:50:01.00)	56.9	74.6	29.9
NOR116_2862588_140612_0001.NBF	(2014/06/11 23:55:01.00)	49.7	69	31.3
NOR116_2862588_140612_0002.NBF	(2014/06/12 00:00:01.00)	37	48.5	29.8
NOR116_2862588_140612_0003.NBF	(2014/06/12 00:05:01.00)	59.1	77.8	31.3
NOR116_2862588_140612_0004.NBF	(2014/06/12 00:10:00.00)	49.4	68.7	31.7
NOR116_2862588_140612_0005.NBF	(2014/06/12 00:15:00.00)	52.8	73.6	31.5
NOR116_2862588_140612_0006.NBF	(2014/06/12 00:20:00.00)	57.8	73.7	29.6
NOR116_2862588_140612_0007.NBF	(2014/06/12 00:25:00.00)	56.1	74.3	29.4
NOR116_2862588_140612_0008.NBF	(2014/06/12 00:30:00.00)	31.6	40.5	27.2
NOR116_2862588_140612_0009.NBF	(2014/06/12 00:35:01.00)	29.5	40.6	26.3
NOR116_2862588_140612_0010.NBF	(2014/06/12 00:40:01.00)	55	71.2	28.3



NOR116_2862588_140612_0011.NBF	(2014/06/12 00:45:00.00)	62.7	77.7	28.5
NOR116_2862588_140612_0012.NBF	(2014/06/12 00:50:00.00)	57.9	74	28.2
NOR116_2862588_140612_0013.NBF	(2014/06/12 00:55:00.00)	44.6	67.7	27.8
NOR116_2862588_140612_0014.NBF	(2014/06/12 01:00:01.00)	57.8	75.4	29.3
NOR116_2862588_140612_0015.NBF	(2014/06/12 01:05:00.00)	30.1	34.9	28.9
NOR116_2862588_140612_0016.NBF	(2014/06/12 01:10:01.00)	37.3	49.6	30.2
NOR116_2862588_140612_0017.NBF	(2014/06/12 01:15:01.00)	30.9	35.2	28.9
NOR116_2862588_140612_0018.NBF	(2014/06/12 01:20:01.00)	52.2	68	28.3
NOR116_2862588_140612_0019.NBF	(2014/06/12 01:25:00.00)	39.3	53	29.4
NOR116_2862588_140612_0020.NBF	(2014/06/12 01:30:01.00)	34.5	46.9	31
NOR116_2862588_140612_0021.NBF	(2014/06/12 01:35:01.00)	52.2	67.3	29.4
NOR116_2862588_140612_0022.NBF	(2014/06/12 01:40:00.00)	32.2	39.9	29.4
NOR116_2862588_140612_0023.NBF	(2014/06/12 01:45:01.00)	33	39	29.4
NOR116_2862588_140612_0024.NBF	(2014/06/12 01:50:01.00)	34.5	47.8	28.7
NOR116_2862588_140612_0025.NBF	(2014/06/12 01:55:01.00)	33.3	46.7	26.9
NOR116_2862588_140612_0026.NBF	(2014/06/12 02:00:01.00)	33.3	47.9	27.4
NOR116_2862588_140612_0027.NBF	(2014/06/12 02:05:01.00)	31	40.9	28.1
NOR116_2862588_140612_0028.NBF	(2014/06/12 02:10:01.00)	31.5	38.8	28.7
NOR116_2862588_140612_0029.NBF	(2014/06/12 02:15:01.00)	33.2	46.2	29.6
NOR116_2862588_140612_0030.NBF	(2014/06/12 02:20:01.00)	33.1	44.5	28.5
NOR116_2862588_140612_0031.NBF	(2014/06/12 02:25:01.00)	31	39.2	28.1
NOR116_2862588_140612_0032.NBF	(2014/06/12 02:30:01.00)	30.9	46.3	27.6
NOR116_2862588_140612_0033.NBF	(2014/06/12 02:35:01.00)	30.8	41.4	27.9
