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Consulting Acoustical & Vibration Engineers

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NOISE & VIBRATION ASSESSMENT
SUMMER HILL FLOUR MILL
CONCEPT PLAN

41.6268.R1:CFCD5
Rev 02

Prepared for: EG Funds Management
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APPENDICES

1.0 INTRODUCTION

Atkins Acoustics was commissioned by EG Funds Management to carry out a noise and vibration assessment for the proposed Concept Plan application for the re-development of the Summer Hill Flour Mill site for residential and commercial use. The assessment has been conducted considering the *NSW Department of Planning – Director-Generals Requirements* (DGRs) issued on the 16 December 2010. In accordance with the DGRs the *NSW Department of Planning 'Development Near Rail Corridors and Busy Roads – Interim Guideline'* has been considered.

The proposal involves retaining and re-use of heritage mill buildings and concrete storage silos, and the construction of a number of additional buildings to accommodate both commercial and residential uses. The purpose of the assessment was to determine the acoustical constraints for the proposed development *(Appendix 1)* with respect to noise and vibration exposure. The assessment is to provide guidance for the concept in terms of acoustic privacy and residential amenity.

1.1 Site Context

Inspections confirmed that the site is bounded by Smith Street to the north, existing unused freight rail corridor to the east and existing buildings fronting Edward Street and Edward Street to the south-west and west. The site is potentially exposed to future light rail activities within the presently unused freight rail corridor, rail noise from the Inner West / South rail line to the north (also accommodates through trains on Western and Northern Lines), and road traffic noise from Smith Street (north) and Old Canterbury Road (south).

Site inspections confirmed that the existing freight rail tracks adjacent the site are typically installed 'at grade' or in a cutting up to 1.5 metres deep. It is our understanding that the future light rail would utilise the existing rail alignment.

Inspections, aural observations and ambient noise measurements, confirmed that the site is also exposed to noise from aircraft associated with the operation of the Sydney Kingsford Smith Airport.

The Concept Plan is for the development to incorporate mixed uses, including commercial components such as studios, cafes, retail and similar uses. The detailed design would need to account for potential noise amenity conflicts e.g. late trading for café/restaurant adjacent residential uses.

This report has been prepared to assist with planning considerations for the site and presents conceptual ameliorative measures to address noise and vibration exposure and has considered the Concept Plan prepared by Hassell.

2.0 ASSESSMENT GOALS

2.1 Director-Generals Requirements

The specific DGR's relating to acoustics for the Concept Plan as outlined in the NSW Department of Planning correspondence dated 16 December 2010, is as follows:

> ***8. Noise and Vibration***
>
> *The EA should address the issue of noise and vibration impacts (including from road, heavy rail and aircraft) and provide details of how these will be managed and ameliorated through the design of the building, in compliance with relevant Australian Standards and the Department's Interim Guidelines for Developments near Rail Corridors and Busy Roads.*

In addition, *Item 5* of the DGR's refers to *'Environmental and Amenity Impacts'* that addresses a number of disciplines, but also refers to 'acoustic privacy' and 'residential amenity'. It is our understanding of this general requirement, that the main focus is on appropriate design for acoustic privacy between residential apartments/dwellings, and consideration of potential acoustic conflicts between commercial and residential uses throughout the development.

In the absence of specific guidelines for 'acoustic privacy' and 'amenity', this assessment has considered the requirements of the *Building Code of Australia (BCA) Part F5* and *DECCW, Noise Guide for Local Government (NGLG)*.

2.2 Noise and Vibration

The NSW Department of Planning *'Development near Rail Corridors and Busy Roads – Interim Guideline' (2008)* published interim guidelines for assessing rail and road related noise intrusion and ground vibration for residential development. Additional information for the assessment of ground vibration generated by rail activities is provided in *'The Interim Guidelines for the Assessment of Noise from Rail Infrastructure Projects' (DECC, 2007)* and *Assessing Vibration: a technical guideline (DECC, 2006)*.

2.2.1 Road / Rail Noise

For rail / road traffic noise, the *'Development near Rail Corridors and Busy Roads – Interim Guideline'* recommend the following internal noise levels for habitable areas within residential buildings.

Table 1: Allowable Internal Noise Level Criteria ($L_{Aeq,T}$)

Area of Use	Time Period	Internal Noise Level
Sleeping	Night (10pm to 7am)	35
Living	Any time	40

2.2.2 Rail Vibration

For comparison of vibration in terms of human response, *Table 2* presents a summary of levels referenced to likely perception.

Table 2: Human Perception of Vibration
Source: German Standard DIN 4150 (1986)

Vibration Levels mm/sec	Likely Perception
0.15	Perception Threshold
0.35	Barely Noticeable
1.0	Noticeable
2.2	Easily Noticeable
6.0	Strongly Noticeable
14.0	Very Strongly Noticeable

The *DECCW*, *Assessing Vibration: a technical guideline* provides guidance for assessment of 'intermittent' vibration, such as that generated by trains. For intermittent vibration, the guideline recommends the use of a vibration dose value (VDV). Acceptable values of VDV are presented in *Table 3*.

Table 3: Recommended Vibration Dose Values for Intermittent Vibration

Type of Occupancy	Recommended Vibration Dose Value for Intermittent Vibration ($m/s^{1.75}$)			
	Daytime[1]		Night-time[2]	
	Preferred Value	Maximum Value	Preferred Value	Maximum Value
Residences	0.20	0.40	0.13	0.26
Offices	0.40	0.80	0.40	0.80

Notes: 1. *Daytime is from 7:00am to 10:00pm*
2. *Night-time is from 10:00pm to 7:00am*

The *DECCW*, *Assessing Vibration: a technical guideline* provides goals for assessing human response and potential disturbance to the occupants of buildings. *Table 4* presents a summary of RMS vibration levels referenced to specific frequency bands adjusted by multiplying factors for residential receptors referenced to human response *(BS 6472-1992. Figure B1.4).*

Table 4: Vibration Levels for Assessment of Human Comfort

Frequency (Hz)	RMS Velocity Level (mm/s)			
	Continuous Vibration		Intermittent Vibration	
	Day (2)	Night (1.4)	Day (60)	Night (20)
1	3.2	2.2	95	31
1.25	2.3	1.6	68	22
1.6	1.6	1.1	47	15
2	1.1	0.8	33	11
2.5	0.8	0.6	24	8.0
3.15	0.6	0.4	17	5.8
4	0.4	0.3	19	4.0
5	0.3	0.2	9.5	3.2
6.3	0.3	0.2	7.6	2.5
8	0.2	0.1	6.0	2.0
10	0.2	0.1	6.0	2.0
12.5	0.2	0.1	6.0	2.0
16	0.2	0.1	6.0	2.0
20	0.2	0.1	6.0	2.0
25	0.2	0.1	6.0	2.0
31.5	0.2	0.1	5.4	1.8
40	0.2	0.1	6.0	2.0
50	0.2	0.1	6.0	2.0
63	0.2	0.1	6.0	2.0
80	0.2	0.1	6.0	2.0

() Number in brackets refers to multiplying factor used to specify satisfactory magnitudes of building vibration with respect to human response in accordance with *DECCW*, *Assessing Vibration: a technical guideline Table B.1.*

German Standard DIN4150 Part 3 (1986) provides guidelines for evaluating the effects of vibration on structures. The values recommended in the standard are summarised in *Table 5*. The values are the maximum levels measured in any direction at the building foundation.

Table 5: Safety Limits for Structural Damage

Type of Structure	Vibration Level (mm/s)		
	<10Hz	**10Hz to 50Hz**	**50Hz to 100Hz**
Commercial/industrial buildings or buildings with similar design	20	20 to 40	40 to 50
Dwellings and buildings of similar design and/or use	5	5 to 15	15 to 20
Structures of great intrinsic value (eg. buildings under preservation)	3	3 to 8	8 to 10

Source: German Standard DIN4150

2.3 Aircraft Noise

The assessment was conducted in accordance with the requirements of the Australian Standard AS2021:2000 '*Acoustics – Acoustics – Aircraft Noise Intrusion – Building Siting and Construction*'

Reference to the Aircraft Noise Exposure Forecast (ANEF) 2023/2024, the proposed development is located within the ANEF 25-30 contours.

For the purpose of design development, the following indoor design goals (*Table 6*), as stipulated in *Table 3.3* of AS2021:2000, have been used to establish the aircraft noise reduction (ANR), with windows/doors in the closed position. If windows or doors were open for ventilation purposes, the ANR of the building would be significantly reduced.

Table 6: Indoor Design Goals - Aircraft

L_{Amax} dB(A) re 20×10^{-6} Pa

Use of Area	Indoor Design Goal dB(A)
Residential	
- Sleeping areas	50
- Habitable spaces	55
- Bathrooms, toilets, laundries	60

Table 6: Indoor Design Goals – Aircraft (cont.)

L_{Amax} dB(A) re 20 × 10^{-6} Pa

Use of Area	Indoor Design Goal dB(A)
Commercial buildings, offices and shops	
- Private offices, conference rooms	55
- Drafting, open offices	65
- Typing, data processing	70
- Shops, supermarkets, showrooms	75

2.4 Acoustic Privacy

In terms of 'acoustic privacy' within the development, the detailed design would consider the requirements presented in *Part F5* of the *Building Code of Australia*. The *BCA* specifies the following minimum deemed-to-satisfy and acoustic performance requirements for the construction of residential buildings.

Part F5: Sound Transmission and Insulation

F5.0 Deemed-to-Satisfy Provisions

*(a) Where a Building Solution is proposed to comply with the Deemed-to-Satisfy Provisions, Performance Requirements **FP5.1** to **FP5.6** are satisfied by complying with **F5.1** to **F5.7.***

*(b) Where a Building Solution is proposed as an Alternative Solution to the Deemed-to-Satisfy Provisions of **F5.1** to **F5.7**, the relevant Performance Requirements must be determined in accordance with **A0.10**.*

F5.1 Application of Part

The deemed to satisfy provisions of this Part apply to Class 2 and 3 buildings and Class 9c aged care buildings.

