SOUND BARRIER SOLUTIONS

ENVIRONMENTAL NOISE BARRIER DESIGN STUDY

Hales Sawmills
Shropshire
March 2013

Sound Barrier Solutions Limited
The Coach House, 97 Northampton Road, Market Harborough, Leicestershire, LE16 9HD,
Tel / Fax : 01858 432667 Email: info@soundbarriersolutions.com
Registered in Cardiff No. 3577151

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AIM OF STUDY

The aim of this study was to provide an assessment of the potential impact of noise on the surrounding area to the proposed new Hales Sawmill site near Market Drayton. As part of this process it was necessary to carry out live noise measurements which were used in the production of a three dimensional computer model. The model was then used to examine how noise will spread out from the site and subsequently to examine what impact the site will have on the current background noise levels of the area.

INTRODUCTION:

Background to the study:

The owners of Hales Sawmill are in the process of relocating their current site to a location north of Market Drayton in Shropshire. The new site is currently used as livestock pastureland and is located opposite a large Wiseman dairy. Also in the vicinity are a livestock market and various other industrial units.

The industrial estate generates noise from various sources but the most prominent source is the regular lorry movements to and from the dairy. The dairy is in operation 24 hours a day and as such is responsible for approximately 144 lorry movements every day. In addition to this though infrequent in operation is the livestock market which is also a major source of noise generation. Whilst the new site itself is currently a green field, the area in general is currently impacted by substantial industrial operations.

These operations all take place to the west of the new site and properties located in this general area will be influenced primarily by the existing businesses. Properties to the north and east however may be impacted by any new noise generated through the sawmill re-location.

To the east of the site running north to south along the entire site boundary is a canal which has a number of semi-permanent moorings for narrow boats. There is also one farmhouse situated approximately 100m away however the next closest residence is situated approximately 385 meters from the eastern boundary of the site.

The client has already planned into the site design a 3-4m high earth bund along the towpath of the canal. The bund will have a 6m footprint and though it is primarily being constructed to meet the need for a wildlife corridor it may also provide some noise protection to the farm and any moored narrow boats on the canal. On site operations will be spread across a few buildings however the noisiest operations will all be housed in one building. There will be some lorry movements to and from the site however there are only expected to be 4 lorry arrivals each morning. These vehicles will leave the same day therefore there will be 8 lorry movements per day. The main sawmill will only operate during daytime hours however it is expected that some deliveries may be received between 6am and 7am in the morning. There will therefore be some movement of forklift trucks during what is still technically speaking the night time period, in addition to this the kiln will be operational 24 hours every day.

This study will determine the extent of the noise impact from the various processes using the most appropriate standards for assessment for both day and night time scenarios. It will also determine the optimum height for the bund.

BS 4142: 1997

Assessing the impact of any given noise source is often a complex issue due to the subjective nature of noise in general. There are a number of standards and procedures available to assist in quantifying noise and providing guidance as to the impact it may have on listeners.

BS4142 is the test method for 'Rating industrial noise affecting mixed residential and industrial areas'

> *'This British Standard describes a method of determining the level of a noise of an industrial nature, together with procedures for assessing whether the noise in question is likely to give rise to complaints from persons living in the vicinity. The user is reminded that this standard is not based on substantive research but rather on accumulated experience…*
>
> *Response to noise is subjective and affected by many factors (acoustic and non-acoustic). In general, the likelihood of complaint in response to a noise depends on factors including the margin by which it exceeds the background noise level, its absolute level, time of day, change in the noise environment etc., as well as local attitudes to the premises and the nature of the neighbourhood. This standard is only concerned with the rating of a noise of an industrial nature, based on the margin by which it exceeds a background noise level with an appropriate allowance for the acoustic features present in the noise. As this margin increases, so does the likelihood of complaint.*
>
> *The standard is necessarily general in character and may not cover all situations. The likelihood that an individual will complain depends on individual attitudes and perceptions in addition to the noise levels and acoustic features present. This standard makes no recommendations in respect of the extent to which individual attitudes and perceptions should be taken into account in any particular case.'*

It was necessary to undertake a BS4142 assessment of the noise which will be introduced to the area and establish the relationship between the new noise and the normal background levels. BS4142 suggests that if the rating level (weighted specific noise level) exceeds the local background noise level by around 10dB then complaints are likely. The document considers a difference of 5dB to be of 'marginal significance', and that if the rating level is more than 10dB *below* the background noise then complaints are unlikely.