NOR116_2862588_140612_0034.NBF	(2014/06/12 02:40:01.00)	33	40.8	28.8
NOR116_2862588_140612_0035.NBF	(2014/06/12 02:45:01.00)	31.7	39.9	28.2
NOR116_2862588_140612_0036.NBF	(2014/06/12 02:50:01.00)	57.3	71.6	29.2
NOR116_2862588_140612_0037.NBF	(2014/06/12 02:55:00.00)	53.3	68.5	28.5
NOR116_2862588_140612_0038.NBF	(2014/06/12 03:00:01.00)	32.4	38.8	30.1
NOR116_2862588_140612_0039.NBF	(2014/06/12 03:05:01.00)	32.3	37.6	30.5
NOR116_2862588_140612_0040.NBF	(2014/06/12 03:10:01.00)	33.9	41.2	29.6
NOR116_2862588_140612_0041.NBF	(2014/06/12 03:15:01.00)	55.1	68.8	31
NOR116_2862588_140612_0042.NBF	(2014/06/12 03:20:00.00)	32.2	45.7	28.9
NOR116_2862588_140612_0043.NBF	(2014/06/12 03:25:01.00)	36.2	49.3	29.6
NOR116_2862588_140612_0044.NBF	(2014/06/12 03:30:01.00)	42.5	60.8	35.6
NOR116_2862588_140612_0045.NBF	(2014/06/12 03:35:01.00)	52.6	67.1	38.6
NOR116_2862588_140612_0046.NBF	(2014/06/12 03:40:00.00)	53.3	65.5	44.4
NOR116_2862588_140612_0047.NBF	(2014/06/12 03:45:00.00)	57	72.2	46.6
NOR116_2862588_140612_0048.NBF	(2014/06/12 03:50:00.00)	54.9	66.6	47
NOR116_2862588_140612_0049.NBF	(2014/06/12 03:55:00.00)	55.6	66.9	48.3
NOR116_2862588_140612_0050.NBF	(2014/06/12 04:00:00.00)	55.1	66.6	47.6
NOR116_2862588_140612_0051.NBF	(2014/06/12 04:05:00.00)	53.1	66.4	47.8
NOR116_2862588_140612_0052.NBF	(2014/06/12 04:10:00.00)	51.4	60.8	46.2
NOR116_2862588_140612_0053.NBF	(2014/06/12 04:15:00.00)	49.6	61.1	45.4
NOR116_2862588_140612_0054.NBF	(2014/06/12 04:20:00.00)	49.9	62	44
NOR116_2862588_140612_0055.NBF	(2014/06/12 04:25:00.00)	49.7	66	43
NOR116_2862588_140612_0056.NBF	(2014/06/12 04:30:00.00)	47.1	56.8	43.1
NOR116_2862588_140612_0057.NBF	(2014/06/12 04:35:01.00)	47.7	54.1	44
NOR116_2862588_140612_0058.NBF	(2014/06/12 04:40:01.00)	56.8	74.5	42.9
NOR116_2862588_140612_0059.NBF	(2014/06/12 04:45:00.00)	47.5	56.1	42.8
NOR116_2862588_140612_0060.NBF	(2014/06/12 04:50:01.00)	57.6	74.4	40.7
NOR116_2862588_140612_0061.NBF	(2014/06/12 04:55:00.00)	48.9	58.4	42.8
NOR116_2862588_140612_0062.NBF	(2014/06/12 05:00:01.00)	52.5	60.2	43.2
NOR116_2862588_140612_0063.NBF	(2014/06/12 05:05:00.00)	54.1	65.2	40.7
NOR116_2862588_140612_0064.NBF	(2014/06/12 05:10:00.00)	56.2	73	42.1
NOR116_2862588_140612_0065.NBF	(2014/06/12 05:15:00.00)	56.7	71.9	42.7
NOR116_2862588_140612_0066.NBF	(2014/06/12 05:20:00.00)	55.7	72.2	41.8