F5.2 Determination of airborne sound insulation ratings

A form of construction required to have an airborne sound insulation rating must –

(a) have the required value for weighted sound reduction index (R_w) or weighted sound reduction index with spectrum adaptation term (R_w+C_{tr}) determined in accordance with AS/NZS 1276.1 or ISO 717.1 using results from laboratory measurements; or
*(b) comply with **Specification F5.2***

F5.3 Determination of impact sound insulation ratings

(a) A floor in a building required to have an impact sound insulation rating must –
- *(i) have the required value for weighted normalised impact sound pressure level with spectrum adaptation term ($L_{n,w}+C_l$) determined in accordance with AS/ISO 717.2 using results from laboratory measurements; or*
- *(ii) comply with **Specification F5.2***

(b) A wall in a building required to have an impact sound insulation rating must -
- *(i) for a Class 2 or 3 building be of discontinuous construction; and*
- *(ii) for a Class 9c aged care building, must:*
  - *(A) for other than masonry, be two or more separate leaves without rigid mechanical connection except at the periphery; or*
  - *(B) be identical with a prototype that is no less resistant to the transmission of impact sound when tested in accordance with **Specification F5.5** than a wall listed in Table 2 of **Specification F5.2***

(c) For the purposes of this Part, discontinuous construction means a wall having a minimum 20mm cavity between 2 separate leaves, and
- *(i) for masonry, where wall ties are required to connect leaves, the ties are of the resilient type; and*
- *(ii) for other than masonry, there is no mechanical linkage between leaves except a periphery.*

F5.4 Sound insulation rating of floors

(a) A floor in a Class 2 or 3 building must have an R_w+C_{tr} (airborne) not less than 50 and an $L_{n,w}+C_l$ (impact) not more than 62 if it separates –
- *(i) sole-occupancy units; or*
- *(ii) a sole-occupancy unit from a plant room, lift shaft, stairway, public corridor, public lobby or the like, or parts of a different classification.*

(b) A floor in a Class 9c aged care building separating sole-occupancy units must have and R_w not less than 45.

F5.5 Sound insulation rating of walls

(a) A wall in a Class 2 or 3 building must –
- *(i) have an Rw +Ctr (airborne) not less than 50 if it separates sole-occupancy units; and*
- *(ii) have an Rw (airborne) of not less than 50, if it separates a sole-occupancy unit from a plant room, lift shaft, stairway, public corridor, public lobby or the like, or parts of a different classification, and*
- *(iii) comply with **F5.3(b)** if it separates:*
  - *(A) a bathroom, sanitary compartment, laundry or kitchen in one sole-occupancy unit from a habitable room (other than a kitchen) in an adjoining unit; or*
  - *(B) A sole-occupancy unit from a plant room or lift shaft.*

(b) A door may be incorporated in a wall in a Class 2 or 3 building that separates a sole-occupancy unit from a stairway, public corridor, public lobby or the like, may incorporate a door provided the door assembly has an R_w not less than 30.
(c) A wall in a Class 9c aged care building must have an R_w not less than 45 if it separates –
(i) sole-occupancy units; or
(ii) a sole occupancy unit from a kitchen, bathroom, sanitary compartment (not being an associated en-suite), laundry, plant room or utilities room.
*(d) In addition to (c), a wall separating a sole-occupancy unit in a Class 9c aged care building from a kitchen or laundry must comply with **F5.3(b)***
(e) Where a wall required to have sound insulation has a floor above, the wall must continue to –
(i) the underside of the floor above; or
(ii) a ceiling that provides the sound insulation required for the wall
(f) Where a wall required to have sound insulation has a roof above, the wall must continue to –
(i) the underside of the roof above; or
(ii) a ceiling that provides the sound insulation required for the wall.

F5.6 Sound insulation rating of services

(a) If a duct, soil, waste or water supply pipe, including a duct or pipe that is located in a wall or floor cavity, serves or passes through more than one sole-occupancy unit, the duct or pipe must be separated from the rooms of any sole-occupancy unit by construction with an $R_w + C_{tr}$ (airborne) or not less than –
(i) 40 if the adjacent room is a habitable room (other than a kitchen); or
(ii) 25 if the adjacent room is a kitchen or a non-habitable room
(b) If a storm water pipe passes through a sole-occupancy unit it must be separated in accordance with (a)(i) and (ii).

F5.7 Sound isolation of pumps

A flexible coupling must be used at the point of connection between the service pipes in the building and any circulating pump or other pump.

Specification F5.2 Sound Insulation for Building Elements

*(a) **Masonry** – Units must be laid with all joints filled solid, including those between the masonry and any adjoining construction*
*(b) **Concrete Slabs** – Joints between concrete slabs or panels and any adjoining construction must be filled solid*
*(c) **Sheeting Materials** –*
(i) if one layer is required on both sides of a wall, it must be fastened to the studs with joints staggered on opposite sides
(ii) if two layers are required, the second layer must be fastened over the first layer so that the joints do not coincide with those of the first layer; and
(iii) joints between sheets or between sheets and any adjoining construction must be taped and filled solid.

(d) ***Timber or steel-framed construction*** *– perimeter framing members must be securely fixed to the adjoining structure and –*
- *(i) bedded in resilient compound; or*
- *(ii) the joints must be caulked so that there are no voids between the framing members and the adjoining structure.*

(e) ***Services*** *–*
- *(i) Services must not be chased into concrete or masonry elements.*
- *(ii) A door or panel required to have a certain Rw + Ctr that provides access to a duct, pipe or other service must –*
  - *(A) not open into any habitable room (other than a kitchen); and*
  - *(B) be firmly fixed so as to overlap the frame or rebate of the frame by not less than 10mm, be fitted with a sealing gasket along all edges and be constructed of –*
    - *(aa) wood, particleboard or blockboard not less than 33mm thick; or*
    - *(bb) compressed fibre reinforced cement sheeting not less than 9mm thick; or*
    - *(cc) other suitable material with a mass per unit area not less than 24.4kg/m^2*
- *(iii) A water supply pipe must –*
  - *(A) only be installed in the cavity of discontinuous construction; and*
  - *(B) in the case of a pipe that serves only one sole-occupancy unit, not be fixed to the wall leaf on the side adjoining any other sole-occupancy unit and have a clearance not less than 10mm to the other wall leaf.*
- *(iv) Electrical outlets must be offset from each other –*
  - *(A) in masonry walling, not less than 100mm; and*
  - *(B) in timber or steel framed walling, not less than 300mm.*

2.5 Noise Amenity

In terms of noise amenity, particularly with respect to different uses such as residential and commercial, Ashfield Council does not have any specific published acoustic requirements.

Accordingly during the detailed design phase, future commercial uses within the Concept Plan should be assessed utilising the procedures outlined in the *DECCW, Noise Guide for Local Government*, with respect to noise emissions and potential impacts on other uses including residential. In addition, all mechanical plant and equipment servicing both residential and commercial components of the development would require acoustic assessment during the detailed design phase to ensure that an appropriate level of noise amenity is achieved.

Where the development proposes to accommodate licensed premises, the noise requirements of the *Office of Liquor and Gaming (OLGR)* would need to be considered, specifically:

- *The L_{A10} noise level emitted from a licensed premises shall not exceed the background noise levels in any Octave Band Centre Frequency (31.5Hz to 8KHz) by more than 5dB between 7.00am and 12.00 midnight at the boundary of any residential affected residence.*

- *The L_{A10} noise level emitted from licensed premises shall not exceed the background noise levels in any Octave Band Centre Frequency (31.5Hz to 8KHz) between 12.00 midnight and 7.00am at the boundary of any residential affected residence.*

- *Not withstanding compliance with the above, the noise from a licensed premise shall not be audible within any habitable room in any residential premises between 12.00 midnight and 7.00am.*

- *For the purpose of this condition the L_{A10} can be taken as the average maximum deflection of the noise emission from the licensed premises.*

The Concept Plan allows for areas of the development to accommodate commercial uses. Final tenants and uses would not be determined until the development has been approved, detailed design completed and construction commenced.

It would be normal practice for proposed tenants of the commercial components, to apply to Council for development approval. As part of the Development Approval and Assessment process, it is expected that supporting documentation, including a site-specific noise assessment would be provided and demonstrate that noise amenity would not be adversely affected.

3.0 SITE MEASUREMENTS

For the purpose of assessing rail noise and vibration exposure levels, attended and unattended *(Appendix 2*) site measurements were conducted between Thursday 24 January 2008 to Friday 1 February 2008.

Noise measurements were recorded at four (4) reference locations (*Appendix 1*) on the subject development site as follows:

Location R1: south portion of site
Location R2: north-east portion of site
Location R3: central northern portion of site
Location R4: north-west portion of site

The instrumentation selected for the unattended noise measurements consisted of four (4) RTA Technology Environmental Noise Loggers. The reference level of each instrument was checked prior to and after the measurements with a NATA calibrated Bruel & Kjaer Sound Level Calibrator Type 4230, Serial No. 623590, with no significant drift recorded. Loggers were installed in free-field conditions.

Table 7 presents a summary of the measured day (7.00am to 10.00pm) and night (10.00pm to 7.00am) L_{Aeq} noise levels at the reference measurement locations. It is noted that measurement Location 2 (north-east) is largely dominated by rail noise from the commuter rail line to the north, whilst Location 3 (central north) is exposed to both rail noise and road traffic noise from Smith Street.

Table 7: Measured L_{Aeq} Noise Levels – Summer Hill
dB(A) re: 20 x 10^{-6} Pa

Date	Measured Noise Level (dB(A))	
	Day	Night
Location R1: South		
Thu 24/1/08	-	53
Fri 25/1/08	60	51
Sat 26/1/08	57	53
Sun 27/1/08	61	53
Mon 28/1/08	54	56
Tue 29/1/08	*64*	53
Wed 30/1/08	61	54
L_{Aeq}	**59**	**53**
Location R2: North-east		
Thu 24/1/08	-	58
Fri 25/1/08	61	56
Sat 26/1/08	59	56
Sun 27/1/08	61	55
Mon 28/1/08	57	57
Tue 29/1/08	63	55
Wed 30/1/08	62	-
L_{Aeq}	**61**	**56**
Location R3: Central North		
Thu 24/1/08	-	56
Fri 25/1/08	62	55
Sat 26/1/08	60	55
Sun 27/1/08	63	55
Mon 28/1/08	58	54
Tue 29/1/08	62	55
Wed 30/1/08	63	57
Thu 31/1/08	63	56
Fri 1/2/08	61	-
L_{Aeq}	**62**	**56**
Location R4: North-west		
Thu 24/1/08	-	54
Fri 25/1/08	61	52
Sat 26/1/08	59	54
Sun 27/1/08	63	55
Mon 28/1/08	58	54
Tue 29/1/08	62	55
Wed 30/1/08	64	56
Thu 31/1/08	63	54
Fri 1/2/08	61	-
L_{Aeq}	**62**	**54**

Level in *Italics* deleted due to extraneous noise

A review of the noise measurement results confirmed the night-time RBL background L_{A90} noise levels ranged between 39-46dB(A), with typical minimum background levels of 34-42dB(A). As the measurements were conducted during the

continued operation of the Allied Mills flour mill, , it would be beneficial to conduct some additional site measurements during the detailed design to confirm background L_{A90} levels in the absence of the Allied Mills operations for the purpose of confirming noise amenity design goals.

3.1 Road Traffic Noise

From the site measurements, the calculated free-field $L_{Aeq,T}$ road noise levels at the southern portion of the site are in the order of $L_{Aeq,15hr}$ 59dB(A) and $L_{Aeq,9hr}$ 53dB(A) from Old Canterbury Road, whilst on the central northern and north-western portions of the site the ambient road noise levels were in the order of $L_{Aeq,15hr}$ 62dB(A) and $L_{Aeq,9hr}$ 56dB(A).

