

NOISE ASSESSMENT OF A
PROPOSED STORE REDEVELOPMENT
AT TESCO,
BARTON UPON HUMBER

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REPORT - Tesco, Barton upon Humber

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Executive Summary

An assessment has been carried out of the impact of noise from a proposed store extension, including a small increase in the car parking area, new non food retail unit, change of location of service yard and installation of additional plant, as shown in drawings in Appendix A at an existing food store at Tesco, Barton upon Humber.

A survey of existing ambient noise levels was carried out in June 2009, to assist with this assessment.

Assessment methodology has been considered with reference to appropriate British Standards and World Health Organisation Guidelines for Community Noise.

Noise levels have been predicted at the nearest noise sensitive receptors, taking into consideration the attenuation of noise over the distances concerned and the screening effects of various elements, with reference to the local topography. The attenuation provided by the screening has been calculated as shown in detail in Appendix C.

Predicted noise levels have been compared to guideline values and noise control limits have been proposed for the mechanical services plant. Predicted levels have been found to be within guidance/target values. Hence the development is predicted to result in no significant harm to amenity as a result of noise.

1.0 Introduction

- 1.1 The Sharps Redmore Partnership (SRP) has been instructed by DPP on behalf of Tesco Stores Ltd, to undertake a noise assessment of a proposal to redevelop the their existing store at Barton upon Humber. Site location and proposed site layout plans are attached in Appendix A.
- 1.2 The objective of the assessment is to determine how noise that may be generated as a result of the proposal would affect the amenities of local residents.
- 1.3 The site is located to the north of Barton upon Humber town centre and is 2.34ha in size. The site is defined as edge-of-centre for planning purposes. The majority of the site is unallocated within the North Lincolnshire Local Plan however, the northern area of the site forms part of a mixed use allocation, due to a lapsed planning permission for the development of this area for a medical centre.
- 1.4 The substantial majority of the site is occupied by the existing Tesco store alongside associated areas for servicing, car parking and landscaping. In addition to this, the site includes a vacant building which is associated with the ropewalk to the north of the site. Tesco has been operating from the site since 2008. Currently Tesco share the building with The Factory Shop which is a discount retail store selling fashion, footwear, home ware and accessories. To the north of the application site is a residential area and the Grade II listed Ropewalk Building which has been converted to artist's studios and a café/ shop. The site is bounded to the east and south by Maltkiln Road. Beyond the Road to the south and south east of the site are residential properties. To the east of the site is a site in an industrial use. The site is bounded to the West by a dyke. Beyond the dyke are both residential and industrial land uses.
- 1.5 It is proposed to extend the existing Tesco store, relocate the Factory Shop to a new unit to the north of the site, to build a new service yard for the Tesco Store and to provide a new petrol filling station as well as amending the car park layout.

- 1.6 Trading hours are not currently restricted on the site (other than on Sundays). Similarly, deliveries are permitted at any time. It is understood that the proposed extension will similarly seek permission to operate and accept deliveries at all times, day and night.
- 1.7 Section 2.0 of this report contains a discussion of the available methods of assessment and assessment criteria.
- 1.8 Section 3.0 of this report sets out the findings of an acoustic survey, undertaken at noise sensitive areas around the site.
- 1.9 The different components of operational noise are considered in sections 4.0 to 7.0 of this report, and section 8.0 considers construction noise.
- 1.10 The assessment conclusions are contained in section 9.0 of this report.
- 1.11 A guide to the acoustic terminology used in this report is shown in Appendix D.

2.0 Assessment methodology and criteria

2.1 The effect produced by the introduction of a certain noise source may be determined by several methods, as follows:

- i) The effect may be determined by reference to guideline noise values. British Standard (BS) 8233:1999 and World Health Organisation (WHO) “*Community Noise*” contain such guidelines. This method is well suited to the assessment of noise from activity or equipment that is fixed within a defined boundary.
- ii) Alternatively, the impact may be determined by considering the change in noise level that would result from the proposal, in an appropriate noise index for the characteristic of the noise in question. There are various criteria linking change in noise level to effect. This is the method that is suited to, for example, the assessment of noise from road traffic because it is capable of displaying impact to all properties adjacent to a road link irrespective of their distance from the road.
- iii) Another method is to compare the resultant noise level against the background noise level (L_{A90}) of the area. This is the method employed by BS 4142:1997 to determine the likelihood of complaint from noise of an industrial nature. It is best suited to the assessment of steady or pseudo-steady noise.

2.2 With these comments in mind, the components of noise have been assessed as follows:

- | | | |
|-----|---------------------------|------------------------|
| i | car park changes | -guideline values |
| ii | service yard | -guideline values |
| iii | mechanical services plant | -BS 4142: 1997 |
| iv | road traffic | -change in noise level |
| v | construction noise | -guideline values |
| vi | petrol filling station | -guideline values |

Guideline noise values

- 2.3 There are a number of guidance documents that contain recommended guideline noise values. These are discussed below.
- 2.4 Planning Policy Guidance (PPG) 24 “Planning and Noise” contains comprehensive advice on the subject of noise both in the circumstances of a residential development or a noise producing development.
- 2.5 In relation to proposed residential development, PPG 24 sets noise limits in terms of “noise exposure categories” (NECs). At the lowest NEC (NEC A) where noise is not a determining factor, the PPG 24 limit for day (0700 – 2300 hours) is $L_{Aeq,16hr} < 55$ dB and for night $L_{Aeq,8hr} < 45$ dB
- 2.6 In PPG 24 Annex 3, reference is made to BS 8233:1987 (now superseded by BS 8233:1999).
- 2.7 This Standard is principally intended to assist in the design of new dwellings; however, the Standard does state that it may be used in the assessment of noise from new sources being brought to existing dwellings.
- 2.8 BS 8233:1999 was based on the advice contained in a draft of World Health Organisation document “Guidelines for community noise”. This document was released in final form in 2000.
- 2.9 The WHO advice is the most useful, comprehensive, and pertinent advice in this case, because it is not specific to the circumstances of the assessment. Instead, it provides guidance on acceptable limits in for example schools, dwellings and offices.
- 2.10 The WHO guideline values are appropriate to what are termed “critical health effects”. This means that the limits are at the lowest noise level that would result in any psychological, physiological or sociological effect.

2.11 The National Physical Laboratory document “*Health Effect based noise assessment methods; a review and feasibility study*”, (September 1998) contains an “interpretation” of the WHO guidelines (then in draft form) for the DETR. The summary of this section of the NPL report states

“In essence, the WHO guidelines represent a consensus view of international expert opinion on the lowest threshold noise levels below which the occurrence rates of particular effects can be assumed to be negligible. Exceedances of the WHO guideline values do not necessarily imply significant noise impact and indeed, it may be that significant impacts do not occur until much higher degrees of noise exposure are reached” (paragraph 5.4).

2.12 In an earlier section of the NPL paper entitled “*Practical Noise Criteria - balancing the desirable and affordable*” the authors explain that there is the tendency in the scientific community to assume that the thresholds of unacceptability equate to the WHO thresholds of low or negligible noise effects (page 23).

2.13 The paper explains that the “*definition of a threshold of unacceptability is essentially a matter of social, economic and political interpretation*” (page 23).

2.14 It can be seen that the NPL advice to the DETR is that no absolute noise limits are available which denote the threshold of unacceptability of a scheme. However, it is felt that compliance with the limits given by WHO and BS 8233: 1999 would denote a “good” noise climate in relation to this scheme.

2.15 In this respect the guideline values are robust against the national planning policy that “significant environmental impacts should be avoided and alternative options which might reduce or eliminate those impacts pursued” (my emphasis) (Ref PPS1, Paragraph 19).