NOR116_2862588_140612_0067.NBF	(2014/06/12 05:25:00.00)	50.9	62.3	41.2
NOR116_2862588_140612_0068.NBF	(2014/06/12 05:30:01.00)	50.9	69.3	39.7
NOR116_2862588_140612_0069.NBF	(2014/06/12 05:35:01.00)	55.9	72.2	41.5
NOR116_2862588_140612_0070.NBF	(2014/06/12 05:40:01.00)	46.6	58	41.1
NOR116_2862588_140612_0071.NBF	(2014/06/12 05:45:01.00)	51.8	69.2	40.9
NOR116_2862588_140612_0072.NBF	(2014/06/12 05:50:01.00)	46.1	55.9	40.2
NOR116_2862588_140612_0073.NBF	(2014/06/12 05:55:01.00)	46.3	56.4	40.7
NOR116_2862588_140612_0074.NBF	(2014/06/12 06:00:01.00)	49	57.7	41.1
NOR116_2862588_140612_0075.NBF	(2014/06/12 06:05:01.00)	49.1	62.2	38.4
NOR116_2862588_140612_0076.NBF	(2014/06/12 06:10:01.00)	55.5	68	41.1
NOR116_2862588_140612_0077.NBF	(2014/06/12 06:15:01.00)	47.3	57	41.4
NOR116_2862588_140612_0078.NBF	(2014/06/12 06:20:01.00)	49.6	62.6	42
NOR116_2862588_140612_0079.NBF	(2014/06/12 06:25:01.00)	45.9	59.6	40.3
NOR116_2862588_140612_0080.NBF	(2014/06/12 06:30:01.00)	45.8	59.3	38.5
NOR116_2862588_140612_0081.NBF	(2014/06/12 06:35:01.00)	45.6	55.8	39.7
NOR116_2862588_140612_0082.NBF	(2014/06/12 06:40:01.00)	47.6	55.7	41.9
NOR116_2862588_140612_0083.NBF	(2014/06/12 06:45:01.00)	49.4	60.9	41.7
NOR116_2862588_140612_0084.NBF	(2014/06/12 06:50:01.00)	46.9	57.1	40.3
NOR116_2862588_140612_0085.NBF	(2014/06/12 06:55:01.00)	48.4	57.3	42
NOR116_2862588_140612_0086.NBF	(2014/06/12 07:00:01.00)	48.4	57.7	42.1
NOR116_2862588_140612_0087.NBF	(2014/06/12 07:05:01.00)	47	60.5	38.9
NOR116_2862588_140612_0088.NBF	(2014/06/12 07:10:01.00)	49.7	58.7	41.4
NOR116_2862588_140612_0089.NBF	(2014/06/12 07:15:01.00)	51.2	60.3	43.3
NOR116_2862588_140612_0090.NBF	(2014/06/12 07:20:01.00)	55.2	66.8	42
NOR116_2862588_140612_0091.NBF	(2014/06/12 07:25:01.00)	53.9	71.9	42.2
NOR116_2862588_140612_0092.NBF	(2014/06/12 07:30:01.00)	52	71.4	42.1
NOR116_2862588_140612_0093.NBF	(2014/06/12 07:35:01.00)	54.3	71.8	41.8
NOR116_2862588_140612_0094.NBF	(2014/06/12 07:40:01.00)	56.7	73.8	43.5
NOR116_2862588_140612_0095.NBF	(2014/06/12 07:45:01.00)	47	53.1	42.8
NOR116_2862588_140612_0096.NBF	(2014/06/12 07:50:01.00)	59.1	76.8	43.7
NOR116_2862588_140612_0097.NBF	(2014/06/12 07:55:01.00)	57.7	72.8	44.8
NOR116_2862588_140612_0098.NBF	(2014/06/12 08:00:01.00)	48.2	58	43.2
NOR116_2862588_140612_0099.NBF	(2014/06/12 08:05:01.00)	53.3	62.9	46.3
NOR116_2862588_140612_0100.NBF	(2014/06/12 08:10:01.00)	56.8	71	45.8
NOR116_2862588_140612_0101.NBF	(2014/06/12 08:15:01.00)	59.9	75.1	42.9
NOR116_2862588_140612_0102.NBF	(2014/06/12 08:20:01.00)	48.5	59.7	42.9
NOR116_2862588_140612_0103.NBF	(2014/06/12 08:25:01.00)	47.3	59.2	42.4
NOR116_2862588_140612_0104.NBF	(2014/06/12 08:30:01.00)	52.6	71	43.3
NOR116_2862588_140612_0105.NBF	(2014/06/12 08:35:01.00)	47.8	58.8	43.3
NOR116_2862588_140612_0106.NBF	(2014/06/12 08:40:01.00)	51.6	65.5	46
NOR116_2862588_140612_0107.NBF	(2014/06/12 08:45:01.00)	53.7	66.1	43.3
NOR116_2862588_140612_0108.NBF	(2014/06/12 08:50:01.00)	56.7	66.5	45.1
NOR116_2862588_140612_0109.NBF	(2014/06/12 08:55:01.00)	55.7	64.9	44.7
NOR116_2862588_140612_0110.NBF	(2014/06/12 09:00:01.00)	58.5	76.9	43.4
NOR116_2862588_140612_0111.NBF	(2014/06/12 09:05:01.00)	58.5	73.3	45
NOR116_2862588_140612_0112.NBF	(2014/06/12 09:10:01.00)	52.5	68.2	41.9
NOR116_2862588_140612_0113.NBF	(2014/06/12 09:15:01.00)	53.6	70.4	40.9
NOR116_2862588_140612_0114.NBF	(2014/06/12 09:20:01.00)	53.6	65.5	42.5
NOR116_2862588_140612_0115.NBF	(2014/06/12 09:25:01.00)	50.7	64	41.9
NOR116_2862588_140612_0116.NBF	(2014/06/12 09:30:01.00)	57.9	74.6	45
NOR116_2862588_140612_0117.NBF	(2014/06/12 09:35:01.00)	48	60.7	40.8
NOR116_2862588_140612_0118.NBF	(2014/06/12 09:40:01.00)	55.6	71.5	43.7