Taking into account façade reflection (+2.5dB) and potential for reduced shielding and increased exposure to Old Canterbury Road to the south, the corrected predicted façade levels are $L_{Aeq,15hr}$ 65dB(A) and $L_{Aeq,9hr}$ 59dB(A) at the southern most residential building, and $L_{Aeq,15hr}$ 65dB(A) and $L_{Aeq,9hr}$ 59dB(A) at the northern portion of the site.

3.2 Rail Noise & Vibration

3.2.1 Rail Noise

The good line rail corridor that abuts the site to the east is being redeveloped to accommodate a light rail system linking Central Station to Dulwich Hill. Site attended noise measurements were conducted of the light rail operating between Central Station and Lilyfield, to establish envisaged noise emissions. Noise audits were conducted adjacent the light rail on Brennan Road between Gladstone and Starling Streets on Wednesday 30 January 2008 from 11.30am to 12.30pm. Measurements were conducted at a reference distance of approximately twenty (20) metres from the centre-line of the light rail track.

The results of the measurements confirmed SEL levels of 73-79dB(A) (avg. 77dB(A)) and L_{Amax} 65-78dB(A) (avg. 72dB(A)) in free-field conditions. A

review of the schedule for the Central to Lilyfield light rail confirms a schedule of approximately twelve (12) trips per hour.

$L_{Aeq,1hr}$ noise levels were predicted considering twelve (12) trips per hour, façade reflection and the following formula:

$$\mathbf{L_{Aeq(1hr)} = SEL_t + 10log(Nt)-10log(3600)}$$

where:
- $\mathbf{SEL_t}$ = single event sound pressure level (light-rail)
- **Nt** = number of 4 carriage light-rail movements in one (1) hour
- **3600** = number of seconds in one (1) hour

The results of the predictions utilising the assumptions presented confirmed a façade level of $L_{Aeq,1hr}$ 55dB(A), at twenty (20) metres from the rail line.

In terms of the northern portion of the site, and potential impacts associated with the rail operations on the Inner West / South rail line (also accommodating through trains on Western and Northern Lines), measurements at Location 2 (north-east) have confirmed L_{Aeq} noise levels of $L_{Aeq,15hr}$ 65dB(A) and $L_{Aeq,9hr}$ 59dB(A) façade corrected. At upper levels of the proposed building within the northern portion of the site, there is potential for increased exposure to rail operations on the Inner West / South rail line resulting in facade noise levels of $L_{Aeq,15hr}$ 68dB(A) and $L_{Aeq,9hr}$ 62dB(A).

3.2.2 Rail Vibration

Site attended ground vibration measurements were undertaken adjacent the light rail on Brennan Road between Gladstone and Starling Streets on Wednesday 30 January 2008 from 11.30am to 12.30pm for eleven (11) train passbys. Measurements were conducted at a reference distance of approximately twenty (20) metres from the centre-line of the light rail track. The measurements were conducted on the concrete kerb ‘at grade’ with the railway alignment. The location was considered representative of a typical building setback of twenty (20) metres from the railway alignment for

envisaged development at Summer Hill. *Table 8* presents a summary of the results and assessment goals for continuous vibration (Curve 1.4 - night).

Table 8: Measured Ground Vibration Levels

Frequency (Hz)	Train Reference Measurement Number											Night (Curve 1.4) Acc mm/s^2
	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	
1.6	0.21	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.02	0.01	**11.20**
2	0.22	0.06	0.02	0.02	0.02	0.02	0.01	0.01	0.02	0.02	0.02	**9.80**
2.5	0.14	0.07	0.03	0.02	0.03	0.02	0.02	0.02	0.02	0.02	0.02	**8.82**
3.15	0.20	0.09	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.02	**7.98**
4	0.25	0.12	0.04	0.03	0.03	0.04	0.03	0.03	0.03	0.03	0.03	**7.00**
5	0.21	0.12	0.04	0.04	0.04	0.03	0.03	0.03	0.03	0.03	0.04	**7.00**
6.3	0.25	0.11	0.04	0.04	0.04	0.04	0.03	0.03	0.04	0.04	0.03	**7.00**
8	0.17	0.10	0.04	0.03	0.04	0.03	0.05	0.04	0.03	0.04	0.03	**7.00**
10	0.18	0.12	0.04	0.04	0.03	0.04	0.04	0.03	0.04	0.04	0.03	**8.75**
12.5	0.19	0.10	0.06	0.04	0.05	0.05	0.06	0.04	0.04	0.04	0.04	**10.93**
16	0.16	0.20	0.18	0.07	0.11	0.10	0.17	0.08	0.16	0.10	0.13	**14.00**
20	0.77	0.99	0.88	0.62	1.35	0.91	1.74	0.53	0.76	0.73	0.69	**17.50**
25	2.57	3.35	4.95	1.91	4.22	2.99	2.92	1.58	3.13	2.92	3.27	**21.84**
31.5	4.52	7.24	6.84	3.47	8.61	5.31	7.76	3.02	6.92	5.31	6.31	**27.58**
40	5.43	7.59	6.53	4.52	6.92	6.10	7.59	4.79	6.53	6.46	6.53	**35.00**
50	3.80	5.01	4.47	3.24	4.22	2.92	3.89	3.55	4.22	3.63	4.42	**43.82**
63	2.32	2.21	2.72	2.26	2.85	2.16	2.79	2.57	2.24	2.37	2.40	**55.16**
80	1.97	1.55	1.62	1.64	1.53	1.64	1.45	1.68	1.51	1.64	1.55	**70.00**

The results in *Table 8* show that the vibration levels recorded were below the recommended limits of *BS 6472: 1992* at a reference distance of twenty (20) metres representing the closest envisaged proposed building facade/footing.

Vibration dose values were predicted for light rail operations, utilising the measured vibration levels, measurable duration of train movement of 20 seconds, 20m setback from rail line, and 12 trains per hour accounting for a total of 288 trains trips per day, and floor amplification factor of 2 when compared to the measured ground vibration levels. The calculations confirmed a VDV of 0.040m/s$^{1.75}$ and demonstrate that the predicted vibration dose is below the day and night values (*Table 4*) recommended by the *DECC, Assessing Vibration: a technical guideline*.

With respect to the main railway north of the site, ground vibration is not an issue considering the elevated nature of the railway, distance separation and intervening topography and has not been considered further.

3.3 Aircraft Noise

Reference to AS2021:2000, the calculation of maximum aircraft noise exposure levels requires the distance co-ordinates for the building site relative to the aerodrome runways to be established, which includes:

- the perpendicular distance from the proposed development to the extended runway centre-line (DS);
- the distance from the closer end of the relevant runway to the intersection of the extended runway centre-line and the perpendicular line passing through the proposed development (DL); and
- the distance from the further end of the relevant runway to the intersection of the runway centre-line and the perpendicular line passing through the proposed development (DT).

The relevant distance co-ordinates for Sydney Kingsford Smith Airport used in the calculation are outlined in *Table 9* below.

Table 9: Distance Co-ordinates of Site Relative to Airport Runways

Distance Co-ordinate	Distance (m)
Main Runway (16R/34L)	
DT	8500
DL	4280
DS	0*-1700

* 0 DS for take off only

Table 10 presents a summary of the predicted maximum aircraft noise levels from the main north/south runway (16R/34L) due to take-off and landing operations from different aircraft types.

Table 10: Predicted Maximum Aircraft Noise Level
dB(A) re 20 × 10^{-6} Pa

Aircraft Type	Predicted Maximum Aircraft Noise Level	
	Main Runway (16R/34L)	
	Take-off	Landing
Boeing 727	89	57
Boeing 747-400 (long)	89	61
Boeing 747 400 (short)	80	61
Boeing 737-300, Boeing 737-400, Airbus A320	74	54
Boeing 767 (long)	83	57
Boeing 767 (short)	77	57
British Aerospace BAe146	76	50
SAAB 340, Boeing Dash 8, Fokker F50	63	49
Corporate Jet	71	46
Light General Aviation Aircraft	69	48

Correspondence with Qantas has confirmed that Boeing 747-200B aircraft are no longer operated by Qantas or any other domestic carrier at Kingsford Smith Airport. There may be some freight operators that utilise these planes, however they are considered to be less than 1% of aircraft movements and therefore Boeing 747-200B aircraft were not considered further in this assessment. Based on the assessment procedures from AS2021:2000, maximum aircraft noise levels of up to 89dB(A) are predicted for a take-off of a Boeing 727, 747-400 aircraft on the main runway (16R/34L) assuming a zero sideline distance (direct flyover). A review of ANEF charts, FAC reporting and site observations confirm that direct flyovers from aircraft occur at the site. Studies by Airservices Australia confirmed that Airbus A380 aircraft are 6dB quieter on departure, and 2-4dB quieter on arrival, than Boeing 747-400 aircraft.

It should be noted that the maximum aircraft noise level for the site calculated in accordance with the Standard, is based on average maximum levels. Accordingly, aircraft noise events may exceed the derived maximum noise level.

4.0 ASSESSMENT

The assessment has considered potential noise impacts from road, rail and aircraft on the proposed development. This section of the report provides an assessment of the noise impacts, and noise reductions for building facades required in order to meet the specified noise goals.

4.1 Road Traffic Noise

Considering the noise measurement data and assuming building setbacks in the order of thirty (30) metres to Old Canterbury Road (south) and ten to fifteen (10-15) metres from the centreline of Smith Street (north), façade noise levels of $L_{Aeq,15hr}$ 65dB(A) and $L_{Aeq,9hr}$ 59dB(A) are calculated.

In order to satisfy the recommended project noise goals (*Section 2.2.1*) of $L_{Aeq,24hr}$ 40dB(A) (living areas) and $L_{Aeq,9hr}$ 35dB(A) (sleeping areas) would require the upgrading of glazing to building façades. Considering composite facades comprising masonry walls and glazed windows and doors, we anticipate, subject to final building design that single glazing installed within acoustic rated wind / door frames would be required subject to final internal finishes and area of windows / doors.

4.2 Rail Noise & Vibration

The noise and vibration assessment for the proposed development has considered the requirements of the NSW Department of Planning *'Development near Rail Corridors and Busy Roads – Interim Guideline' (2008)*.

4.2.1 Rail Traffic Noise

Site audit measurements conducted at the light rail operating between Central and Lilyfield at a reference distance of twenty (20) metres confirmed a predicted $L_{Aeq,1hr}$ noise level 54dB(A). Considering a nominal building facade noise reduction of 10-12dB(A) (with windows open for ventilation purposes), the

recommended internal noise goals of $L_{Aeq,24hr}$ 40dB(A) (living) and $L_{Aeq,9hr}$ 35dB(A) (sleeping) are exceeded. With the doors and windows closed, the assessment has shown that the recommended internal noise levels would be achieved with typical standard single glazed windows / doors.