2.16 The PPG 24, WHO and BS 8233 guideline values are summarised in the following table:

Document	Limit	Guidance
PPG 24	$L_{AeqT} < 55$ dB	“Noise exposure level A” where noise is not a determining factor for proposed residential development. (Daytime)
PPG 24	$L_{AeqT} < 45$ dB	“Noise exposure level A” where noise is not a determining factor for proposed residential development (Night)
World Health Organisation “Community Noise 2000”	$L_{AeqT} = 55$ dB	Few seriously annoyed, daytime and evening. (Continuous noise, outdoor living areas)
	$L_{AeqT} = 50$ dB	Few moderately annoyed, daytime and evening. (Continuous noise, outdoor living areas).
	$L_{AeqT} = 35$ dB	Acceptable level to avoid speech interference, daytime and evening. (Continuous noise, dwellings, indoors)
	$L_{AeqT} = 45$ dB	To avoid sleep disturbance, window open at night. (Continuous noise, outside bedrooms, outdoor values)
	$L_{AeqT} = 30$ dB	To avoid sleep disturbance at night. (Continuous noise, bedrooms, indoors)
	$L_{AMAX} = 60$ dB	To avoid sleep disturbance, window open at night. (Noise peaks, outside bedrooms, outdoor values)
	$L_{AMAX} = 45$ dB	To avoid sleep disturbance at night. (Noise peaks, bedrooms, indoors)
BS 8233 : 1999 “Sound Insulation and noise reduction for buildings”	$L_{AeqT} = 55$ dB	Upper limit for external steady noise. (Gardens and balconies).
	$L_{AeqT} = 30$ dB	Good resting/sleeping conditions for living rooms during the day (Internal – steady noise)
	$L_{AeqT} = 40$ dB	Reasonable resting/sleeping conditions for living rooms during the day. (Internal – steady noise)
	$L_{AeqT} = 30$ dB	Good resting/sleeping conditions for bedrooms during the night. (Internal – steady noise)
	$L_{AeqT} = 35$ dB	Reasonable resting/sleeping conditions for bedrooms during the night. (Internal – steady noise)
	$L_{AMAX} = 45$ dB	Limit for individual noise events for a reasonable standard in bedrooms at night. (Internal)

- 2.17 For L_{AeqT} criteria the time base (T) given in the documents is 16 hours for daytime limits and 8 hours for night time limits. When assessing impact, this has the tendency to smooth out the hourly variations in noise level. In order to ensure a robust assessment, our calculations are carried out to a 1 hour time base, which is a more stringent assessment than is given in the guidance documents.

Construction Noise

- 2.18 With regard to construction noise, a noise level of $L_{AeqT} = 70$ dB was originally recommended in The Wilson Report: 1963 as a daytime (0700 - 1900 hours) dBA limit in rural, suburban and urban areas away from main road traffic and industrial noise. The aim was to limit noise within a building to a level at which conversation would not be too difficult with the window shut. Windows today provide better sound insulation than the nominal 15-20 dBA reduction considered typical in the early 1960's and a noise limit of up to around 75 dB $L_{Aeq,day}$ is generally considered to be appropriate.
- 2.19 In the light of this advice, it is considered that a reasonable design noise limit of $L_{Aeq,day} = 75$ dB at 1 metre from property facades is valid for this site, although it is usual to permit higher noise levels for shorter time periods, with a maximum “not to be exceeded” noise level of 90 dBA.
- 2.20 The appropriate design noise limits for construction works should be discussed and agreed with the local planning authority.

Changes in noise level

- 2.21 PPG 24 notes that changes in noise levels of less than 3 dBA are not perceptible under normal conditions and changes of 10 dBA are equivalent to a doubling of loudness. This guidance has been accepted by inspectors, at inquiry, to encompass changes in noise levels in the index L_{AeqT} in relation to traffic noise.

2.22 The following table has been employed widely by acoustic consultants and practitioners in the subject:

Change in noise level L_{AeqT} dB	Response	Impact
< 3	Imperceptible	None
3 – 5	Perceptible	Slight/marginal
6 – 10	Up to a doubling of loudness	Significant
11 – 15	Over a doubling of loudness	Substantial
> 15	-	Severe

BS 4142:1997

2.23 As discussed, this BS enables the likelihood of complaint to be determined according to the following summary process:

- i. Determine the background noise levels, in terms of the index L_{A90} , at the receptor locations of interest.
- ii. Determine the specific noise level of the source being assessed, in terms of its L_{AeqT} level (T = 1 hour for day or 5 minutes for night), at the receptor location of interest.
- iii. Correct (penalise) the rating level, if the source noise is of tonal or intermittent nature so as to attract attention. The correction factor is 5 dB. The resultant level is termed the rating noise level.
- iv. Compare the rating noise level with the background noise level; the greater the difference between the two, the higher the likelihood of complaint of the noise.
- v. Differences (rating – background) of around +10 dB indicate that complaints are likely; a difference of +5 dB is of marginal significance; a difference of -10 dB is a positive indication that complaints are unlikely.

- vi. The general intent of the planning system is to ensure that a development does not result in “significant environmental impacts”. This is, in our judgement, equivalent to the BS 4142 marginal significance criterion of +5 dB.

2.24 However, since there is already plant operating at the site, and the existing background noise level is influenced to an extent by this, the target level selected for control of noise from the proposed new plant is that the predicted level be no greater than the existing background noise level.

3.0 Survey details

3.1 Noise levels were measured between 22nd and 24th June 2009, with a supplementary short survey during the evening of 29th June 2009, at various positions in the vicinity of the proposal site (these are marked in Figure A1 in Appendix A).

3.2 The measurement positions were selected to be representative of those noise sensitive premises that are closest to the site.

3.3 The noise measurements were taken throughout the 24 hour period. Weather conditions during each survey were dry with an occasional light breeze.

3.4 Noise levels were measured using a precision sound level meter: a Bruel and Kjaer type 2236, which was calibrated at the start and end of each survey and no drift was noted.

3.5 Measurements taken at other locations were 1.5 metres above ground level and in a free field. Locations were sited as shown in Figure A1 in Appendix A, distances between locations and nearby significant features as follows:

Location 1: 1 metre from the kerb of Waterside Road

Location 2: 3 metres from kerb of Maltkiln Road

Location 2a: 8 metres from kerb of Maltkiln Road

Location 3: 1 metre from kerb of Maltkiln Road

Location 4: 9 metres from kerb of Maltkiln Road

3.6 The full results of the noise survey are displayed in Appendix B, and are summarised in Table 3.1 below:

Table 3.1: Summary of noise survey results

Location	Daytime		Night time		
	L _{AeqT} dB	L _{A90} dB	L _{AeqT} dB	L _{A90} dB	L _{Amax} dB
1	47-63	32-43	34-57	32-37	47-81
2	48-62	28-49	33-56	28-38	52-78
2a *	46-55	29-38	-	-	-
3	47-62	30-44	36-55	28-41	53-76
4	44-56	30-47	37-55	28-41	49-71
5	29-47	30-39	28-50	25-39	36-64

Note *: Readings taken at 2a only during the evening.

4.0 Noise from the proposed car park area (including recycling)

Car parking

4.1 It is proposed to make modifications to the car parking area, as shown in Figure A2 in Appendix A. This area will continue to include a recycling facility, broadly in the same location as at present.

4.2 The shortest distances between the edges of these noise sources and the closest receptors will be:

Car park to closest residential facade in Maltkiln Road: 40m (currently 50m)

Car park to closest residential facade in Waterside Road: 45m (currently 50m)

Car park to closest residential facade in Trinity Walk: 3m (currently 80m)

Recycling area to closest residential facade in Maltkiln Road: 30m (currently 55m)

Recycling area to closest residential facade in Waterside Road: 50m (currently 45m)

4.3 Surveys of noise levels at the boundaries of retail car parks have shown that levels range from $L_{Aeq,1hr} = 43$ dB to 48 dB at a distance of 10 metres. The peak level, dictated by car door or boot slams is typically $L_{Amax} = 66$ dB at the same distance.

4.4 Distance and screening will attenuate these levels, and 3 dB must be added to the resultant level for the façade effect. Table 4.1 below shows the attenuation for each pathway. Proposed barriers consist of a 3 metre high fence around the recycling area (sited as shown in Figure A2 in Appendix A); a 3 metre high fence around the car parking area on the northern boundary; and the existing wall to the western perimeter of the site (height approximately 1.5 metres). Barrier calculations are shown for each pathway in Appendix C for both a receptor at first floor (for night time) and ground level (for day time).

Table 4.1 Adjustments to level due to attenuation with distance, screening and façade reflections during the day

Source	Receptor	Distance attenuation relative to 10m, dB	Barrier attenuation, dB	Façade effect	Total attenuation, dB
Car park	Malkiln Road	-6	0	+3 dB	-3
	Waterside Road	-7	-8	+3 dB	-12
	Trinity Walk	+3	-12	+3 dB	-6
Recycling centre	Malkiln Road	-10	-13	+3 dB	-20
	Waterside Road	-14	-13	+3 dB	-23

4.5 Daytime levels from car park noise at each façade would be (assuming that the car park generates the highest level of 48 dB) would therefore be:

Malkiln Road	= 45 dB ($L_{Aeq, 1hour}$)
Waterside Road	= 36 dB ($L_{Aeq, 1hour}$)
Trinity Walk	= 42 dB ($L_{Aeq, 1hour}$)

4.6 It has been observed that customers park as close to the store entrance as possible. At night, when there are significantly fewer cars in the car park, the distance between the closest vehicle and the nearest the residential property will be increased. In particular, Tesco have advised that the area immediately adjacent to the northern boundary will be monitored by their security to ensure that it is not used at night. This increase in distance at night has been reflected in the figures used in Table 4.2 below.