Plot 61 - Living Room (Day)

BRE		Switch to Reverberation Time Calculation	
<b>Building Envelope Insulation</b>			
2) Select elements of facade structure, and enter corresponding internal surface area in m <sup>2</sup> OR enter number of vents.			
<b>1) Enter room dimensions or volume</b>		<b>HELP</b>	
<input type="radio"/> Use dimensions	<input type="radio"/> Use volume	Surface area OR number of vents	
x <input type="text" value="4"/> m	<input type="text" value="45"/> m <sup>3</sup>		
y <input type="text" value="6"/> m			
z <input type="text" value="2.8"/> m			
Volume <input type="text" value="2.8"/> m <sup>3</sup>			
OR			
3) Enter reverberation time of the room.			
<input type="text" value="0.5"/> seconds			
		View/Edit Data	
4) Select exterior sound level type			
Option (A) <input type="radio"/> User defined spectrum			
<input type="text" value="Greenhill Road (trains)"/>			
View/Edit Data			
Option (B) <input checked="" type="radio"/> Spectrum shape			
Select spectrum shape and enter free field exterior sound level, L <sub>Aeq</sub> (considering only the octave bands between 125Hz and 2kHz)			
L <sub>Aeq</sub> <input type="text" value="55"/> dB			
<input type="text" value="ISO 717 - 1 (Ctr)"/>			
View Data			
<b>Internal sound level</b>			
L <sub>Aeq</sub> <input type="text" value="30.7"/> dB			



Plot 61 — Bedroom (night)