A review of noise measurements conducted on the northern portion of the site (Location 2), taking into account potential for increased exposure to the rail lines to the north, has confirmed façade noise levels of $L_{Aeq,15hr}$ 68dB(A) (living) and $L_{Aeq,9hr}$ 62dB(A) (sleeping). Considering a nominal building facade noise reduction of 10-12dB(A) (with windows open for ventilation purposes), the recommended internal noise goals of $L_{Aeq,24hr}$ 40dB(A) (living) and $L_{Aeq,9hr}$ 35dB(A) (sleeping) are exceeded. To achieve the internal design noise levels would require acoustic upgrading of the glazing proposed for the building façades. Considering envisaged composite facades we would anticipate that the internal design noise levels would be satisfied with the incorporation single panes of safety or laminated glass installed with acoustic rated frames with perimeter acoustic seals subject to final internal finishes and area of windows / doors.

4.2.2 Rail Traffic Ground Vibration

Site measurements conducted at an equivalent site, to represent potential light rail activities confirmed that the 'at grade' ground vibration levels at the a reference distance of 20 metres from the rail alignment, adjacent the Central to Lilyfield line, satisfied the recommended levels contained within *DECCW*, *Assessing Vibration: a technical guideline* in terms of a vibration dose value (VDV) and assessment of human comfort.

4.3 Aircraft Noise

Predicted aircraft noise levels were established from the procedures of AS2021-2000 and presented in *Section 3.3*. Review of the site noise measurements confirmed average maximum noise levels in the order of 80-89dB(A).

Taking into account the internal design noise goals of AS2021-2000 and envisaged composite façade, the assessment has identified that the glazing within the buildings would require to be upgraded in order to achieve the internal design noise goals.

In order to achieve the internal design noise levels of AS2021-2000 for the various components of the concept plan, will require a range of upgraded glazing options ranging from single glazing, safety/laminated glass to double glazed or alternate high performance systems. In terms of the areas of the concept plan that require greater acoustic performance, such as bedrooms and living spaces to residential areas, the option of enclosed (louvred) balconies / terraces / loggias may be considered.

5.0 RECOMMENDATIONS

The following conceptual controls are presented for the purpose of evaluating minimum building requirements for residential and commercial development within the Summer Hill site, for the purpose of addressing road, rail and aircraft noise intrusion. Finalisation of the controls would be dependent on the architectural design, location of windows/doors and detailed during design development and submitted with the Construction Certificate application.

5.1 Building Noise Controls

The $L_{Aeq,T}$ road and rail noise levels (*Section 3.1 & 3.2*) and predicted maximum aircraft noise levels (*Section 3.3*) have shown that noise control treatments are required. To control internal noise levels in the proposed development it has been assumed that doors and windows would be closed. It has been demonstrated that noise from aircraft is the controlling factor in the determination of façade noise controls for the development. Providing the required façade treatment is incorporated into the development to address aircraft noise, noise impacts from rail and road traffic would also be ameliorated.

The following descriptions and materials are provided as a guide for typical constructions required.

5.1.1 External Walls

Nominally of masonry construction for example: cavity brick consisting of two (2) leaves of 110mm brick with a 30-50mm cavity, precast concrete panels or existing in-situ masonry construction associated with the retained heritage structures and silos **Rw 50-60**

5.1.2 Window/Door Glazing

Subject to final architectural design, windows/doors incorporated into the development would range from single glazing, safety/laminated glass to double

glazed or alternate high performance systems in order to satisfy the project noise goals. For areas that require greater acoustic performance, such as bedrooms and living spaces to residential areas, the option of enclosed (louvred) balconies or loggias may be considered.

With respect to specific acoustic performance for windows/doors in various components of the concept plan, a detailed acoustic review and specification required would be prepared during the design development and submitted with the Construction certificate documentation.

Glazing for shops, supermarkets and showrooms would be at the discretion of the architect, as high acoustic performance is not required.

5.1.3 Additional Acoustic Requirements

All joints and interfaces between elements of construction should be detailed to reduce flanking (leaking) noise through "tight" jointing and sealing/caulking with non-hardening mastic materials.

In order to provide the required noise reductions, and satisfy internal design noise goals, windows/doors would need to be closed. Accordingly, alternative ventilation would be required. The alternative ventilation options should take into account noise control requirements, to ensure that acoustic performance of the building facades are not de-rated.

5.2 Acoustic Privacy

This report is to support a Concept Plan for the Summer Hill Flour Mill site and detailed architectural design drawings have not been prepared at this stage. However *Section 2.4* has outlined the acoustic requirements of *Part F5* of the *BCA* that would be considered during detailed design development for the precinct, and provided with the Construction Certificate documentation.

5.3 Noise Amenity

The Concept Plan for the Summer Hill Flour Mill site proposes to incorporate residential and commercial uses. There is the potential for a loss of noise amenity, if not carefully considered during the detailed design process.

Accordingly this report has recommended consideration of the noise assessment requirements as documented in the *DECCW, Noise Guide for Local Government*, to ensure that any future commercial uses are designed and managed to satisfy appropriate noise goals.

In addition, should the precinct incorporate licensed premises, the noise requirements of the *Office of Liquor, Gaming and Racing* would need to be considered. Where practical, the Concept Plan should provide separation between conflicting commercial / retail / restaurant areas, from adjacent residential areas, in order to optimise flexibility and reduce the need for ameliorative measures.

6.0 CONCLUSION

An assessment has been conducted to assess the exposure of the Summer Hill Flour Mill Concept Plan to noise and vibration associated with road, rail and aircraft traffic. In addition the assessment has considered, and recommended procedures to address 'acoustic privacy' and 'noise amenity'.

The assessment has utilised attended measurements and unattended measurements, and considered the *NSW Department of Planning – Director-Generals Requirements* (DGR's) including: *NSW Department of Planning 'Development Near Rail Corridors and Busy Roads – Interim Guideline'*, *DECCW*, *Assessing Vibration: a technical guideline* and Australian Standard AS2021:2000 '*Acoustics – Acoustics – Aircraft Noise Intrusion – Building Siting and Construction*'.

Based on site measurements, the assessment has shown that building treatments would be required to address road, rail and aircraft noise intrusion. The determining factor in façade treatments in order to meet internal design noise levels for residential and commercial components of the Concept Plan, is amelioration of aircraft noise. With effective incorporation of façade treatment to address aircraft noise impacts, the assessment has shown that noise from road and rail noise would be addressed.

The report presents conceptual details of building works that would be required to achieve the indoor sound levels recommended with windows and doors closed. Building noise controls would be reviewed and detailed when building designs have been confirmed and details submitted to Council or approving authority with the Construction Certificate documentation.

Ground vibration measurements were conducted of light rail activities at a location considered representative of the future configuration of the light rail adjacent to the Summer Hill Flour Mill site. The results of the measurements and calculations

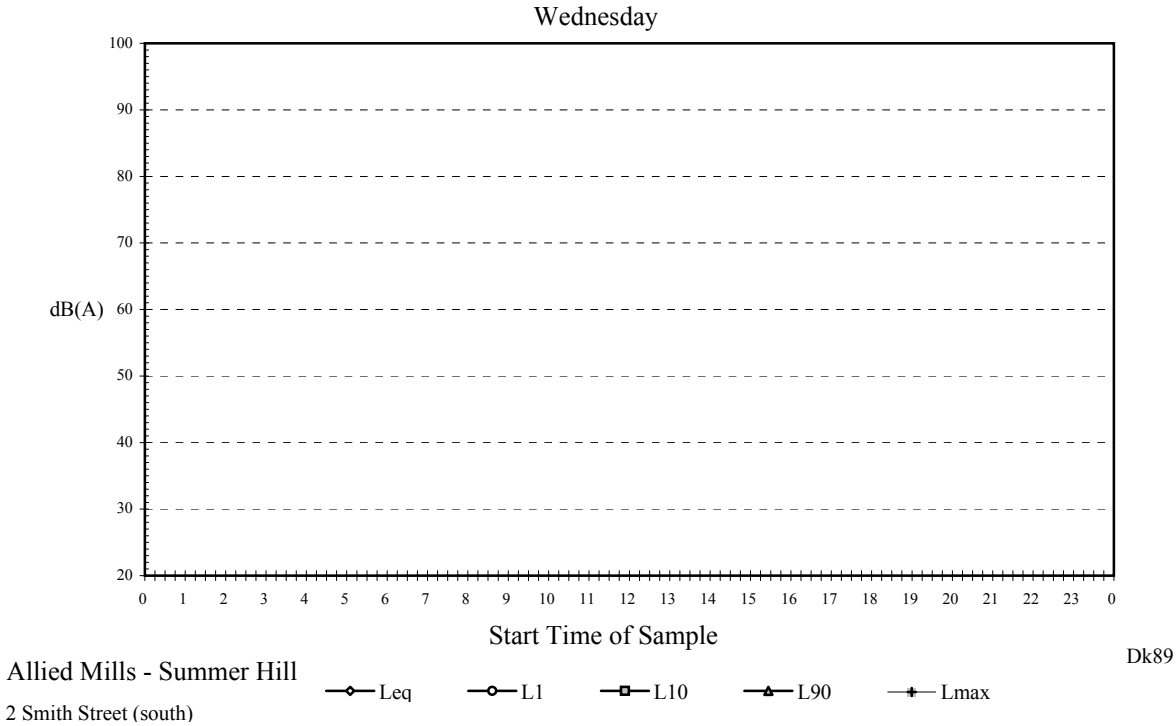
confirm that ground vibration satisfies the recommended levels contained within *DECCW*, *Assessing Vibration: a technical guideline* in terms of a vibration dose value (VDV) and assessment of human comfort.