MEASUREMENT APPROACH:

(Ref Table 1 & Figure 1)

Noise monitoring was undertaken over a 48 hour period between the 27th of February and 1st of March 2013 at two locations on the proposed site, these are shown in Figure 2. The purpose of taking noise measurements was primarily to gather the LA90 'background' noise levels needed to carry out a BS4142 assessment.

In addition to these measurements, short term measurements were made of the band saws and various other noise generating tools and processes at the current site of the sawmill. This was to assist in quantifying the noise sources which will be introduced to the new site and to help verify and 'calibrate' the computer model to ensure that the predicted values

generated were in agreement with real measurements. Measurements were taken at 5m from the sources on the 2nd and 3rd of July 2012. As the proposed lorry movements are not yet happening, it was not possible to measure this process specifically. Instead stock data was used from other similar sites to enable the assessment to be carried out.

During both monitoring periods, the weather was dry and still. Conditions were therefore good for monitoring ensuring that the noise readings were reliable.

Measurement Apparatus

Integrating Real Time Analysers	01-dB type SIP95 (type 1)
Microphone :	01-dB type MK250 half inch
Calibrator :	01-dB type CAL01 (class 1)

The analysers were verified according to the procedure given in BS7580:1997. The analyser also conforms to BS7580:1997 verifying conformance to BSEN60851:1994 Type 1, BSEN60804:1994 Type 1.

METHOD OF ANALYSIS:

Computer Model: "Mithra"

In order to carry out the assessment a computer model was used. The software package "Mithra", a three dimensional computational system, allows for precise acoustic modelling of particular noise sources: road, rail traffic or industrial sources of noise. It shows how the noise interacts with adjacent buildings, taking into account different ground and weather conditions and it examines the effects at different noise frequencies.

The model was produced using known ground topography, positions of the noise sources both fixed machinery and Lorries and the locations of surrounding buildings and houses. The model was then verified using the noise measurements taken to ensure it was giving the correct noise levels. The model was used essentially to calculate the 'Specific Noise levels' required in the BS4142 assessment.

The main difficulty faced in a BS4142 assessment is being able to accurately determine the impact of the noise sources in question in the absence of any other noise source, (roads, railways, birdsong, and other general background noise). Use of computer modelling in this way allows direct prediction of the combined 'Specific Noise Level' of all the processes and removes the complication of calculating this from out of the 'Ambient Noise Level'.

Dominant Noise Sources

There will be various noise sources on the new site which it was assumed will require investigation. These are as described below and the noise levels utilised in the computer models, whether measured or assumed, are shown in the Table which follows:

Sawmill Building:
The model has assumed the presence of two band saws operating in the Sawmill. Whilst these are on continuously the predominant component of the noise they generate is attributable purely to when sawing is actually taking place. The model assumes that cumulatively, the band saws are only actively cutting wood for about 30% of the time.

The Sawmill will also house a Chipper which itself will be contained within an acoustic cover. This will be a new piece of equipment which the client currently does not own. It has therefore not been possible to directly measure the noise output however the client has been advised that the acoustic enclosure can be constructed so as to ensure that the noise output is no louder than the band saws. The worst case scenario for the sake of the model is therefore that it will be as loud as the band saw activity. It is also assumed that realistically, it similarly operates for about 30% of the time.

The final noise generating element to the saw mill will be a dust extraction system with an externally mounted fan. Stock data for a typical system was used for this noise source.

Workshop Building:
This will house the nail guns for panel assembly. The nail gun activity generates very quick impulse noise which decays rapidly with distance. Levels were monitored on the current site and the impact of this impulsive noise source will be treated separately in the analysis.

The workshop will also include an extraction unit and external fan.

Treatment Works:
Though largely a storage area this element does contain some noise generating equipment. This was measured on the current site.