BRE	
<b>Building Envelope Insulation</b>	
<b>Switch to Reverberation Time Calculation</b>	
<b>HELP</b>	
2) Select elements of facade structure, and enter corresponding internal surface area in $\text{m}^2$ OR enter number of vents.	
Surface area OR number of vents	
1) Enter room dimensions or volume	
<input type="radio"/> Use dimensions	
x <input type="text" value="4"/> m	
y <input type="text" value="6"/> m	
z <input type="text" value="2.8"/> m	
Volume <input type="text" value="70.56"/> $\text{m}^3$	
<b>OR</b>	
<input type="radio"/> Use volume	
<input type="text" value="25"/> $\text{m}^3$	
Wall 1 <input type="text" value="Brick/block cavity"/>	<input type="text" value="12"/> $\text{m}^2$
Wall 2 <input type="text" value="None"/>	<input type="text" value="0"/> $\text{m}^2$
Window 1 <input type="text" value="10/12/6 double glazing"/>	<input type="text" value="1.2"/> $\text{m}^2$
Window 2 <input type="text" value="None"/>	<input type="text" value=""/> $\text{m}^2$
Door <input type="text" value="None"/>	<input type="text" value=""/> $\text{m}^2$
Roof/Ceiling <input type="text" value="None"/>	<input type="text" value="0"/> $\text{m}^2$
Vent 1 <input type="text" value="None"/>	<input type="text" value="2"/>
Vent 2 <input type="text" value="Fresh 80 dB"/>	<input type="text" value="1"/>
<b>View/Edit Data</b>	
3) Enter reverberation time of the room.	
<input type="text" value=".5"/> seconds	
4) Select exterior sound level type	
Option (A) <input type="radio"/> User defined spectrum	
<input type="text" value="Greenhill Road (trains)"/>	
<b>View/Edit Data</b>	
Option (B) <input checked="" type="radio"/> Spectrum shape	
Select spectrum shape and enter free field exterior sound level, $L_{Aeq}$ (considering only the octave bands between 125Hz and 2kHz)	
$L_{Aeq}$ <input type="text" value="52"/> dB	
<input type="text" value="ISO 717 - 1 (City)"/>	
<b>View Data</b>	
<b>Internal sound level</b>	
$L_{Aeq}$ <input type="text" value="18.5"/> dB	

Plot 61 — BEDROOM (NIGHT)  $L_A, f_{max}$ .