Table 4.2 Adjustments to level due to attenuation with distance, screening and façade reflections at night

Source	Receptor	Distance attenuation relative to 10m, dB		Barrier attenuation, dB	Façade effect	Total attenuation, dB	
		From area source	From point source			From area source	From point source
Car park	Malkiln Road	-10	-18	0	+3 dB	-7	-15
	Waterside Road	-8	-16	-5	+3 dB	-10	-18
	Trinity Walk	-8	-16	-11	+3 dB	-16	-24
Recycling centre	Malkiln Road	N/A	-10	-12	+3 dB	N/A	-19
	Waterside Road	N/A	-14	-13	+3 dB	N/A	-23

4.7 Night time noise from the car park would be lower than daytime levels, and consequently the source value of 43 dB has been chosen. The night time level at the closest façades would be:

Malkiln Road = 36 dB ($L_{Aeq, 1hour}$)
 Waterside Road = 33 dB ($L_{Aeq, 1hour}$)
 Trinity Walk = 27 dB ($L_{Aeq, 1hour}$)

4.8 The maximum noise levels (from car door slams etc) would be attenuated with distance as from a point source, giving a predicted façade levels of:

Malkiln Road = 49 dB (L_{Amax})
 Waterside Road = 48 dB (L_{Amax})
 Trinity Walk = 42 dB (L_{Amax})

Recycling

4.9 Sharps Redmore Partnership has undertaken numerous noise measurements at retail superstore recycling centres. The most significant noise source is the use of the bottle banks (both filling by the public and emptying). Table 4.3 below contains a summary of typical (free field) noise levels have been recorded and normalised to a distance of 10 metres.

Table 4.3: Noise levels at 10 metres from typical bottle bank use

Activity	Noise (at 10 m) dB	
	$L_{Aeq\ 3\ mins}$	L_{Amax}
Bottles being dropped into the bottle bank	56	77

4.10 Using the corrections from Table 4.1 and 4.2 above, noise levels from use of the recycling area will be as shown in Table 4.4 below.

Table 4.4 Prediction of noise from bottle bank use during continuous use

Receptor location	Resultant sound level (dB)	
	$L_{Aeq\ 3\ mins}$	L_{Amax}
Malkiln Road	37	58
Waterside Road	33	54

4.11 These levels are with the guideline noise values for day and night time noise.

Summary

4.12 Table 4.5 below shows a summary of the noise levels to which each façade around the site will be exposed, achieved by considering a sum or maximum level from each of the above sources during both day and night (at either ground floor level or first floor level respectively). These have been placed next to the relevant guideline values for each time period (as described in Section 2.0 above) for ease of reference.

Table 4.5: Predicted noise exposure around the car parking area / access road etc.

Location	Source	Predicted noise level, dB			Guideline value, dB		
		L _{Aeq, day}	L _{Aeq, night}	L _{Amax}	L _{Aeq, day}	L _{Aeq, night}	L _{Amax}
Malkiln Road	Car park	45	36	49	50-55	45	60
	Recycling	37	37	54			
	Sum	46	40	54			
Waterside Road	Car park	36	33	48			
	Recycling	33	33	54			
	Sum	38	37	54			
Trinity Walk	Car park	42	27	42			

4.13 The above values are considered cumulatively with other noise sources in Section 10.0 below.

5.0 Noise from service yard activity

5.1 There are two service yards proposed, one for the main store operated by Tesco and the other for the smaller retail outlet to the north west of the site. It is necessary for the effective running of the store to accept some deliveries to the food store at night, so the use of this yard at night has been considered. The smaller yard for the retail unit will not be in use outside of daytime hours, and so noise during those hours has not been considered.

Main Tesco Food Store

5.2 There are two potential areas of noise impact from service yard activities:

- a) unloading activity in the service yard;
- b) other activities, i.e. use of the compactor and movement of cages

5.3 The receptors considered to potentially be sensitive to noise from unloading have been identified as those in Maltkiln Road, the closest façade of which is 40 metres away from proposed service yard activities.

5.4 The noise levels of the different components of delivery activity have been measured at many retail sites, and the following maximum levels have been recorded, at a reference distance of 10 metres:

Table 5.1: Noise levels from service activity at 10 metres

Event Noise Level (free field)								
Arrival			Unloading			Departure		
Duration (Mins)	L _{AeqT} (dB)	L _{AMAX} (dB)	Duration (Mins)	L _{AeqT} (dB)	L _{AMAX} (dB)	Duration (Mins)	L _{AeqT} (dB)	L _{AMAX} (dB)
2.5	69	80	30	66	77	0.5	72	80

5.5 It should be noted that the sound levels shown include all service yard noise sources during a delivery such as reversing alarms, refrigeration units, and vehicle manoeuvres. In practice this will overstate the noise emission levels because reversing alarms are not used at sensitive sites at sensitive times, and many of the service vehicles are not refrigerated.

- 5.6 For a proposed store of this size, it is expected that around 8 to 10 HGV deliveries per day would be received, both by Tesco vehicles and by suppliers (bread and milk). Only a single delivery could be handled in an hour, since there is to be only one loading dock.
- 5.7 This assessment takes into account the proposed 4 metre high screen around the service yard. Figures C9, C10 in Appendix C show the calculation of attenuation by screening during daytime and night time (ground level and first floor receptor heights).
- 5.8 Table 5.2 below shows the calculated noise levels resulting from deliveries at the nearest noise sensitive receptors on Maltkiln Road during the night.

Table 5.2 Predicted noise levels from the deliveries in the service yard at the nearest noise sensitive receptors on Maltkiln Road (night time)

Activity	Resultant noise level L_{Aeq} (dB)	Resultant noise level L_{Amax} (dB)
Arrival		
Baseline level	$L_{Aeq2.5} = 69$	80
Distance attenuation to 40 metres = $20 \log^{10}/_{40} = -12$	$L_{Aeq2.5} = 57$	68
Barrier attenuation = -11 (see Fig. C10 in Appendix C)	$L_{Aeq2.5} = 45$	57
Convert to 1 hour = $10 \log^{2.5}/_{60} = -14$ dB	$L_{Aeq,1hr} = 31$	57
Unloading		
Baseline level	$L_{Aeq30} = 66$	77
Distance attenuation to 40 metres = $20 \log^{10}/_{40} = -12$	$L_{Aeq30min} = 54$	65
Barrier attenuation = -11 (see Fig. C10 in Appendix C)	$L_{Aeq30min} = 43$	54
Convert to 1 hour = $10 \log^{30}/_{60} = -3$ dB	$L_{Aeq,1hr} = 40$	54
Departure		
Baseline level	$L_{Aeq0.5} = 72$	80
Distance attenuation to 40 metres = $20 \log^{10}/_{40} = -12$	$L_{Aeq0.5} = 60$	68
Barrier attenuation = -11 (see Fig. C10 in Appendix C)	$L_{Aeq0.5} = 49$	57
Convert to 1 hour = $10 \log^{0.5}/_{60} = -21$ dB	$L_{Aeq,1hr} = 28$	57
Total resultant level		
Addition of components: $L_{Aeq,1hr} = 31 + 40 + 28$	$L_{Aeq,1hr} = 41$	57
Resultant noise at façade (add 3 dB for façade effect)	$L_{Aeq,1hr} = 44$	60

Note 1: day time levels will be 2 dB lower, due to increased screening effect (see Figure C9 in Appendix C.

Note 2: For the purposes of the cumulative noise assessment in Section 10.0, noise sensitive premises opposite the car park / petrol filling station will be exposed to service yard noise at a lower level, since the distance between source and receptor is 70 metres in this case. Levels in this case would be 5dB less than those shown in Table 5.2.

5.9 In order to minimise disturbance at night, the following noise management plan is recommended:

- All vehicle engines and refrigeration to be switched off whilst waiting to enter the service yard
- All engines to be switched off as soon as vehicles are parked at the unloading dock
- Whilst vehicles remain stationary in the service yard, no engines are to be left idling for more than 30 seconds
- No goods pallets or cages to be moved on the open areas within the service yard at night.
- The compactor will not be used at night
- No reversing beepers to be used (automatic with vehicle lights switched on);
- Refrigeration units not to be operated whilst running in the service yard except by way of an electrical system (either on the vehicle or via the store's mains);
- All delivery vehicles to be driven in as quiet a manner as possible, avoiding unnecessary engine revving;
- Delivery scheduling to be undertaken on the basis that no more than two delivery vehicles are proposed to be present in the service yard at any one time;
- Staff to be instructed to work quietly when outside the store or in the service yard - only performing essential tasks at night where noise could be generated;
- Not to operate any external tannoy system or to shout at night.