Kiln:
This will be another new element which is not present on the current site. Its function mechanically is similar to the equipment of the treatment works and so the model has assumed the same noise levels in the absence of precise data. The kiln will also be enclosed inside a building.

Vehicles:
It is expected that a total of 4 lorries per day will arrive at the site, unload, reload and leave again. It is possible that 1 lorry will arrive between 6 and 7am which according to BS4142 is still classed as the night time period. The lorry will enter the site, pull around in front of the storehouse where it will switch off whilst being unloaded. Based on operations observed by SBS Ltd at similar sites this entry process should take around 45 seconds.

There will also be movements from 1 forklift truck in addition to the lorry movements and on advice from the client this has been modelled in 6 representative locations along the length of the site. The specific machine which will be used has not yet been acquired by the client and so it has not been possible to measure its noise output. Stock data from within our noise modelling software was therefore used.

Source Type	Noise level	Measurement Distance	Data Source	Operation Time	
				Day	Night
Band Saw/Chipper	83dB(A)	5m	Measured at Hales	7am - 7pm	NA
Nail Guns	76 dB LAmax	5m	Measured at Hales	7am - 7pm	NA
Extraction Fans	54dB(A)	1m	SBS Stock Data	7am - 7pm	NA
Treatment works	55dB(A)	5m	Measured at Hales	8am - 11pm	NA
Kiln	55dB(A)	5m	Assumed	7am - 11pm	11pm - 7am
Lorries	104dB(A)	Lw	SBS Stock Data	x3 (7am - 7pm)	x1 (6am - 7am)
Forklift truck	83dB(A)	1m	SBS Stock Data	7am - 7pm	6am - 7am

Source Data Table: *Combination of stock data and live measurements from current Hales site.*

DISCUSSION OF MEASUREMENTS:

(Ref Tables 1-4 and Figures 3-5)

There were a number of different elements which needed to be quantified in order to carry out this assessment. Some of these were directly measured and some were calculated using the computer model. One of the factors complicating this particular situation is the fact that in contrast to the fixed machining processes, the lorry and forklift noise sources are not consistent, neither in nature nor operation time. In other words, all lorries sound slightly different as their perceived 'loudness' can vary according to the type, loading, general condition of the vehicle and also on how it is being driven. In addition to this, though the proposed volume of lorry movements is low (1 every hour) it is never-the-less important to quantify the impact of this. This combination of factors gives rise to a noise source which is both intermittent and changeable in nature. BS4142 works best when the 'problem' noise in question is consistent. As this is not the case in this location it was important that the approach taken be a fair representation of the real situation.

The test method relies on being able to quantify, at the location of the persons receiving the noise, the 'specific noise level' due to the source or sources under investigation. This is then compared to the background noise of the same area. The extent to which the two differ has a bearing on the likelihood that people will complain about the noise. It is generally possible to measure the residual noise and subsequently the background noise for an area when noise sources are not operational. However it is much more difficult to measure the specific noise of individual sources without the residual noise (due to passing traffic, birdsong, other localised noise sources etc) present, as this cannot be removed. However BS4142 allows for the specific noise level of the sources to be calculated where measurement is not practicable or is likely to be inaccurate.

In this case, it was decided that the most accurate way to determine the specific noise levels would be to use existing data recorded on similar sites (for lorries forklifts and fans) and subsequently the MITHRA computer model to calculate the level offsite. In the case of the Sawmill processes, the data recorded at the current sawmill site was used to model the sources of noise and also to calibrate the noise model itself so that it would produce the correct noise levels. This is possible because the data used was collected close in to the various machines and because the noise levels are substantial and consistent in operation. As a result, the impact of residual noise in the data was negligible and can be ignored.

Finally, after ensuring that the model simulated the noise sources accurately, it was used to calculate the specific noise levels (which are cumulative and time averaged levels) during the daytime and night time at various representative receiver points with both a 3m and a 4m bund present. The resultant combined values from the sawmill elements, lorry and forklift movements, extraction fans, treatment plant and kiln are shown in Tables 1 to 4 in the 'Specific Level' columns.