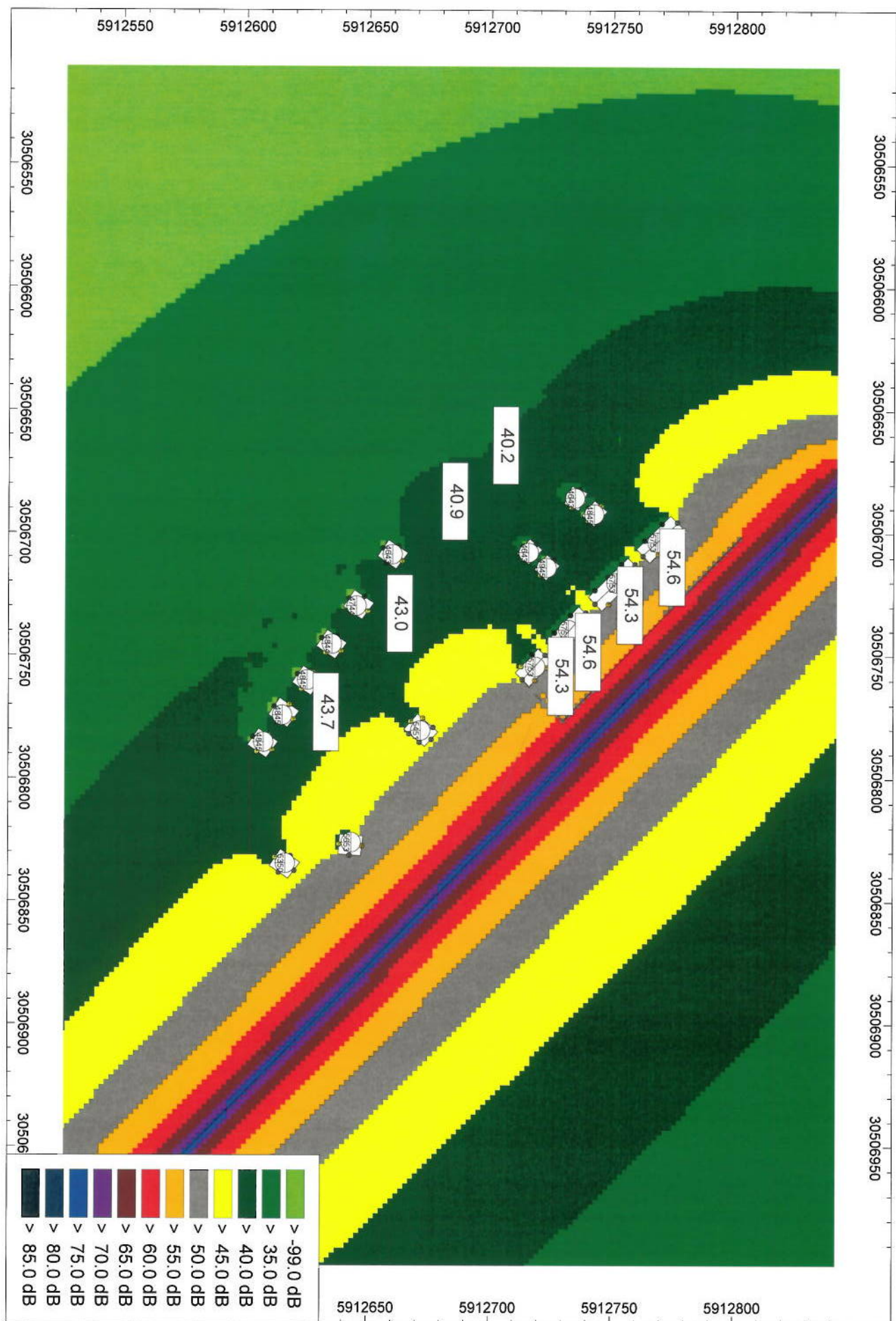
BRE		
<b>Building Envelope Insulation</b>		
Switch to Reverberation Time Calculation		
2) Select elements of facade structure, and enter corresponding internal surface area in $m^2$ OR enter number of vents.		
HELP		
Surface area OR number of vents		
1) Enter room dimensions or volume		
<input checked="" type="radio"/> Use dimensions		
x <input type="text" value="4"/> m		
y <input type="text" value="6"/> m		
z <input type="text" value="2.8"/> m		
Volume <input type="text" value="25"/> $m^3$		
<input checked="" type="radio"/> Use volume		
OR		
Volume <input type="text" value="25"/> $m^3$		
Wall 1	Brick/block cavity	<input type="text" value="12"/> $m^2$
Wall 2	None	<input type="text" value="0"/> $m^2$
Window 1	10/12/6 double glazing	<input type="text" value="1.2"/> $m^2$
Window 2	None	<input type="text" value=""/> $m^2$
Door	None	<input type="text" value=""/> $m^2$
Roof/Ceiling	None	<input type="text" value="0"/> $m^2$
Vent 1	None	<input type="text" value="2"/> $m^2$
Vent 2	Fresh 80 dB	<input type="text" value="1"/> $m^2$
View/Edit Data		
3) Enter reverberation time of the room.		
<input type="text" value=".5"/> seconds		
4) Select exterior sound level type		
Option (A) <input type="radio"/> User defined spectrum		
Option (B) <input checked="" type="radio"/> Spectrum shape		
Select spectrum shape and enter free field exterior sound level, $L_{Aeq}$ (considering only the octave bands between 125Hz and 2kHz)		
$L_{Aeq}$ <input type="text" value="78"/> dB		
ISO 717 - 1 (Ctr) <input type="text" value=""/>		
View Data		
Internal sound level		
$L_{Aeq}$ <input type="text" value="44.5"/> dB		