5.10 Noise from the compactor, which will be operated from time to time during the day for periods of about 3 minutes, would typically be $L_{Aeq} = 61$ dB at a distance of 10 metres. It is not likely to be operated more often than once in a given hour. To assess its impact, therefore, this value must be converted to one hour:

$$\begin{aligned} L_{Aeq, 1hour} &= L_{Aeq, 3min} + 10 \log (3/60) \\ &= 61 - 13 \\ &= 48 \text{ dB} \end{aligned}$$

5.11 This would be reduced by screening and by distance attenuation to give a final noise from compactor use at the nearest sensitive façades (adding 3 dB for façade effect) as follows

$$48 - 13 - 12 + 3 = 26 \text{ dB } L_{Aeq, 1hour}$$

5.12 All levels are below the guideline value for daytime for a “good” noise environment.

5.13 It should be noted that the noise from the service yard will have a cumulative impact when added to noise from the sources considered in Section 4.0 above and the petrol filling station considered below. This cumulative impact is assessed in Section 10.0.

Non Food Retail Unit Servicing

5.14 This facility will only be serviced during the day, and the service area is to be screened, as shown in Figure A2 in Appendix A by a 3 metre fence. The closest noise sensitive premises to this area are at Ropery Lane. The centre of the service yard is 10 metres from the boundary with these premises.

5.15 Unloading in this area is likely to be via tailgate, and hence noise levels will be a little in excess of levels specified for the Tesco store (which is to have a sealed, level loading bay). Typical “worst case” noise levels for a delivery activity will therefore be: $SEL_A = 94$ dB and $L_{Amax} = 85$ dB at 10 metres.

5.16 The screen will provide attenuation of 15 dB (see Figure C11 in Appendix C).

5.17 Hence noise exposure, expressed as a $L_{Aeq, 1 \text{ hour}}$ from a single delivery at the closest noise sensitive façade will be given by:

$$\begin{aligned} L_{Aeq, 1 \text{ hour}} &= SEL_A + 10 \log N - 10 \log t + \text{façade correction} - \\ &\quad \text{distance attenuation} - \text{screening attenuation} \\ &= 94 + 10 \log 1 - 10 \log 3600 + 3 - 0 - 15 \text{ dB} \\ &= 46 \text{ dB} \end{aligned}$$

5.18 Two deliveries in an hour would result in a level 3 dB above this and three deliveries would be a further 2 dB above this. Therefore, even if three deliveries were to be received in an hour, the noise level at the closest noise sensitive premises would be below WHO guideline value for a reasonable noise climate (55dB).

6.0 Noise from mechanical services plant

- 6.1 Such plant may consist of refrigeration and condenser units, air handling units, extract fans, boilers and stand-by generators. It is proposed that a Combined Heat and Power (CHP) unit be sited in the south eastern corner of the service yard as shown in Figure A2 in Appendix A.
- 6.2 The exact nature and location of the plant, and its associated noise characteristics are yet to be determined, so it would be appropriate to impose a planning condition to control noise output from the plant serving the proposed store.
- 6.3 As discussed in section 2.24 above it is recommended that the rating noise level from this plant should be reduced as far as practicable and should not exceed 30 dB during the day and 28 dB at any time in any noise sensitive location. On that basis, the following condition is recommended:

“The rating level of noise emitted by all fixed plant on the site shall not exceed 28 dB dBA (L_{eq}), between 2300 and 0700 hours and 30 dB A(L_{eq}) at any other time. The noise levels shall be determined at the nearest noise sensitive properties to the site. The measurement and assessment shall be made according to BS 4142:1997.”

7.0 Noise from road traffic on existing roads

7.1 A comparison of the increase in road traffic noise can be made by means of the formula found in “Calculation of Road Traffic Noise”:

Increase in Noise Level = $10 \log_{10}$ (future total traffic flow ÷ existing traffic flow)
dB.

7.2 Table 7.1 shows the predicted change in noise levels resulting from additional traffic on the surrounding road network. (Figures are as supplied by Pinnacle Transportation).

Table 7.1: Predicted changes in noise levels due to changes in traffic flow

Road	Total flow, Friday am peak, 2010		
	Without development	With development	Increase, dB
Waterside Road, north of Maltkiln Road	148	159	0.3
Waterside Road, South of Maltkiln Road	465	580	1.0
Maltkiln Road, west of proposed site access	381	507	1.2
Maltkiln Road, east of proposed site access	119	128	0.3

7.3 None of the predicted noise levels exceeds the threshold at which a change in level is likely to be perceptible (3 dB, see Section 2.0 above). The increase in road traffic noise will therefore be insignificant.

8.0 Noise from Petrol Filling Station

8.1 The proposed development includes a four island PFS and kiosk located at the southern part of the site. The nearest residential properties to this in Maltkiln Road. The separation distance between the edge of the PFS forecourt and the nearest noise sensitive premises would be 40 metres.

8.2 Noise surveys have been conducted by SRP of PFS activities, during busy periods and for reduced forecourt activity. Typical noise levels are as follows and have been used in this assessment.

Busy period (day)	$L_{Aeq,1hr} = 56 \text{ dB}$
Reduced activity in the late evening	$L_{Aeq,1hr} = 52 \text{ dB}$
At night	$L_{Aeq,1hr} = 47 \text{ dB}$
Door slams/engine	$L_{Amax} = 66 \text{ dB}$

These figures represent levels at a distance of 10 metres from the forecourt.

8.3 Distance attenuation to the nearest noise sensitive premises would mean a reduction in noise levels of:

$$20 \log (10/40) = -12 \text{ dB}$$

8.4 Adding 3dB for façade effect and using the figures from 8.2 and 8.3 above allows a prediction of filling station noise at the nearest noise sensitive premises as shown in Table 8.1 below:

Table 8.1: Predicted and existing noise levels from the petrol filling station at the nearest noise sensitive premises

Time period	Predicted noise	Guideline values
Busy period (day)	$L_{Aeq,1hr} = 47 \text{ dB}$	$L_{Aeq} = 50 - 55 \text{ dB}$
Reduced activity in the late evening	$L_{Aeq,1hr} = 43 \text{ dB}$	
At night	$L_{Aeq,1hr} = 38 \text{ dB}$	$L_{Aeq} = 45 \text{ dB}$
Door slams / engine (at night)	$L_{Amax} = 57 \text{ dB}$	$L_{Amax} = 60 \text{ dB}$

- 8.5 These figures assume that there are no night time deliveries of petrol to the filling station.
- 8.6 Comparing the predicted values to guideline values, all are below the level necessary for a good noise climate during both day and night. This demonstrates that noise from the petrol filling station will not be significant at the nearest noise sensitive receptor.
- 8.7 Petrol filling station noise is considered cumulatively with noise from car park, access road, service yard etc in section 10.0 below.

9.0 Noise from Construction

9.1 At this stage, it is not possible to be specific about construction activity since no contractor has been appointed. However, it will most likely take place in three phases, as follows:

- excavation and landscaping – including cut and fill
- infrastructure construction
- building construction

9.2 In general, noise from these activities may be best controlled by the following process:

- i. determine the likely extent of construction works (where, when, duration)
- ii. determine noise emission levels by reference to BS 5228
- iii. agree noise amelioration measures with the local authority (amelioration and management controls) and/or noise limits
- iv. prepare a construction works method study in agreement with the local authority.

9.3 In the absence of information about specific construction activities, an assessment of the likely noise implications is provided in the following paragraphs.

Excavation and landscaping

9.4 Activity will extend to the perimeter of the site, but activity at these locations would be limited in period and work would soon move away and extend across the development site.

9.5 These activities are likely to involve the use of dozers, dump trucks, loaders, breakers and excavators.

Infrastructure

- 9.6 This activity consists of installation of additional external hard standing and the required services and footpaths.
- 9.7 Equipment used would be similar to that used for road building, and would likely include the use of excavators, road rollers, dump trucks, a road grader and asphalt spreading equipment.
- 9.8 The nearest residential properties would be around 25 to 30 metres from the closest activity, but this would be for limited periods as work progresses across the site.

Building construction

- 9.9 It is expected that the building construction would be cladding and glazing on a steel frame. Construction of foundations would likely involve pouring concrete from delivery vehicles to form in-situ slabs on site. There is a possibility that piled foundations may be necessary.
- 9.10 The nearest residential properties would be around 10 metres from the closest building construction activity. Strict control over timings and types of operation is likely to be needed in this location.

General

- 9.11 The contractors will need to take note of, and act on, the advice in BS 5228, Code of Practice, Clause 10 on the “*Control of noise and vibration*”, and Annex B “*Noise sources, remedies and their effectiveness*”. Equipment such as breakers and compressors and mobile plant such as excavators and road works equipment will be expected to conform with the appropriate EC directive noise limit.
- 9.12 The least noisy processes would be used wherever possible. The application of noisy processes would be limited to the times of day when the impact would be less critical, such as rush hours.