In addition to these continuous activities there are also impulsive noises in the assembly workshop. In particular nail guns give off a very short sharp bang which also required consideration. This was handled outside of the 1 hour LAeq criteria used for the other sources as an understanding of the peak impulse noise rather than an hourly average is more representative of this operation. Figure 5 shows the pattern of noise spread from around the workshop when a nail gun is fired.

Noise meters were left for a period of 48 hours on the proposed new site to gather the necessary background noise data to which the predicted specific noise levels would be compared. The measurements resulted in an overall level of **37dB LA90** during the daytime (0700-2300) and **33dB** LA90 during the night (2300-0700). Hourly averaged data is provided in Table 5 and monitoring locations shown in Figure 2

Findings and Results

To complete the BS4142 side of the assessment, the specific levels were given a 5dB weighting to provide the 'Rating level'. Section 8.2 of BS4142 justifies this weighting when the noise source in question displays certain characteristics:

> *'8.2 Apply a 5 dB correction if one or more of the following features occur, or are expected to be present for new or modified noise sources:*
> *- the noise contains a distinguishable, discrete, continuous note (whine, hiss, screech, hum, etc.)*
> *- the noise contains distinct impulses (bangs, clicks, clatters, or thumps)*
> *- the noise is irregular enough to attract attention'.*

In this case we would consider the sawmill process noise to be irregular enough to be instantly recognisable as coming from the site and not just general noise from the industrial estate. Whilst the specific levels calculated are a combination of noise impact from multiple sources, the band saws were found to be by far the most dominant noise source during the day time. Whilst the lorry movements could be considered to not warrant the additional 5dB subjectivity rating, (because they would not be distinct enough to be able to tell from distance that the noise they generate is coming from the Hales site rather than any of the other sites in the vicinity) this extra rating level has been included globally due to the dominance of the band saw noise.

The resultant 'rating levels' are therefore also shown in Tables 1-4. Finally these rating levels were compared to the LA90 background levels which were measured during the noise monitoring; these differences are shown as the 'BS4142 Result' in the Tables.

It is important to note that in reality only one property is being assessed in this study. The model was however also programmed to find the noise levels at 14 locations along the tow path of the canal. These locations may or may not be 'occupied' at any given time depending on whether or not a boat happens to be moored there or not.

Examination of Tables 1 & 2 shows that for the daytime scenario, all locations are expected to receive noise levels in excess of the current background levels. For the 3m Bund design the BS4142 results range from 3 to 11 dB over background. This means that for some locations, if a narrow boat was moored there, noise levels might be loud enough for someone to complain.

With the bund height increased to 4m however the BS4142 results reduce to between **1 and 8 dB** over background. Whilst these results would be of 'marginal significance' according to the standard for some locations, importantly, no location is expected to receive noise levels of 10dB or more above background. This is the point at which the standard states that complaints are likely and so according to BS4142 it is unlikely that these levels would cause enough concern for any reasonable person to complain.

Tables 3 & 4 show the results for night time activities. Interestingly it can be seen that when the saw mill itself is not running (i.e. during the night), noise levels are much lower. Even with the presence of a delivery lorry, forklift truck movements and with the kiln in operation many locations will receive levels less than the current background levels. With a 4m bund in place the worst case scenario is levels of 2dB over background. According to the standard, it would be highly unlikely that anyone would complain about such noise levels.

Figures 3 - 5 are noise contour plots which show the spread of noise from the various buildings on the site. The buildings have roller shutter type doors which would typically be left open during working hours. We have taken this into account in the model and as such building facades which contain doors emit more noise than completely sealed facades. In the case of the sawmill building it was found that in order to limit the impact of noise across the eastern boundary, the doors in the east end of the building and also on the far right of the south facing façade should be kept closed during sawing operations.

Figure 5 shows the impact of the impulse noise from nail guns in the workshop. It can be seen that the earth bund serves as an effective barrier for this noise source and reduces the peak level to below the prevailing background noise level at all test locations.

CONCLUSIONS AND RECOMMENDATIONS

The results have shown that under the proposed operational conditions a 4m bund will be more effective as a noise mitigation element than a 3m bund. We would therefore recommend that the client constructs a 4m bund.