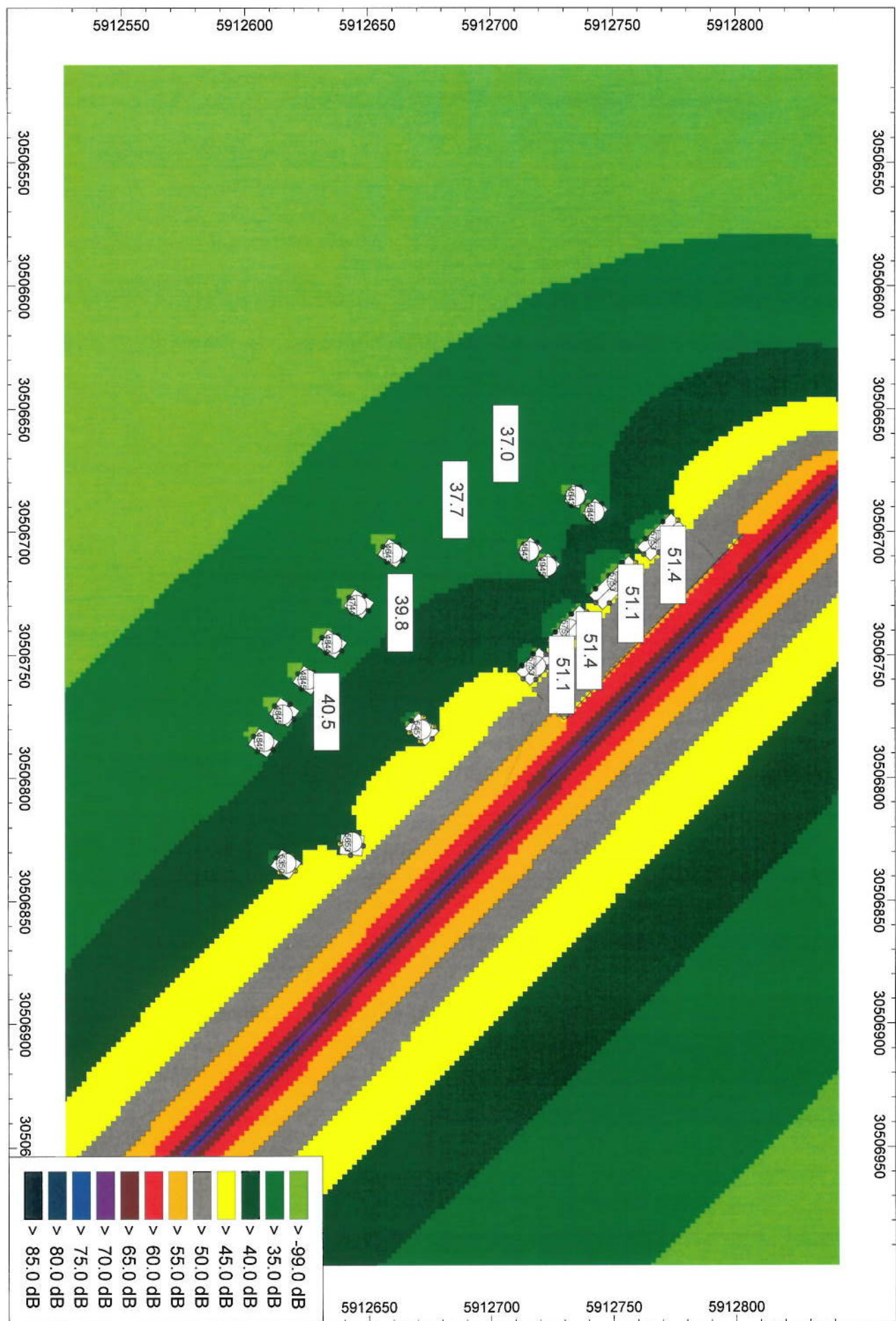
## Annex C

Cadna noise model example graphics.