- 9.13 With regard to the restriction of construction hours, these would likely be restricted to standard hours of 0800-1800 hours weekdays and 0800-1300 hours on Saturdays with no Sunday or bank holiday working allowed.
- 9.14 The routes that would be used by construction vehicles would be agreed with the Local Authority to avoid the most sensitive areas where possible.
- 9.15 Noisy equipment which is not required to be mobile would be located as far from existing residential properties as is practical.
- 9.16 All methods of work, and noise control measures will be agreed with the Local Authority prior to the commencement of works on site, whether by informal undertaking or legislative processes.

10.0 Cumulative Impacts and Assessment Conclusions

10.1 Since there are a number of different predicted noise levels from various sources which have the potential to impact at premises in Maltkiln Road opposite the site entrance, these have been considered cumulatively, as appropriate in Table 10.1 below.

Table 10.1: Cumulative impact from all sources

Receptor	Noise sources	Predicted worst case noise levels, dB			Guideline values, dB		
		L _{Aeq, day}	L _{Aeq, night}	L _{Amax}	L _{Aeq, day}	L _{Aeq, night}	L _{Amax}
Maltkiln Road	Car park / recycling	46	40	54	50-55	45	60
	Service yard	37	39	55			
	Petrol filling station	47	38	57			
	Sum	50	44	57			

10.2 Having undertaken this assessment against objective criteria and considering all cumulative impacts, it is concluded that the development could proceed without the likelihood of subsequent operations harming the amenity of local residents.

10.3 Road Traffic noise from the proposal would cause imperceptible increases in noise level on surrounding roads during the day.

10.4 Noise from construction activities can be controlled by measures to be agreed with the Local Authority.

10.5 The proposed mechanical services on site would best be controlled by a condition limiting noise levels at the nearest noise sensitive premises. Further work will be needed prior to installation to ensure that the units installed is capable to meeting this limit.

APPENDIX A

**PLANS SHOWING NOISE MEASUREMENT LOCATIONS
AND PROPOSED LAYOUT**

Figure A1: Plan showing noise measurement locations

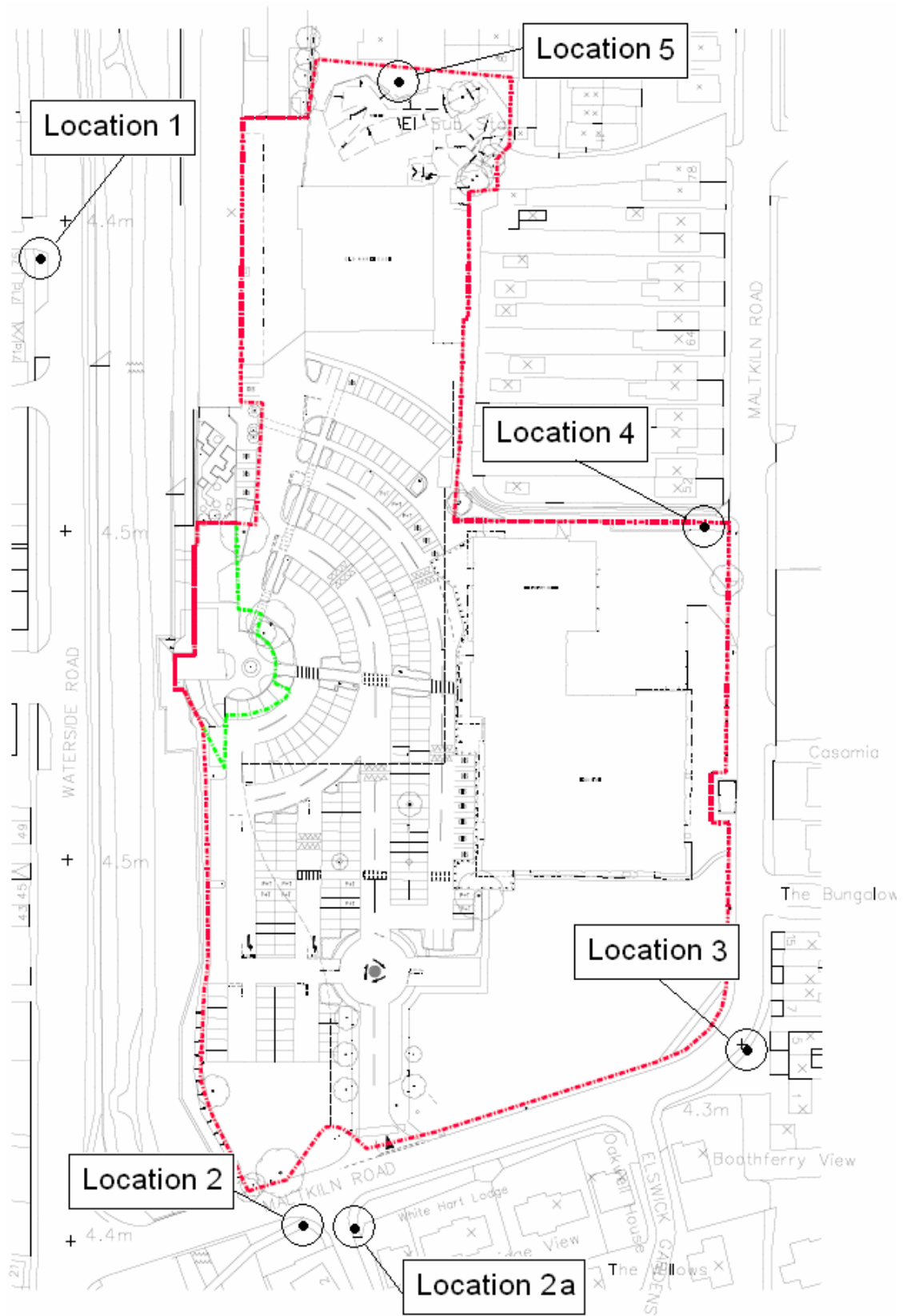
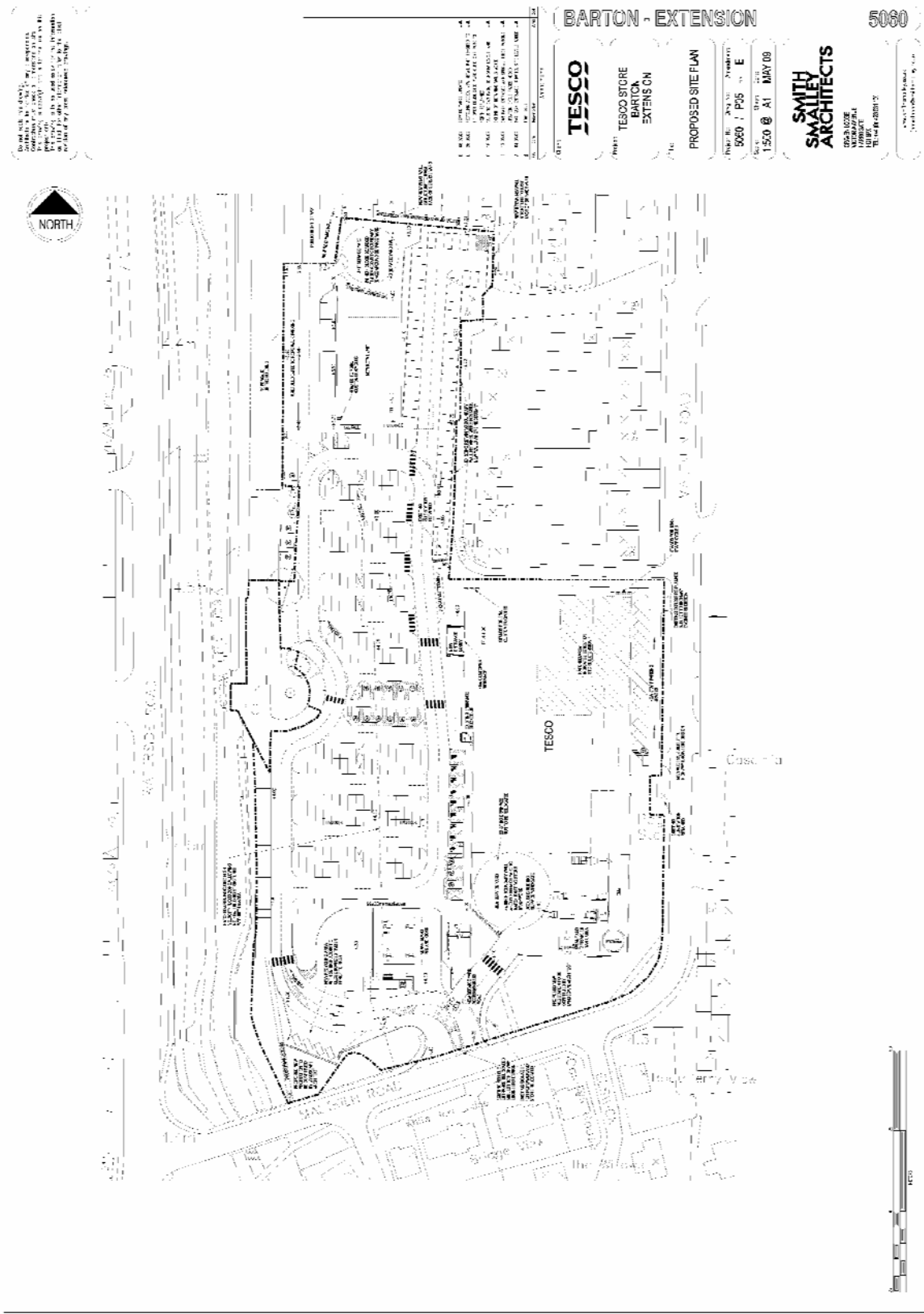