Results have also shown that complaints about noise are not likely to arise from any of the tested locations according to the test standard BS4142 for either day or night time operations. Some locations would however be classed as being 'of marginal significance' or 'above marginal significance' according to the wording of the standard during the daytime only.

It should also be understood that the living environment for narrow boat owners on the canal is not a continual 37dB LA90. By definition the 'background' level is the level which is *exceeded* for 90% of the time (LA90) and therefore the general noise environment will be greater than this for 90% of the time. Given that the contribution to this 'ambient noise' from the proposed new activities on the site is at worst 8dB above background (and this includes a 5dB subjectivity weighting) we would suggest that the new operations on site will have a minimal impact on the overall noise climate of the area.

TABLES

Table 1: BS4142 assessment; daytime, 3m bund				
Daytime Location	Specific Level (LAeq, 1hr)	Rating Level (+5dB)	Background LA90	BS4142 Result
1	35	40	37	3
2	36	41	37	4
3	36	41	37	4
4	37	42	37	5
5	38	43	37	6
6	38	43	37	6
7	39	44	37	7
8	40	45	37	8
9	37	42	37	5
10	43	48	37	11
11	43	48	37	11
12	42	47	37	10
13	39	44	37	7
14	39	44	37	7
15	39	44	37	7

Table 2: BS4142 assessment; daytime, 4m bund				
Daytime Location	Specific Level (LAeq, 1hr)	Rating Level (+5dB)	Background LA90	BS4142 Result
1	33	38	37	1
2	34	39	37	2
3	34	39	37	2
4	34	39	37	2
5	35	40	37	3
6	36	41	37	4
7	36	41	37	4
8	37	42	37	5
9	34	39	37	2
10	40	45	37	8
11	40	45	37	8
12	39	44	37	7
13	39	44	37	7
14	38	43	37	6
15	39	44	37	7

Table 3: BS4142 assessment; Nighttime, 3m bund				
Night Time Location	Specific Level (LAeq, 1hr)	Rating Level (+5dB)	Background LA90	BS4142 Result
1	24	29	33	-4
2	24	29	33	-4
3	23	28	33	-5
4	24	29	33	-4
5	23	28	33	-5
6	26	31	33	-2
7	28	33	33	0
8	29	34	33	1
9	29	34	33	1
10	29	34	33	1
11	29	34	33	1
12	30	35	33	2
13	31	36	33	3
14	32	37	33	4
15	30	35	33	2

Table 4: BS4142 assessment; Nighttime, 4m bund				
Night Time Location	Specific Level (LAeq, 1hr)	Rating Level (+5dB)	Background LA90	BS4142 Result
1	22	27	33	-6
2	23	28	33	-6
3	22	27	33	-6
4	23	28	33	-5
5	22	27	33	-6
6	24	29	33	-4
7	26	31	33	-2
8	27	32	33	-1
9	27	32	33	-1
10	27	32	33	-1
11	27	32	33	-1
12	29	34	33	1
13	29	34	33	1
14	30	35	33	2
15	30	35	33	2

Table 5: L90 hourly Data

Date:Time	Location 1: L90 by Pond	Location 2: L90 by Oak Tree
27/02/2013 11:00	36	35
27/02/2013 12:00	34	33
27/02/2013 13:00	34	33
27/02/2013 14:00	35	34
27/02/2013 15:00	37	35
27/02/2013 16:00	38	37
27/02/2013 17:00	40	38
27/02/2013 18:00	39	37
27/02/2013 19:00	37	36
27/02/2013 20:00	37	36
27/02/2013 21:00	35	34
27/02/2013 22:00	40	37
27/02/2013 23:00	38	38
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28/02/2013 22:00	31	31
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01/03/2013 00:00	26	27
01/03/2013 01:00	30	30
01/03/2013 02:00	32	33
01/03/2013 03:00	30	31
01/03/2013 04:00	26	26
01/03/2013 05:00	30	32
01/03/2013 06:00	33	34
01/03/2013 07:00	37	37
01/03/2013 08:00	38	37
01/03/2013 09:00	37	36
01/03/2013 10:00	38	36

FIGURES

Figure 1: Site layout showing Lorry movements; Receiver positions and location of Bund