APPENDIX 1: SITE CONCEPT PLAN – Measurement Locations

○ **Noise Measurement Locations**

APPENDIX 2: AMBIENT SOUND PRESSURE LEVEL MEASUREMENTS

Ambient Sound Pressure Levels



Allied Mills - Summer Hill

2 Smith Street (south)

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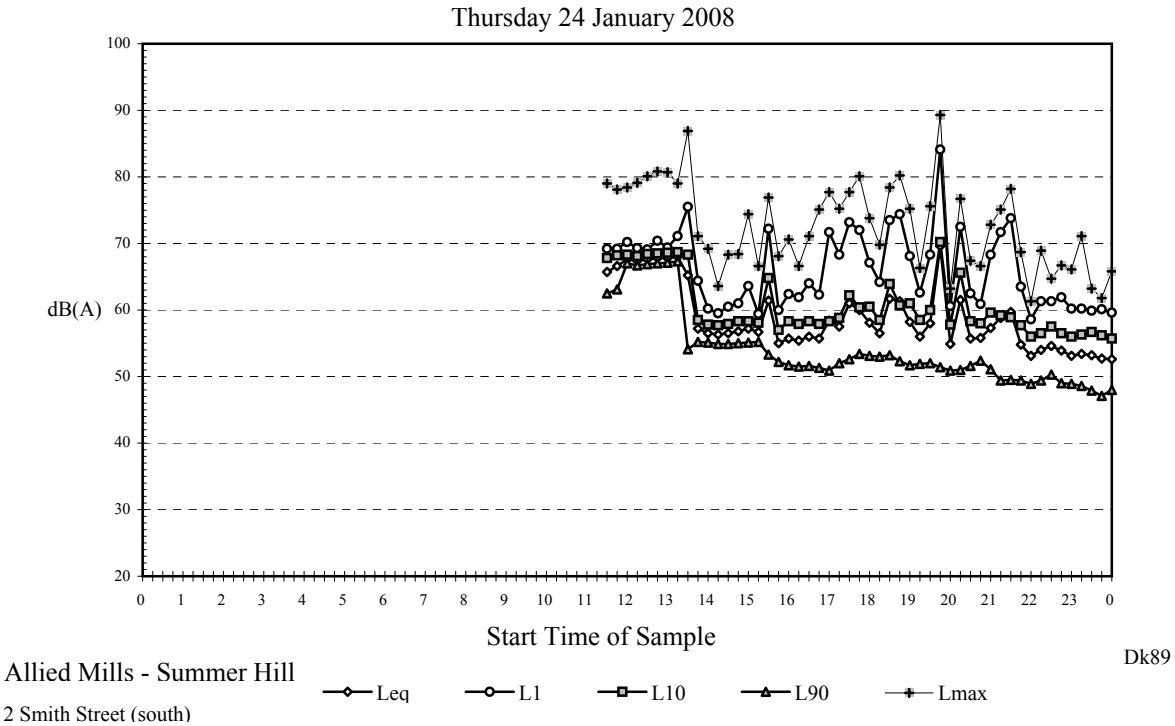

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2 Smith Street (south)

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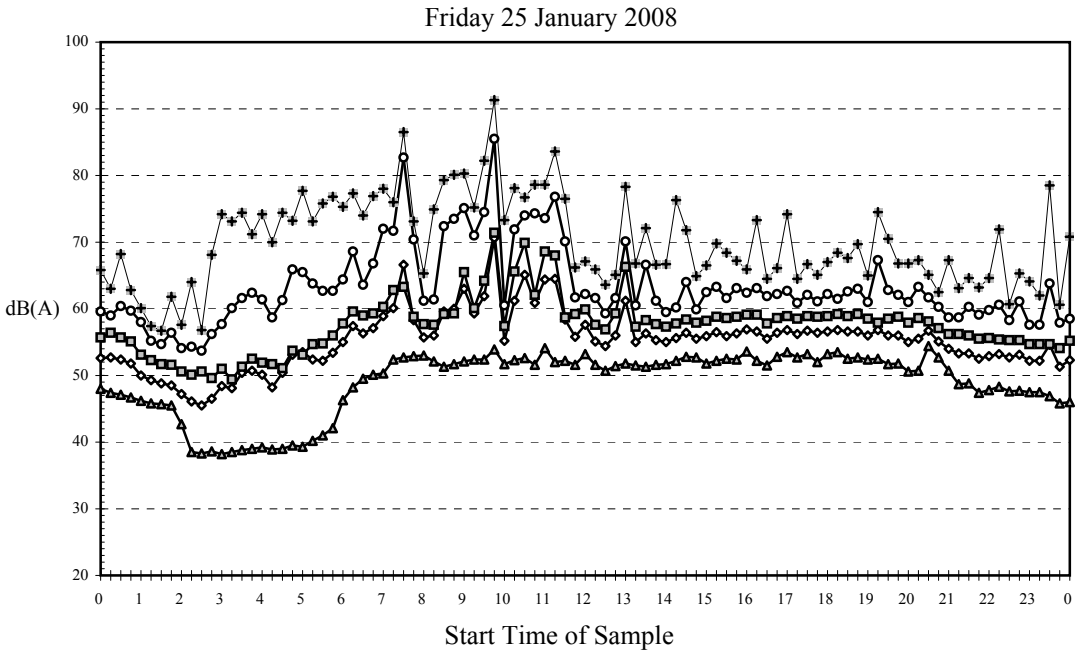
Ambient Sound Pressure Levels



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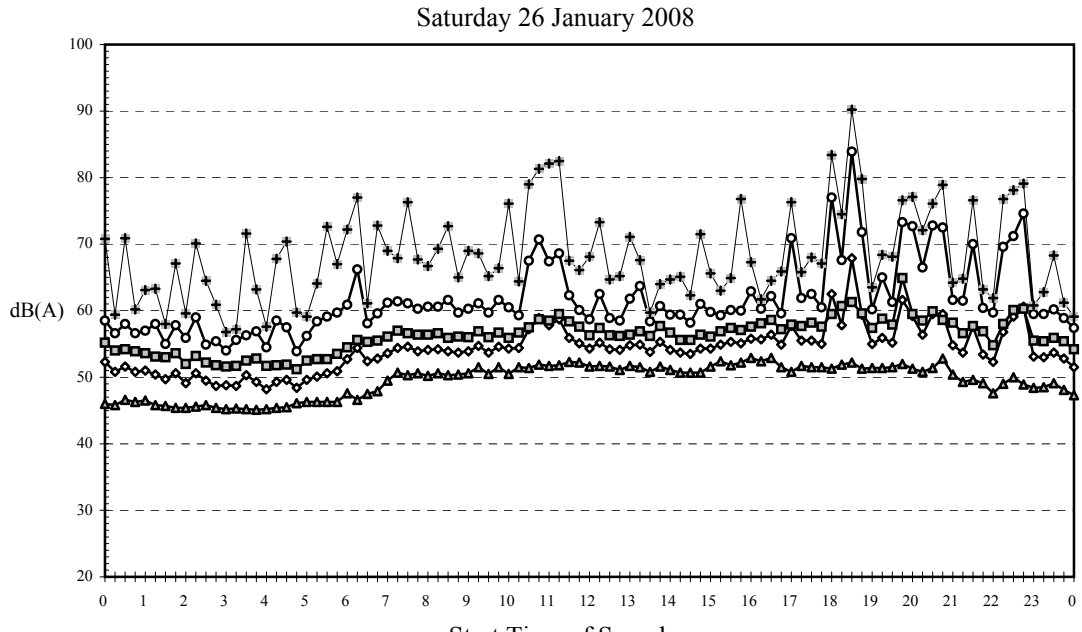

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Allied Mills - Summer Hill

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2 Smith Street (south)

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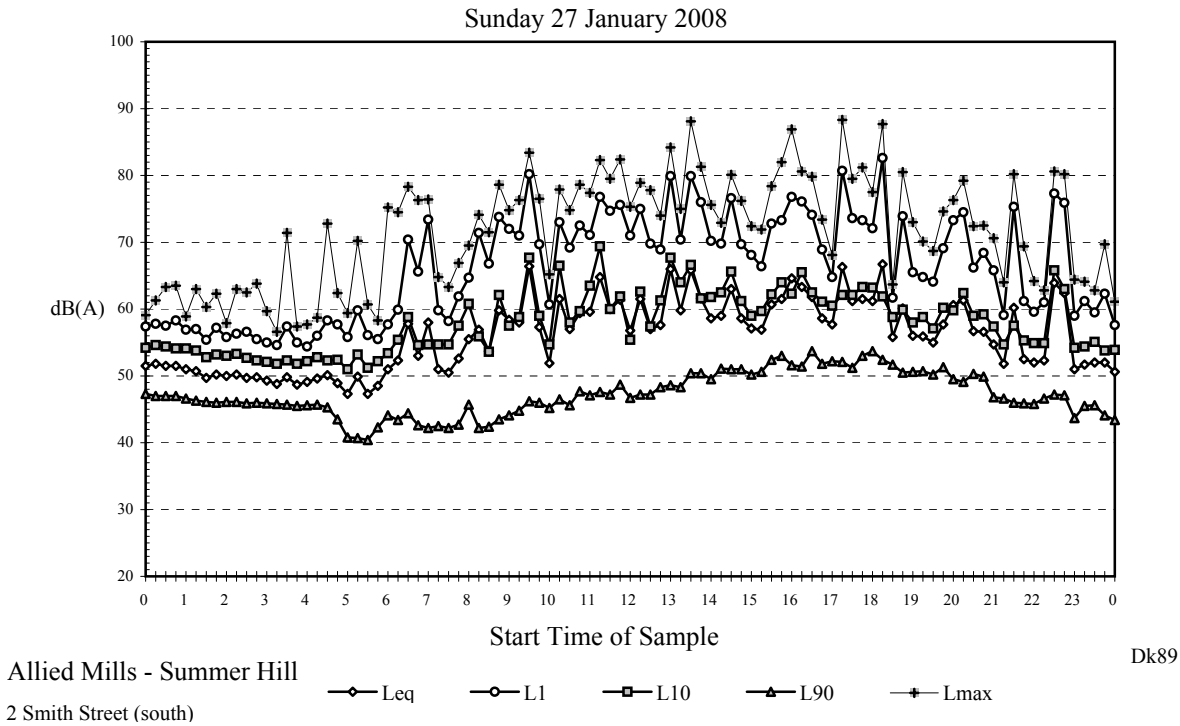