Figure A2: Plan showing proposed layout



APPENDIX B

NOISE SURVEY RESULTS

Table B1: Noise levels measured at Location 1 (all measurements 10 minutes in duration)

Date	Time	Measured Noise Level, dB					Comments
		L _{Aeq}	L _{Amax}	L _{Amin}	L _{A10}	L _{A90}	
22 June 2009	1341	60	74	33	65	37	Road traffic on Waterside Road is dominant. Distant road traffic also audible. Occasional planes, birdsong, workshop noise and dog bark.
	1401	62	77	35	66	38	
	1520	63	78	37	67	43	
	2100	63	82	35	66	38	
	2119	60	80	33	62	36	
	2248	47	73	30	38	32	Local traffic now reduced. Water feature in nearby garden audible. Distant road traffic still contributes
2258	48	72	29	41	32		
24 June 2009	0245	34	52	31	36	32	Distant road traffic, water feature, distant dog barking
	0258	34	47	32	35	33	
	0618	49	73	34	43	36	Birdsong, occasional local traffic, distant traffic
	0635	57	81	35	52	37	Local traffic increasing.

Table B2: Noise levels measured at Location 2 (all measurements 10 minutes in duration)

Date	Time	Measured Noise Level, dB					Comments
		L _{Aeq}	L _{Amax}	L _{Amin}	L _{A10}	L _{A90}	
22 June 2009	2039	62	88	20	63	38	Local traffic and vehicles in Tesco car park dominate. People chatting in car park. Distant road traffic and birdsong also contribute.
	2234	48	69	26	43	28	
	2356	55	78	27	53	30	
24 June 2009	0232	33	52	30	34	31	Distant traffic. Dog barking.
	0352	43	57	34	46	38	Distant traffic. Birdsong.
	0604	56	77	35	55	38	Distant traffic, birdsong, bottle bank in use, occasional vehicles, including one HGV.
	0731	61	80	36	63	40	Local road traffic, including HGV and passing bus. Tesco car park in use, despite shop being closed.
	1020	62	79	42	65	49	Local road traffic dominant. Tesco car park, distant traffic, bird song, occasional plane also contribute.
	1133	61	79	39	64	48	
1228	62	79	39	65	46		

Table B3: Noise levels measured at Location 3 (all measurements 10 minutes in duration)

Date	Time	Measured Noise Level, dB					Comments
		L _{Aeq}	L _{Amax}	L _{Amin}	L _{A10}	L _{A90}	
22 June 2009	2026	54	76	33	55	37	Occasional vehicles on Maltkiln Road. Noise from nearby housing use (people speaking etc.), distant traffic noise. Vehicle movements in Tesco car park also audible.
	2222	50	71	29	50	33	Occasional cars passing. Tesco car park still in use. Distant traffic. TV in nearby house (with window open) forms background.
	2344	36	53	26	35	28	Distant traffic and TV at nearby house
24 June 2009	0219	46	70	28	35	29	Single car pass by on Waterside road. Also able to hear a radio at a nearby house and distant traffic.
	0340	50	64	36	55	41	Bird song (dominant) and distant traffic.
	0552	55	76	33	55	38	Birdsong. Lorry into Tesco service yard (Plus unloading). Cars on Maltkiln Road.
	0719	55	71	35	57	41	Cars on local road, distant traffic, birdsong.
	1008	56	75	38	58	42	Local road traffic, Tesco car park, distant traffic, bird song, dogs barking, speech. L _{max} from jet aircraft flying past.
	1119	54	71	40	57	44	
29 June 2009	2130	55	78	30	54	32	Occasional vehicles passing on Maltkiln Road. Household movements outside houses (early evening only). Distant traffic.
	2240	47	64	28	51	30	

Table B4: Noise levels measured at Location 4 (all measurements 10 minutes in duration)

Date	Time	Measured Noise Level, dB					Comments
		L _{Aeq}	L _{Amax}	L _{Amin}	L _{A10}	L _{A90}	
22 June 2009	2010	53	72	31	57	36	Tesco service yard – lorry unloading in progress. Occasional vehicles passing on Maltkiln Road. Distant traffic.
	2208	44	63	28	41	30	Occasional vehicles passing. Distant traffic, roof top plant (Tesco), bird song.
	2329	38	60	26	34	28	Distant traffic, occasional car pass, plant at Tesco
24 June	0205	37	49	33	38	35	Distant traffic, plant at Tesco. Noise from water feature in nearby garden.

Date	Time	Measured Noise Level, dB					Comments
		L _{Aeq}	L _{Amax}	L _{Amin}	L _{A10}	L _{A90}	
2009	0326	46	65	36	49	39	Distant traffic, plant at Tesco. Noise from water feature in nearby garden. Car starts up near monitoring location. Birdsong
	0539	55	71	37	61	41	Birdsong. Movements in Tesco yard. Water feature, distant traffic. Occasional cars passing.
	0706	54	69	38	58	41	Road traffic, Tesco service yard in use (level variable, dependant on activity), bird song, distant traffic, occasional planes.
	0956	54	71	43	56	46	
	1107	55	74	44	59	47	
	1159	56	78	45	59	47	

Table B5: Noise levels measured at Location 5 (all measurements 10 minutes in duration)

Date	Time	Measured Noise Level, dB					Comments
		L _{Aeq}	L _{Amax}	L _{Amin}	L _{A10}	L _{A90}	
22 June 2009	1322	46	58	36	49	39	Bird song. Distant traffic and occasional plane.
	1450	46	60	36	49	39	
	1500	44	59	34	47	37	
	1955	47	60	30	50	38	Bird song and distant traffic. Also, some noise from banging at premises on Maltkiln Lane: testing fairground equipment. Music from nearby house also audible.
	2153	36	55	28	38	30	Bird song. Distant traffic and sounds from nearby householders – talking, car parking in cul de sac etc.
	2314	29	45	23	31	25	Distant traffic plus dog barking in distance.
24 June 2009	0149	28	36	25	29	27	Distant traffic. Tesco plant audible.
	0312	32	50	28	34	30	Bird song. Distant traffic. Tesco plant audible.
	0524	49	64	33	55	37	
	0650	50	64	33	54	39	

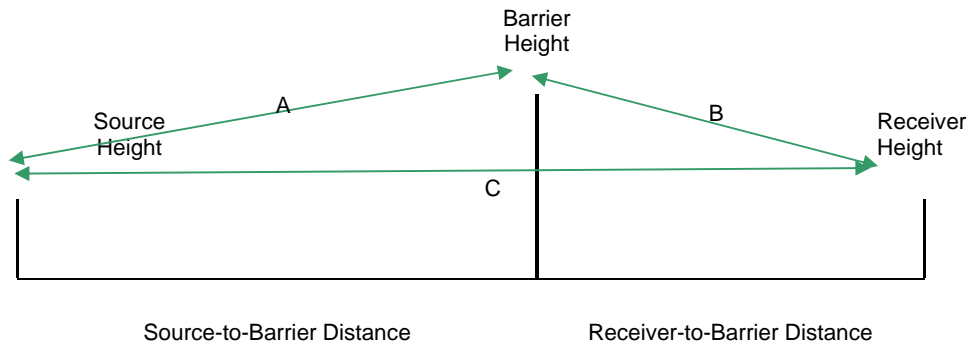
Table B6: Noise levels measured at Location 2a (all measurements 10 minutes in duration)

Date	Time	Measured Noise Level, dB					Comments
		L _{Aeq}	L _{Amax}	L _{Amin}	L _{A10}	L _{A90}	
29 June 2009	2120	55	70	34	59	38	Vehicles on Maltkiln Road – mostly Tesco customers. Shouts from young people in distance. Dog barking.
	2250	46	67	28	43	29	Occasional cars in Maltkiln Road. Distant traffic. Lively voices from people using cash point at Tesco.