Figure 2: Undeveloped Site showing Monitoring locations used for Background Measurements

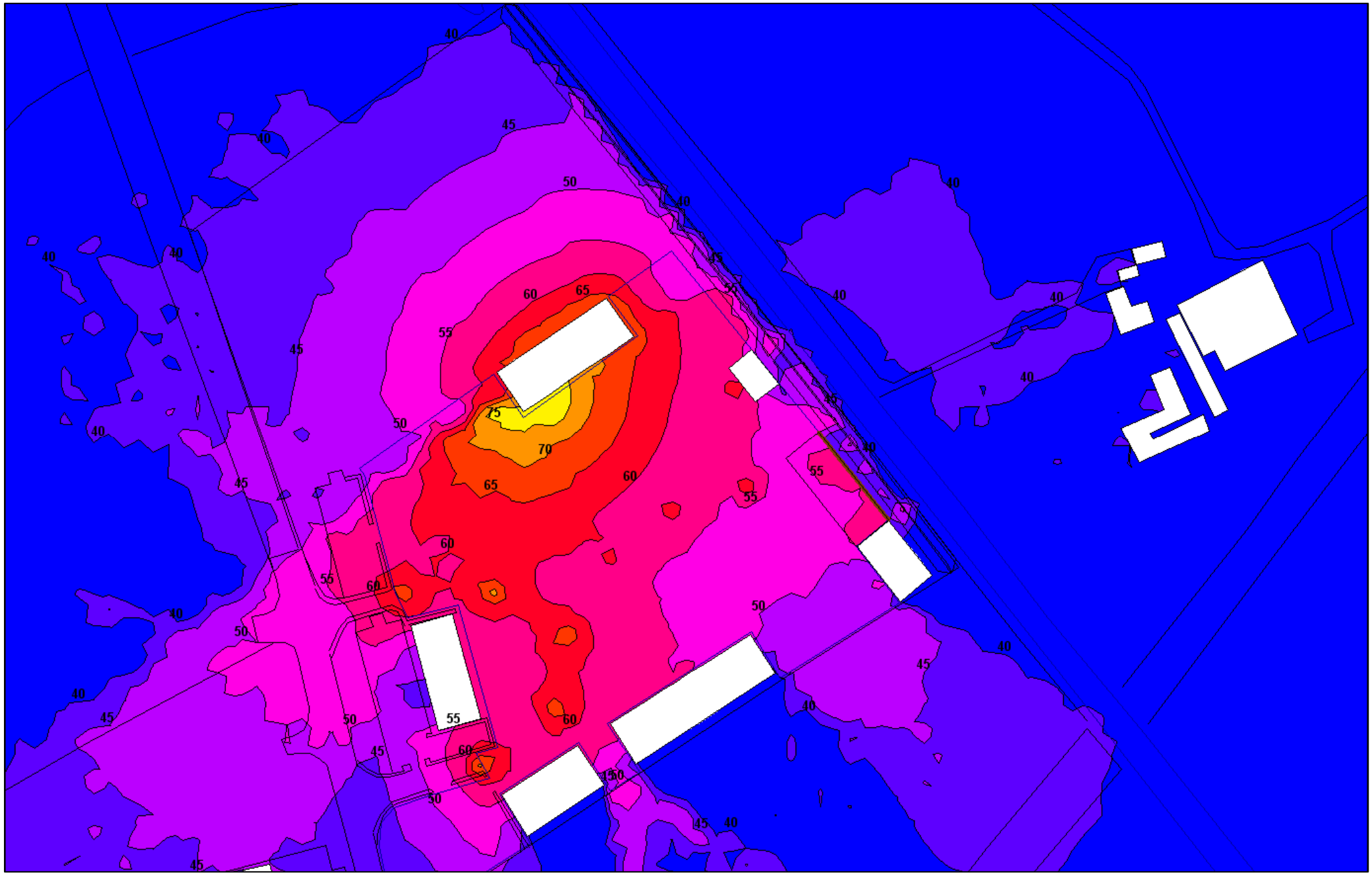

FIGURE 3: Hales Sawmill: BS4142 Assessment SPECIFIC NOISE LEVELS
Day time Ground floor level: LAeq 1 hour