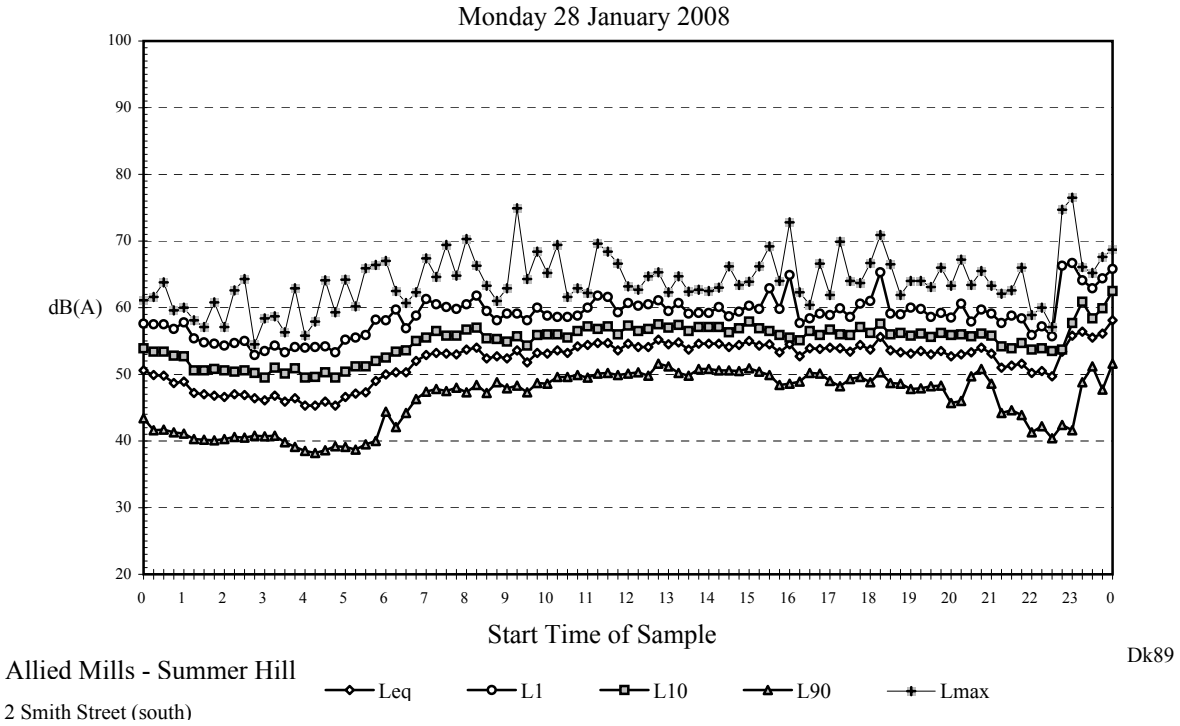

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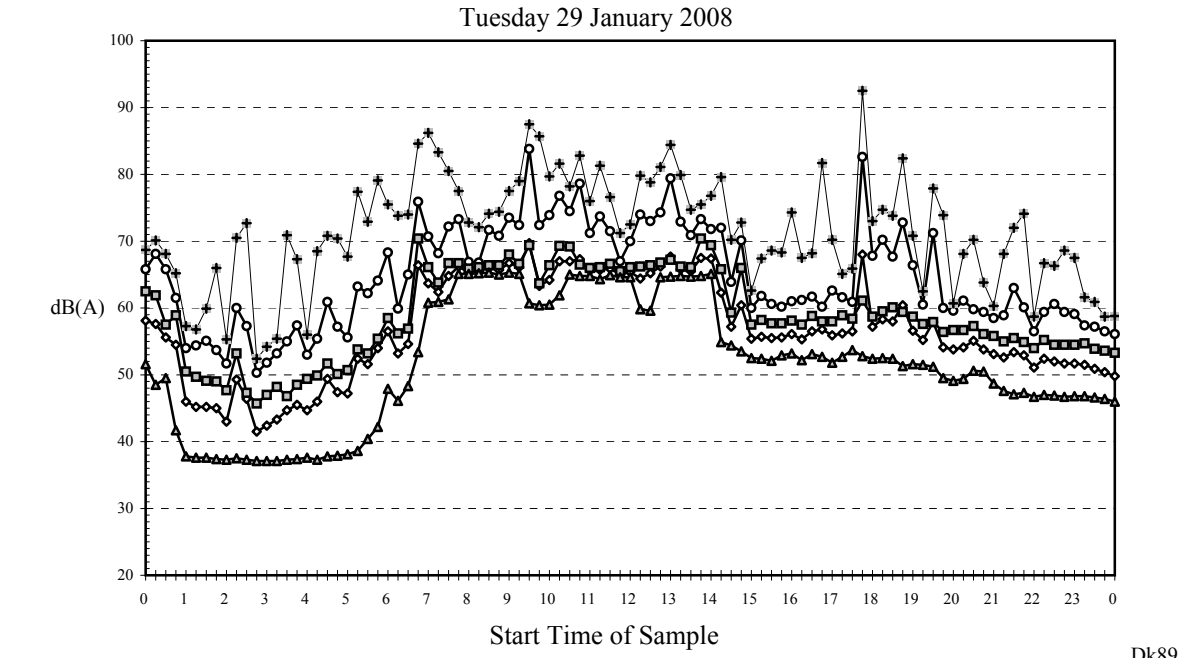

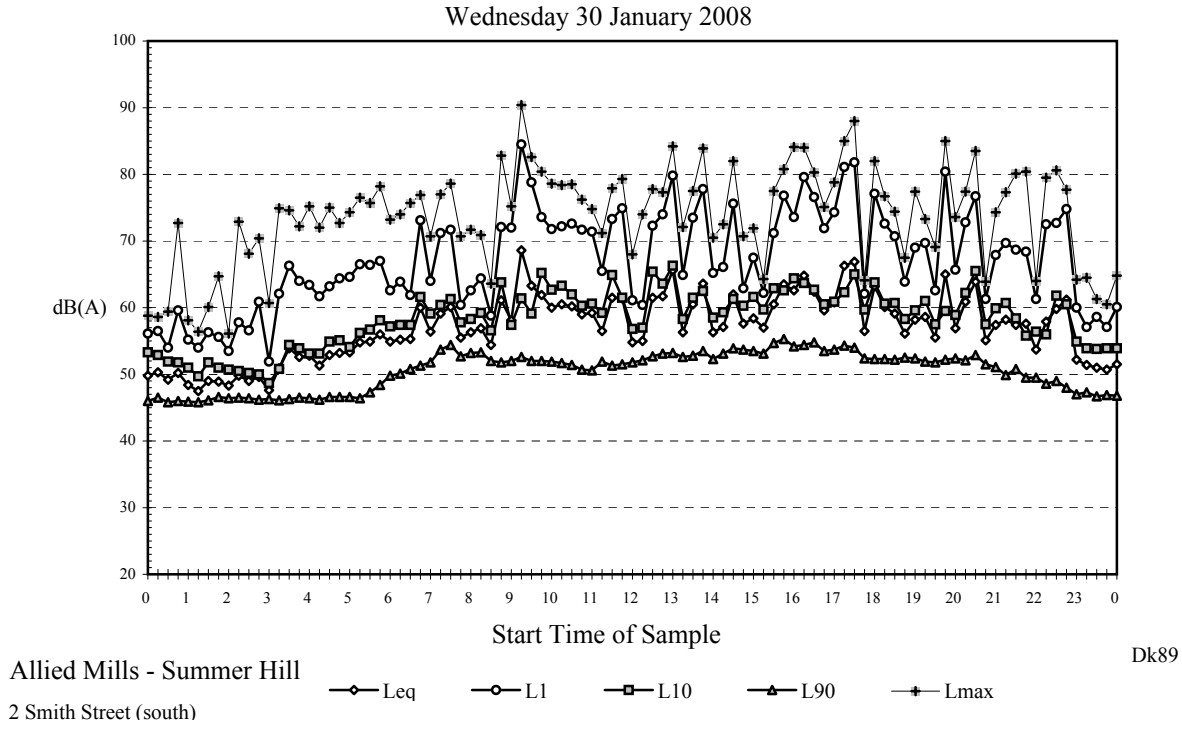

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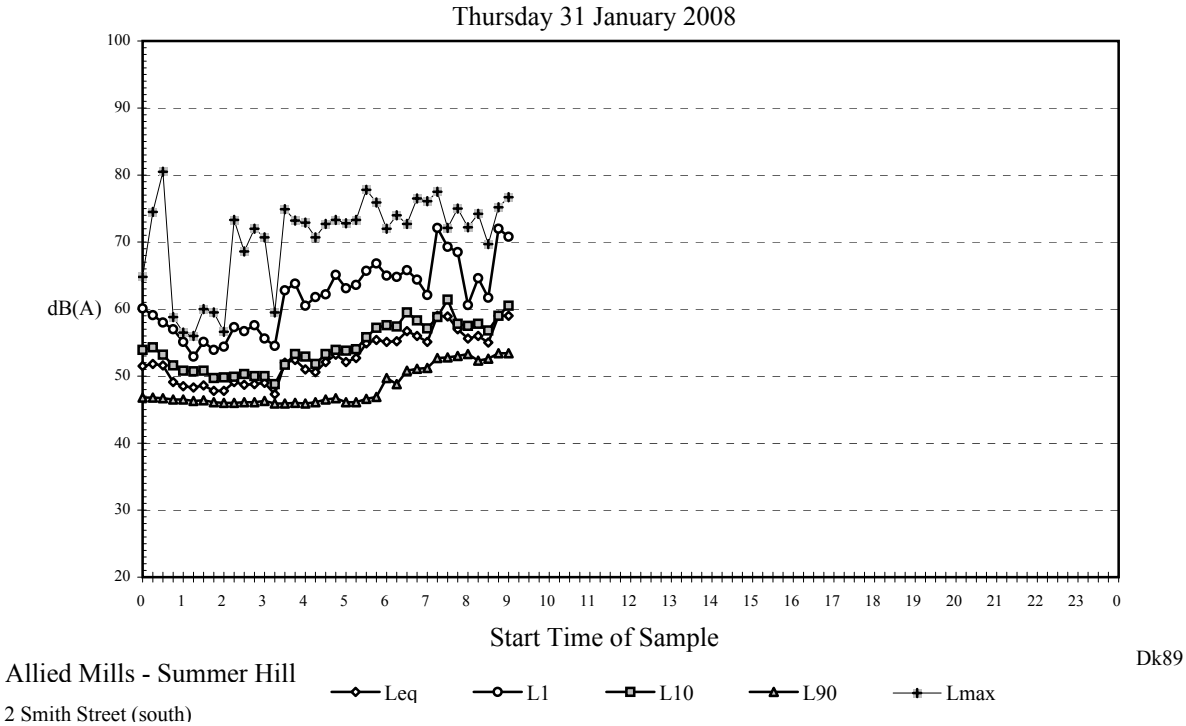