APPENDIX C

SCREENING CALCULATIONS

Figure C3: Barrier calculation for Car park to Trinity Walk (day time)



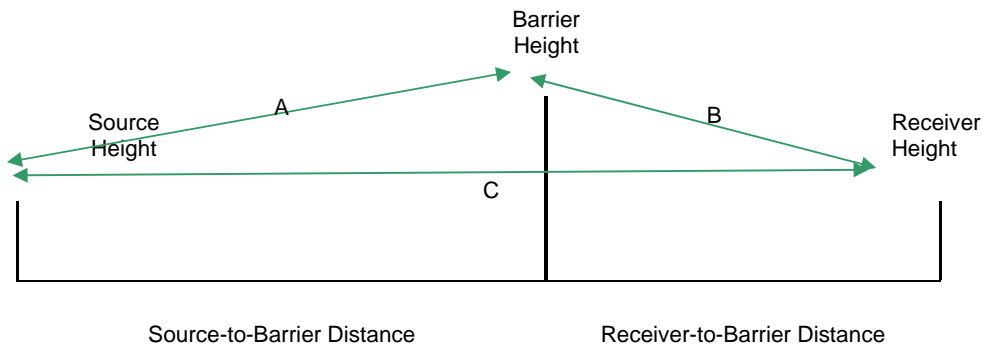
Source-to-Barrier Distance	3.0 m
Receiver-to-Barrier Distance	1.0 m

Source Height	0.5 m
Receiver Height	1.6 m
Barrier Height	2.0 m

Path difference = $\frac{0.283}{m}$
 $(a + b) - c$

Frequency - Hz	63	125	250	500	1K	2K	4K	8K	CRTN
Attenuation - dB	7	9	11	13	16	18	21	24	12 dBA

Figure C4: Barrier calculation for Car park to Trinity Walk (night time)



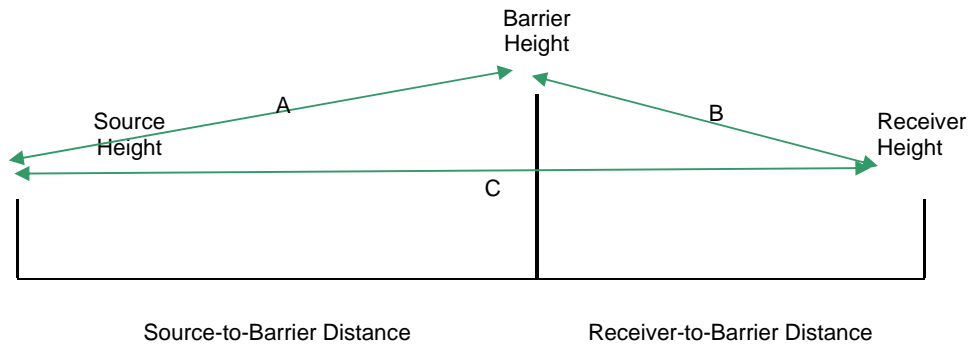
Source-to-Barrier Distance	3.0 m
Receiver-to-Barrier Distance	50.0 m

Source Height	0.5 m
Receiver Height	4.5 m
Barrier Height	2.0 m

Path difference = $\frac{0.266}{m}$
 $(a + b) - c$

Frequency - Hz	63	125	250	500	1K	2K	4K	8K	CRTN
Attenuation - dB	7	8	10	13	15	18	21	24	11 dBA

Figure C5: Barrier calculation for Recycling area to Maltkiln Road (day time)



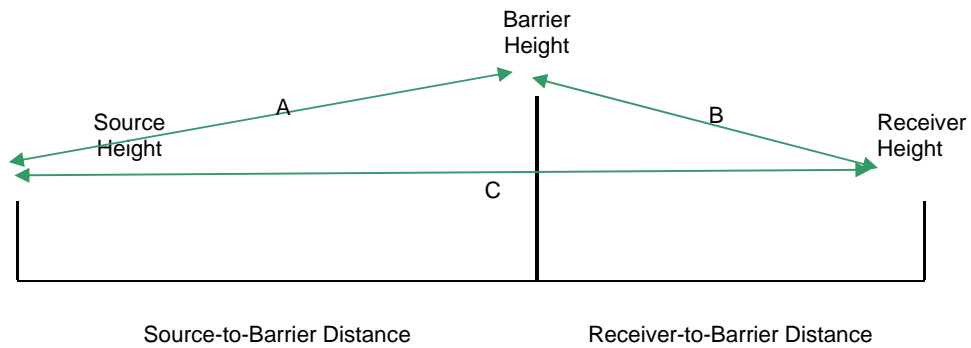
Source-to-Barrier Distance	2.0 m
Receiver-to-Barrier Distance	28.0 m

Source Height	1.5 m
Receiver Height	1.6 m
Barrier Height	3.0 m

Path difference = $\frac{0.535}{m}$
 $(a + b) - c$

Frequency - Hz	63	125	250	500	1K	2K	4K	8K	CRTN
Attenuation - dB	8	10	13	15	18	21	24	27	13 dBA

Figure C6: Barrier calculation for Recycling area to Maltkiln Road (night time)



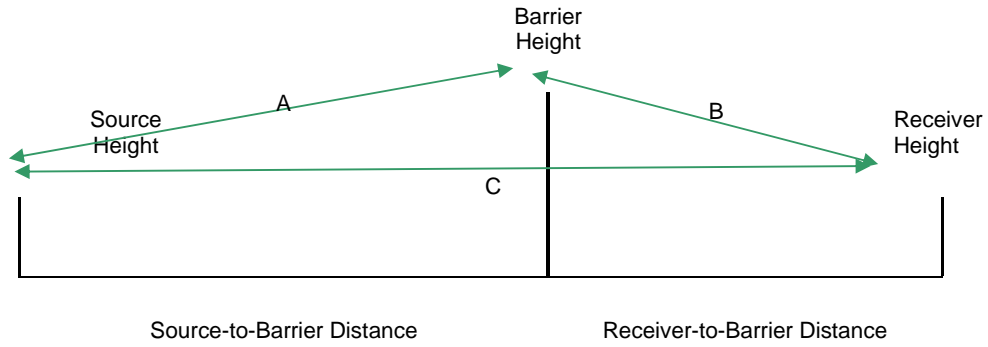
Source-to-Barrier Distance	2.0 m
Receiver-to-Barrier Distance	28.0 m

Source Height	1.5 m
Receiver Height	4.5 m
Barrier Height	3.0 m

Path difference = $\frac{0.391}{m}$
 $(a + b) - c$

Frequency - Hz	63	125	250	500	1K	2K	4K	8K	CRTN
Attenuation - dB	8	9	12	14	17	20	23	26	12 dBA

Figure C7: Barrier calculation for Recycling area to Waterside Road (day time)



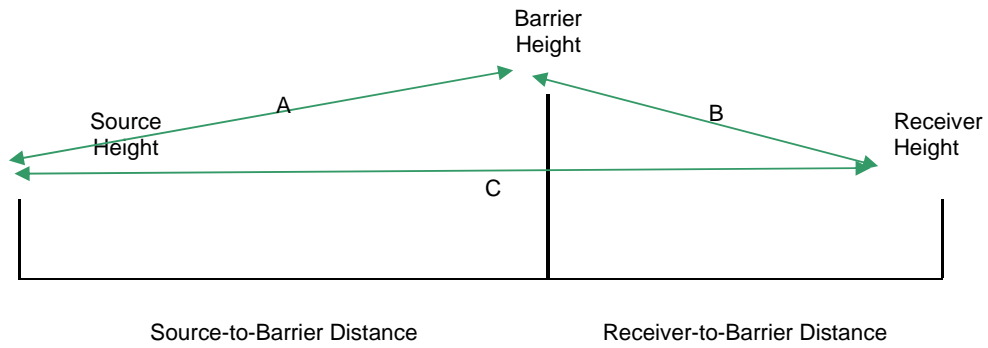
Source-to-Barrier Distance	2.0 m
Receiver-to-Barrier Distance	50.0 m

Source Height	1.5 m
Receiver Height	1.6 m
Barrier Height	3.0 m

Path difference = $\frac{0.520}{(a + b) - c}$ m

Frequency - Hz	63	125	250	500	1K	2K	4K	8K	CRTN
Attenuation - dB	8	10	13	15	18	21	24	27	13 dBA

Figure C8: Barrier calculation for Recycling area to Waterside Road (night time)