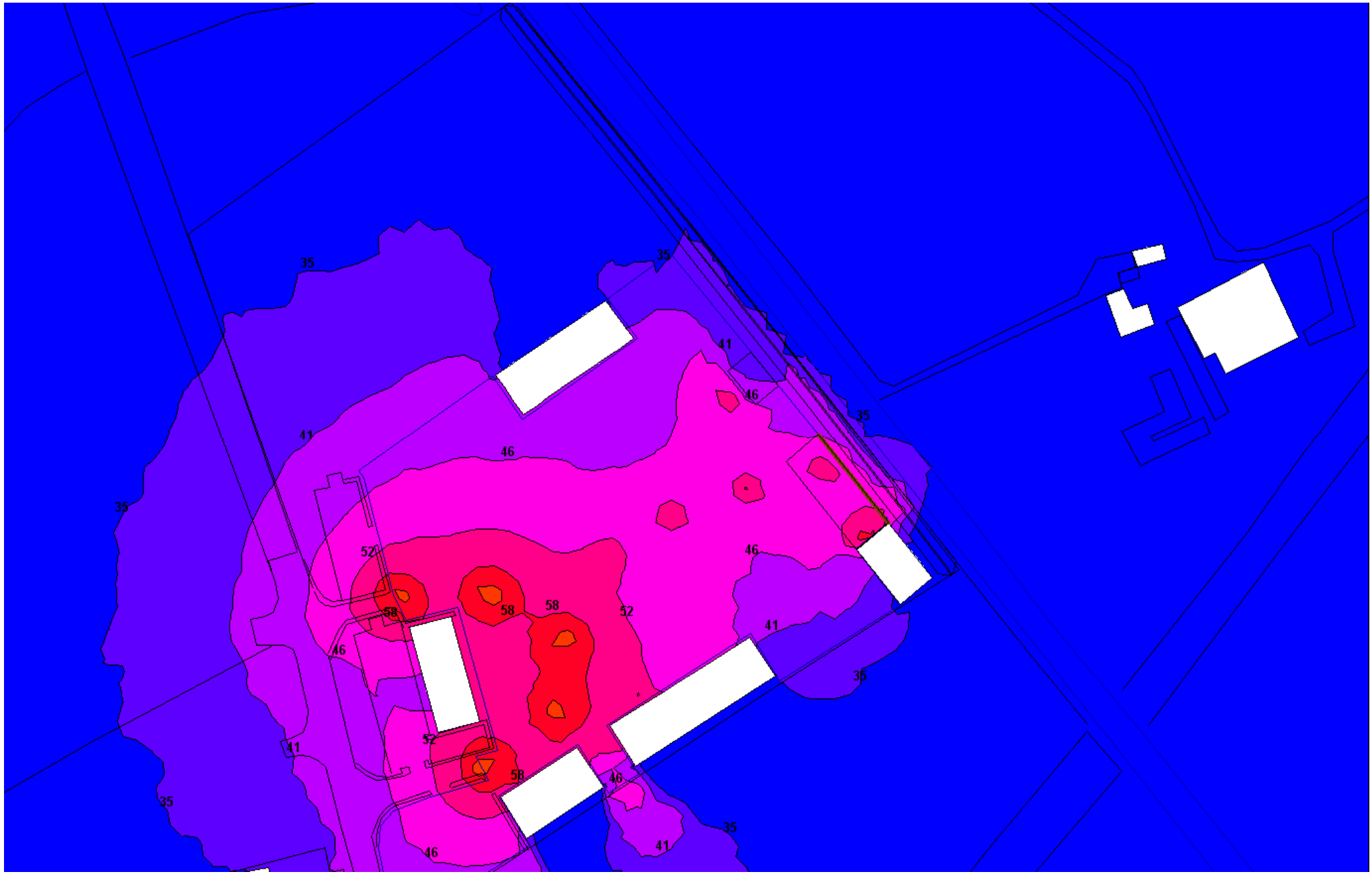

FIGURE 4: Hales Sawmill: BS4142 Assessment SPECIFIC NOISE LEVELS
Night time First floor level: LAeq 5 Min