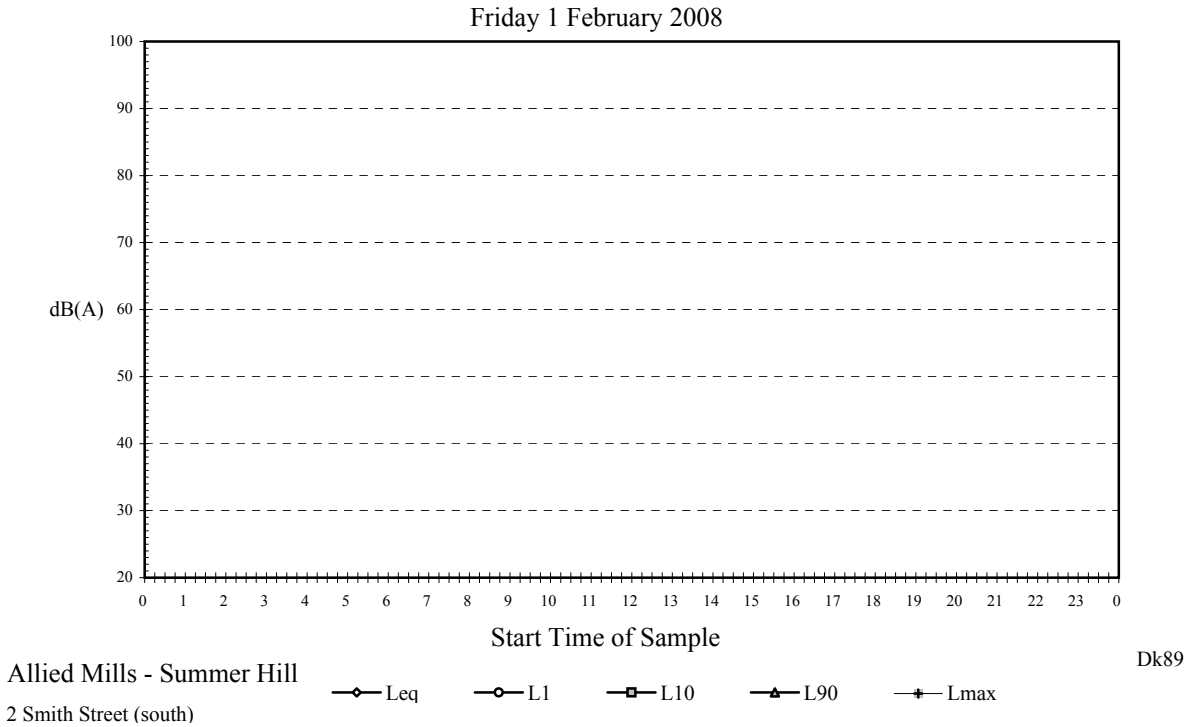

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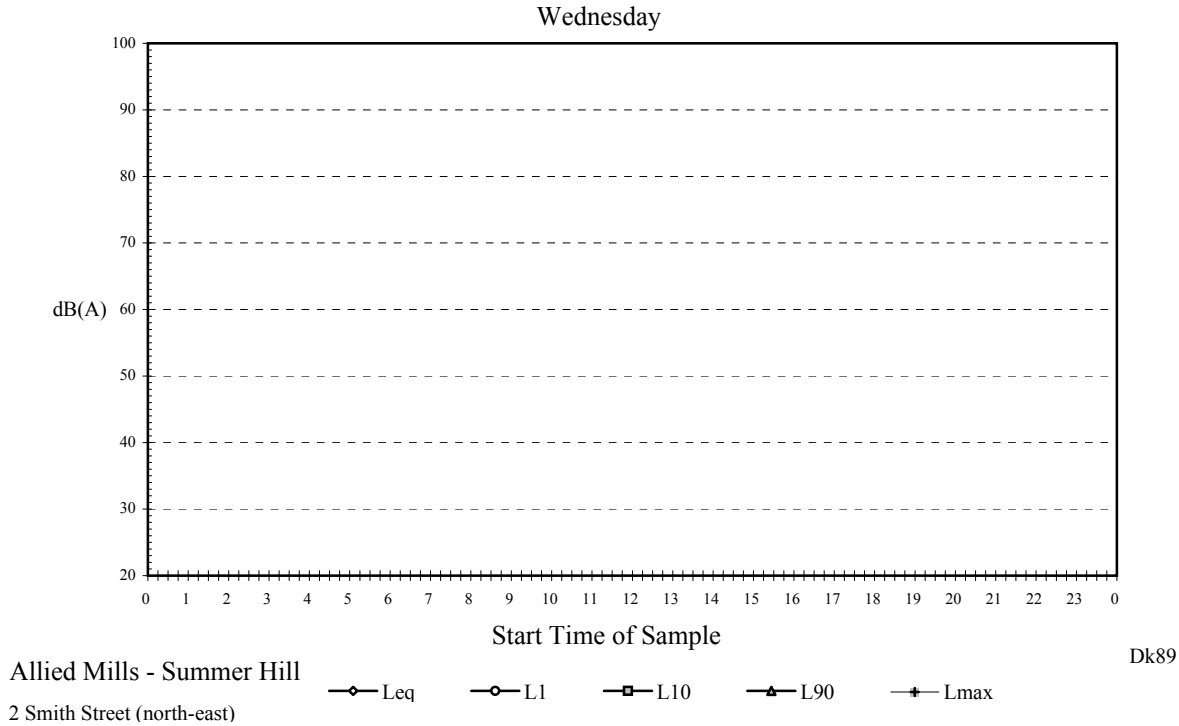

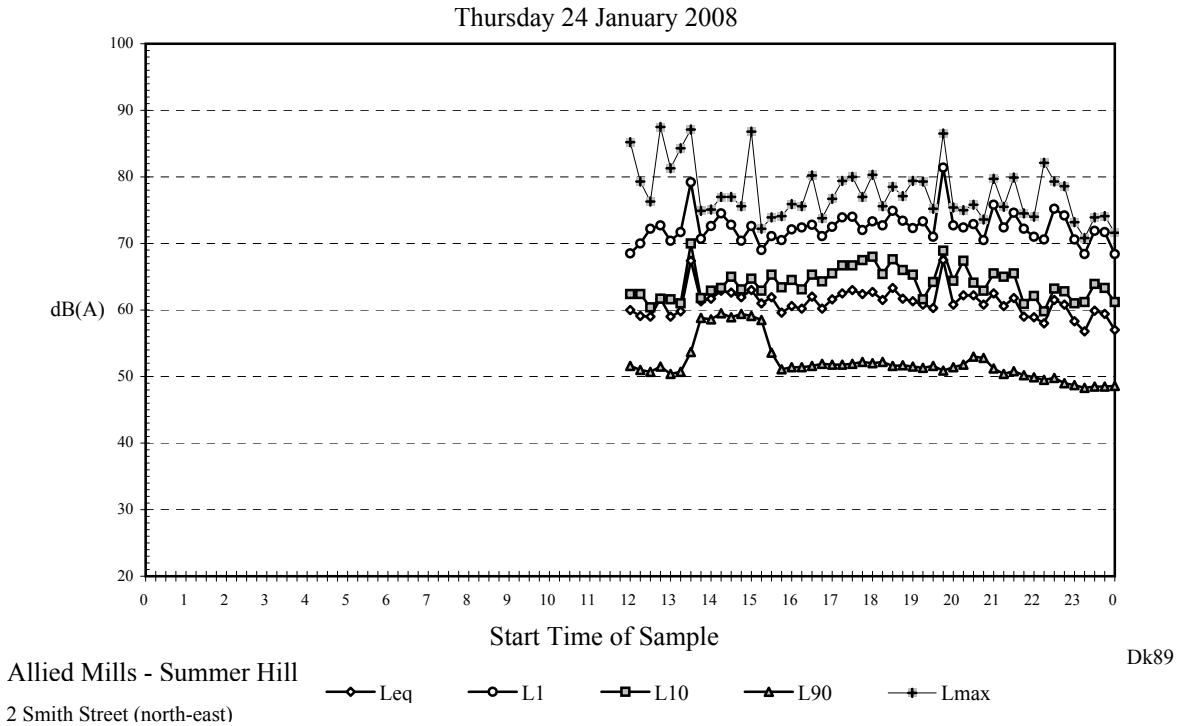

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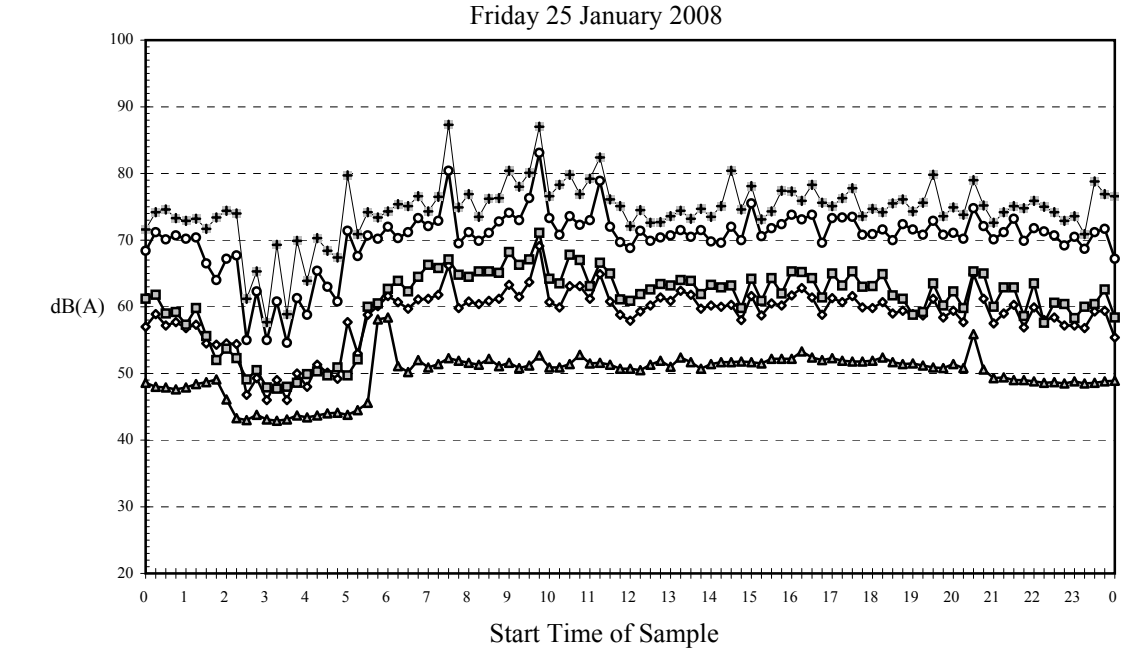

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Allied Mills - Summer Hill

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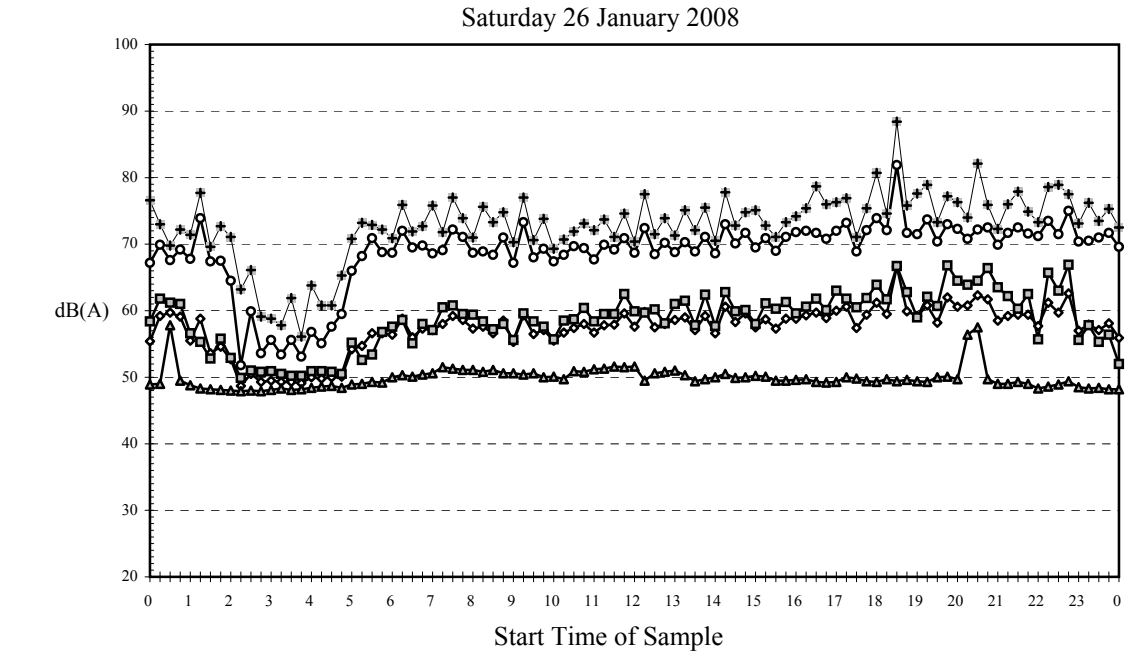