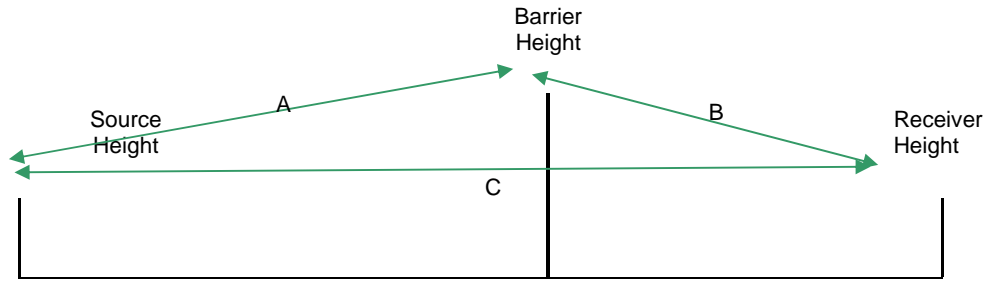
Source-to-Barrier Distance	2.0 m
Receiver-to-Barrier Distance	50.0 m

Source Height	1.5 m
Receiver Height	4.5 m
Barrier Height	3.0 m

Path difference = $\frac{0.436}{(a + b) - c}$ m

Frequency - Hz	63	125	250	500	1K	2K	4K	8K	CRTN
Attenuation - dB	8	10	12	15	17	20	23	26	13 dBA

Figure C9: Barrier calculation for main store Service Yard to Maltkiln Road (day time)



Source-to-Barrier Distance

Receiver-to-Barrier Distance

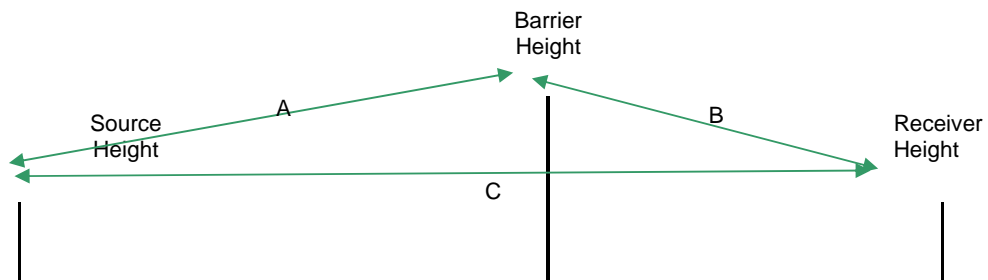
Source-to-Barrier Distance	12.0 m
Receiver-to-Barrier Distance	28.0 m

Source Height	1.0 m
Receiver Height	1.6 m
Barrier Height	4.0 m

Path difference = $\frac{0.467}{m}$
 $(a + b) - c$

Frequency - Hz	63	125	250	500	1K	2K	4K	8K	CRTN
Attenuation - dB	8	10	12	15	18	20	23	26	13 dBA

Figure C10: Barrier calculation for main store Service Yard to Maltkiln Road (night time)



Source-to-Barrier Distance

Receiver-to-Barrier Distance

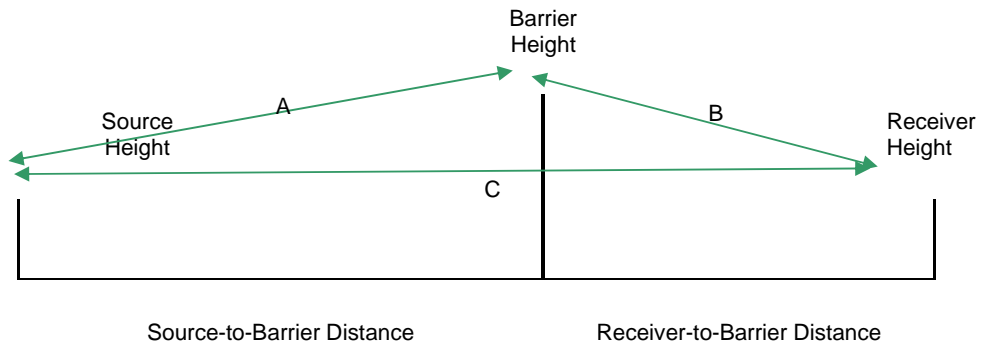
Source-to-Barrier Distance	12.0 m
Receiver-to-Barrier Distance	28.0 m

Source Height	1.0 m
Receiver Height	4.5 m
Barrier Height	4.0 m

Path difference = $\frac{0.221}{m}$
 $(a + b) - c$

Frequency - Hz	63	125	250	500	1K	2K	4K	8K	CRTN
Attenuation - dB	7	8	10	12	15	17	20	23	11 dBA

Figure C11: Barrier calculation for the proposed new retail unit Service Yard to Ropery Lane (day time)



Source-to-Barrier Distance	10.0 m
Receiver-to-Barrier Distance	1.0 m

Source Height	1.5 m
Receiver Height	1.6 m
Barrier Height	3.0 m

Path difference = $\frac{0.832}{(a + b) - c}$ m

Frequency - Hz	63	125	250	500	1K	2K	4K	8K	CRTN
Attenuation - dB	10	12	14	17	20	23	26	29	15 dBA

APPENDIX D

ACOUSTIC TERMINOLOGY

Acoustic Terminology

AMBIENT NOISE

The total encompassing sound in a given situation at a given time. Most often described in terms of the index L_{AeqT} .

DECIBEL (dB)

The ratio of sound pressures that we can hear is a ratio of 10^6 (one million:one). For convenience, therefore, a logarithmic measurement scale is used. The resulting parameter is called the 'sound pressure level' (L_p) and the associated measurement unit is the decibel (dB). As the decibel is a logarithmic ratio, the laws of logarithmic addition and subtraction apply. The threshold of normal hearing is in the region of 0 dB, and 140 dB is the threshold of pain. A change of 1 dB is only perceptible under controlled conditions.

dB(A)

The unit generally used for measuring environmental, traffic or industrial noise is the A-weighted sound pressure level in decibels, denoted dB(A). An 'A'-weighting network can be built into a sound level measuring instrument such that sound levels in dB(A) can be read directly from a meter. The weighting is based on the frequency response of the human ear and has been found to correlate well with human subjective reactions to various sounds. A change of 3 dB(A) is the minimum perceptible under normal conditions, and a change of 10 dB(A) corresponds to a subjective halving or doubling of the loudness of a sound.

EQUIVALENT CONTINUOUS SOUND LEVEL

An index often used for the assessment of overall noise exposure is the equivalent continuous sound level, L_{eq} . This is a notional steady level which would, over a given period of time, deliver the same sound energy as the actual time-varying sound over the same period. Hence fluctuating levels can be described in terms of a single figure level. The 'A' weighted statistical sound level over a time period, T, is denoted L_{AeqT} .

FAÇADE NOISE LEVEL

The noise level adjacent to the façade of a building, usually at a distance of 1 metre.

FREE FIELD NOISE LEVEL

The noise level away from the façade of a building or other structure.

HERTZ (Hz)

Unit of frequency, equal to one cycle per second. Frequency is related to the pitch of a sound.

MAXIMUM AND MINIMUM NOISE LEVELS

The maximum and minimum noise level identified during a measurement period. Experimental data has shown that the human ear does not generally register the full loudness of transient sound events of less than 125 ms. Fast time weighting has an exponential time constant of 125 ms which reflects the ear's response. The maximum level measured with fast time weighting is denoted as $L_{Amax,f}$. The minimum level measured with fast time weighting is denoted as $L_{Amin,f}$. Slow time weighting (S) with an exponential time constant of 1s is used to allow more accurate estimation of the average sound level on a visual display.

STATISTICAL NOISE LEVELS

For levels of noise that vary widely with time, for example road traffic noise, it is necessary to employ an index which allows for this variation. The L_{10} , the level exceeded for ten per cent of the time period under consideration, has been adopted in this country for the assessment of road traffic noise. The L_{90} , the level exceeded for ninety per cent of the time, has been adopted to represent the background noise level. 'A' weighted statistical noise levels are generally used and are denoted L_{A10} , L_{A90} etc. The reference time period (T) is normally included, e.g. $L_{A10, 5min}$ or $L_{A90, 8hr}$. $L_{A10}(18 \text{ hour})$ is the arithmetic average of the 18 individual $L_{A10, 1hr}$ values between 06:00 and 24:00.

TYPICAL LEVELS

Some typical noise levels are given below:

Noise Level dB(A)	Example
130	Threshold of pain
120	Jet aircraft take-off at 100 metres
110	Chain saw at 1 metre
100	Inside disco
90	Heavy lorries at 5 metres
80	Kerbside of busy street
70	Loud radio (in typical domestic room)
60	Office or restaurant
50	Domestic fan heater at 1metre
40	Living room
30	Theatre
20	Remote countryside on still night
10	Sound insulated test chamber
0	Threshold of hearing

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