DAT

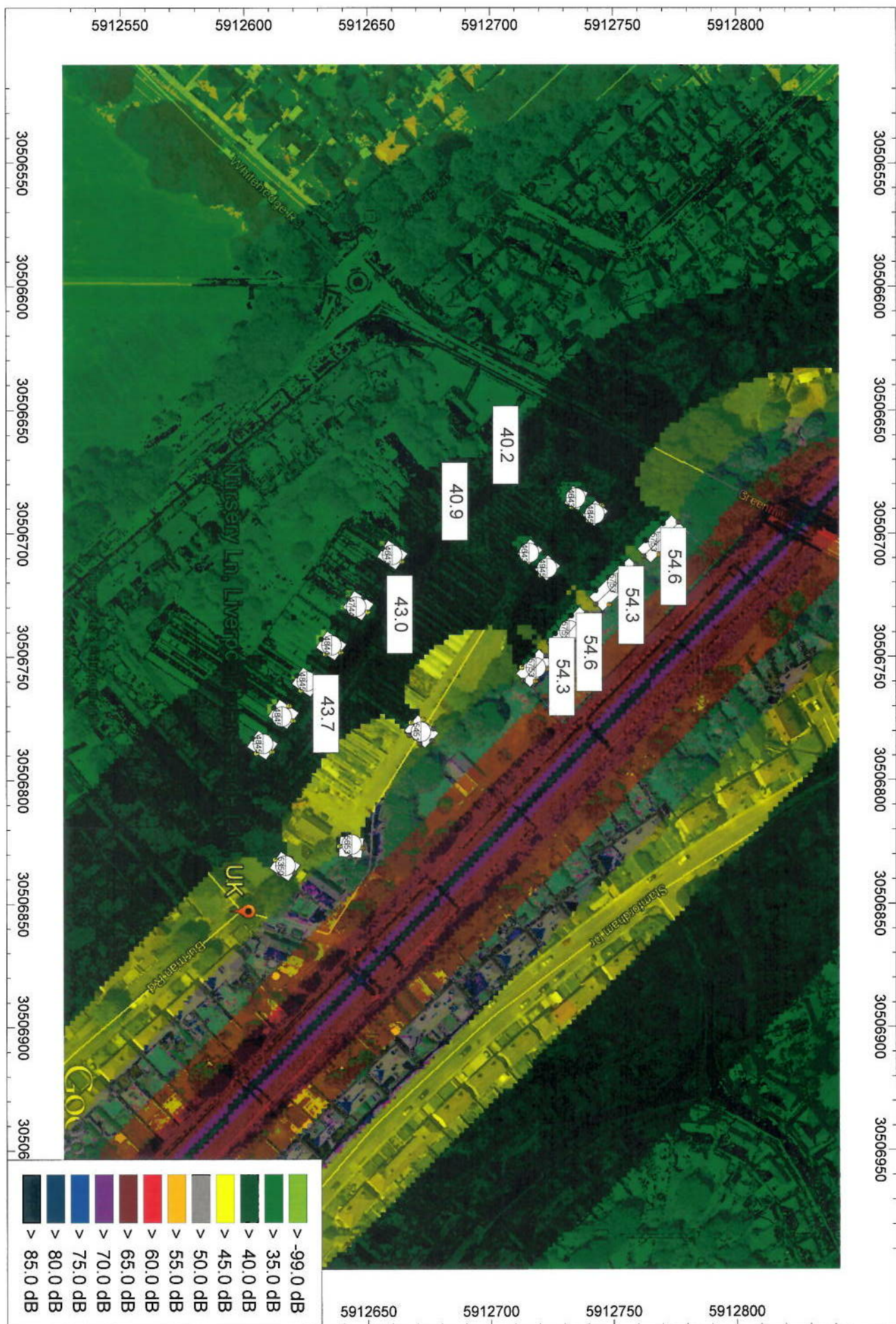


NIGHT





DATA - WITH AERIAL OVERLAY





NIGHT — WITH AERIAL OVERLAY