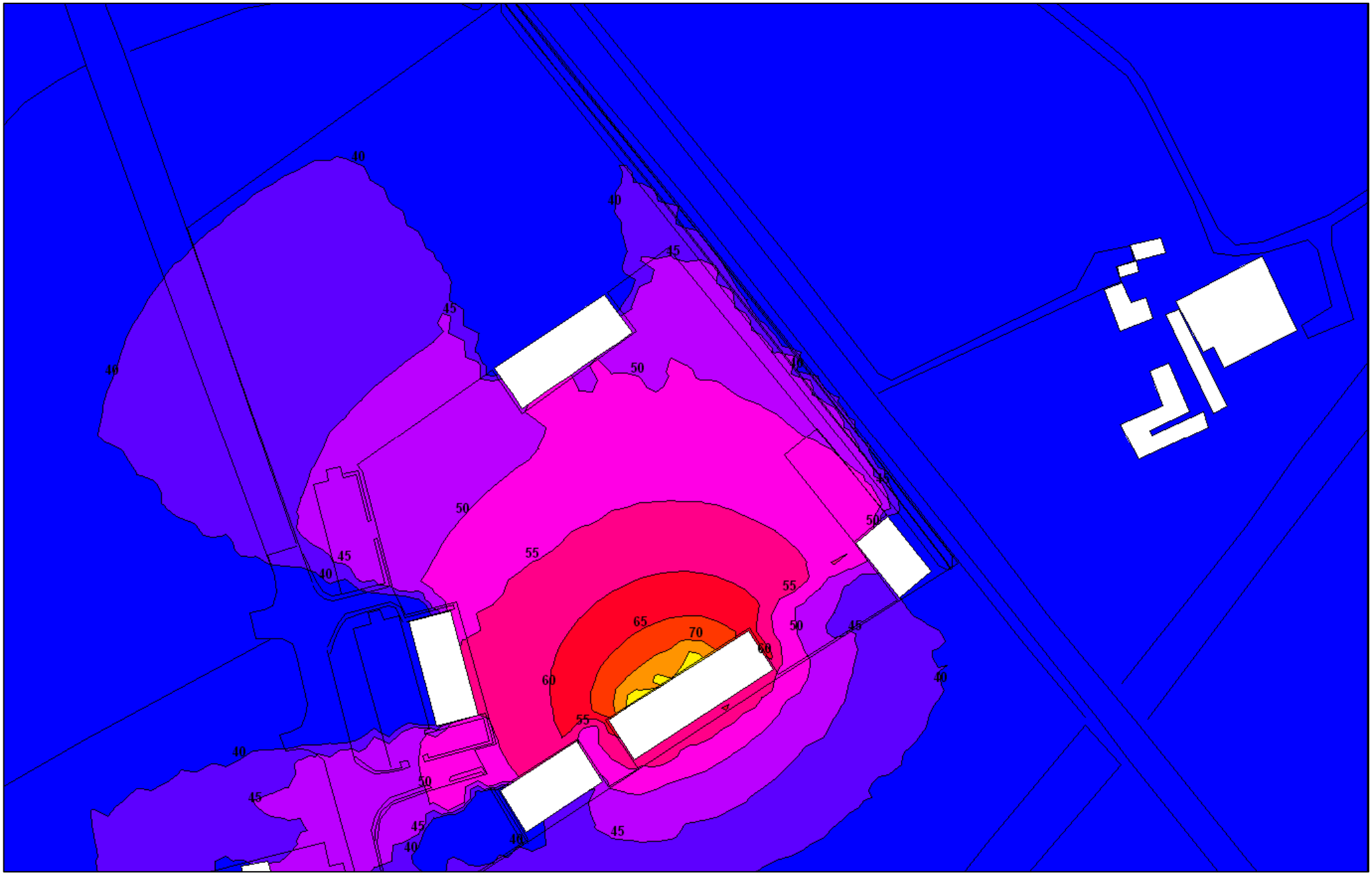

FIGURE 5: Hales Sawmill: NAIL GUN IMPULSE NOISE LEVELS
Day time Ground floor level: LAmax