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Allied Mills - Summer Hill

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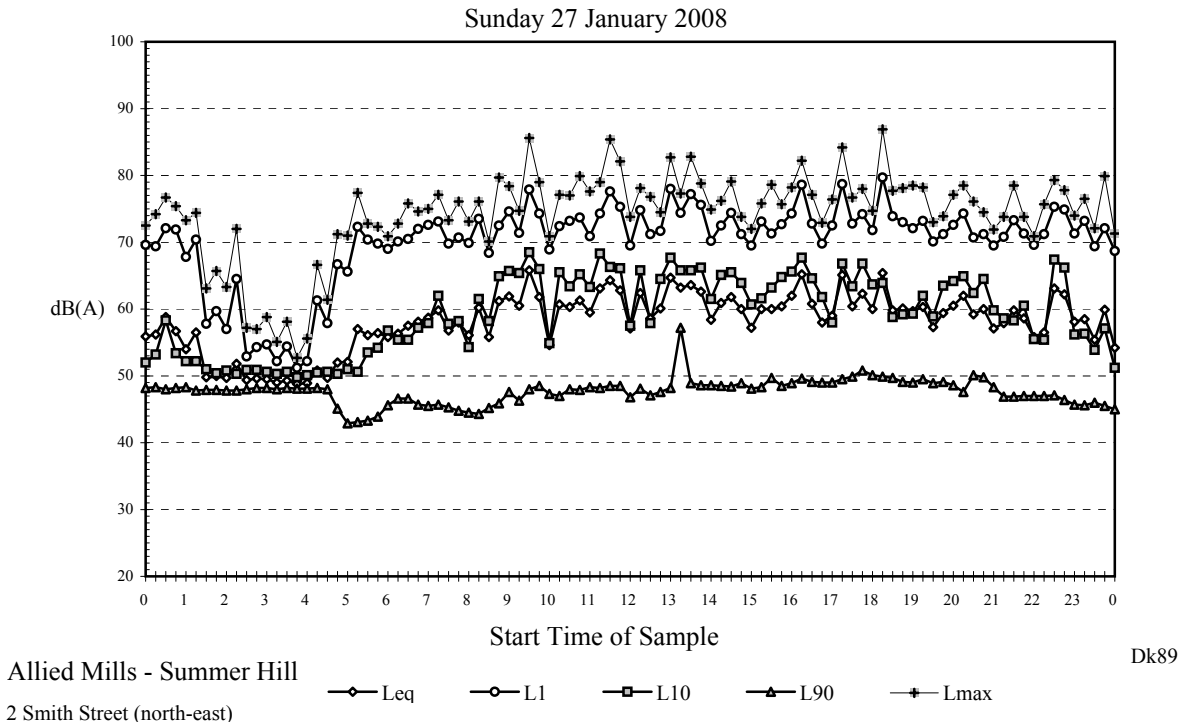
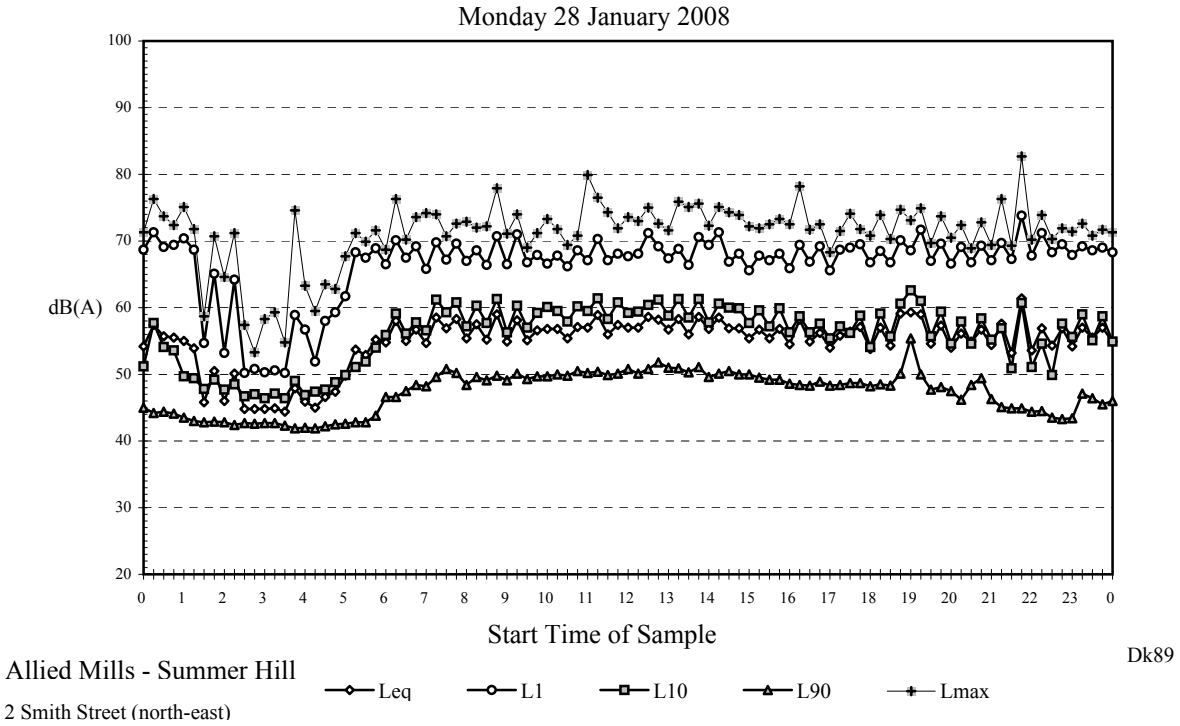
2 Smith Street (north-east)

Ambient Sound Pressure Levels





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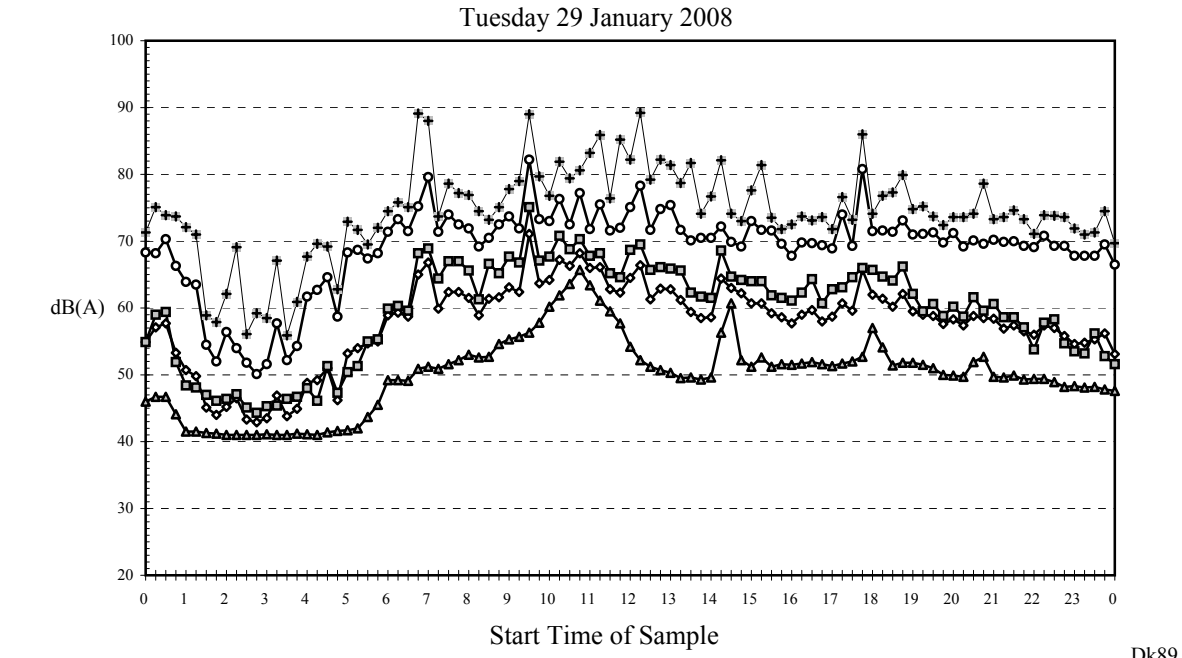

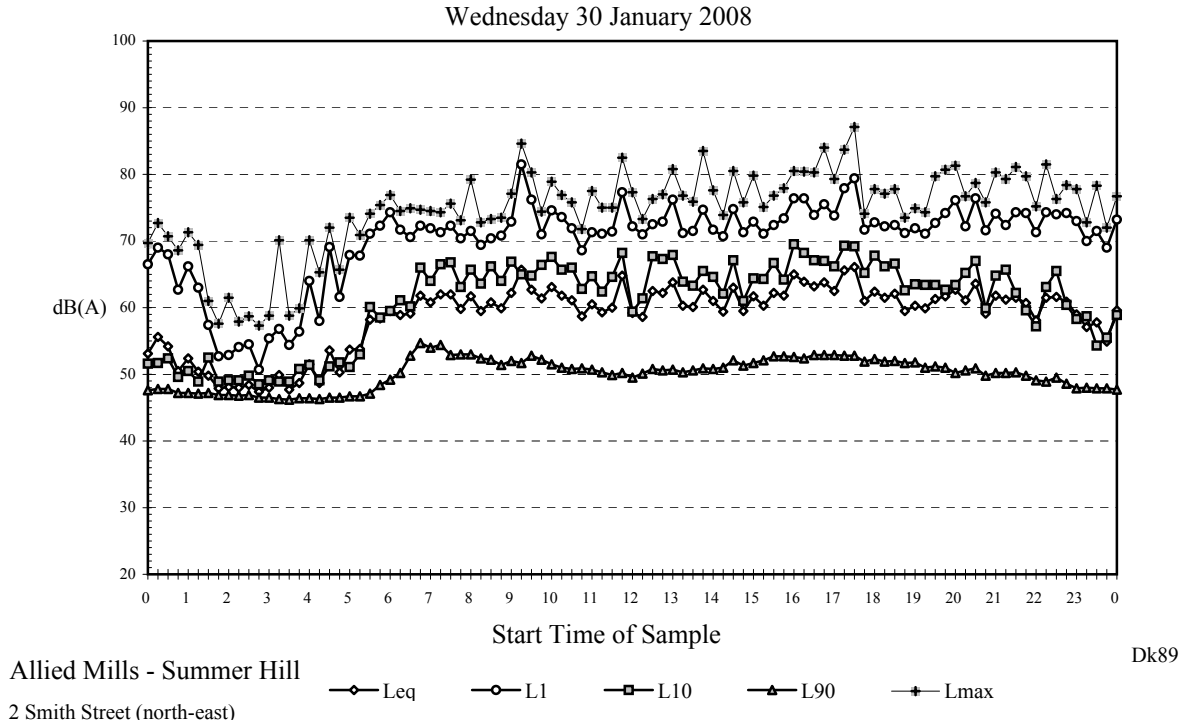

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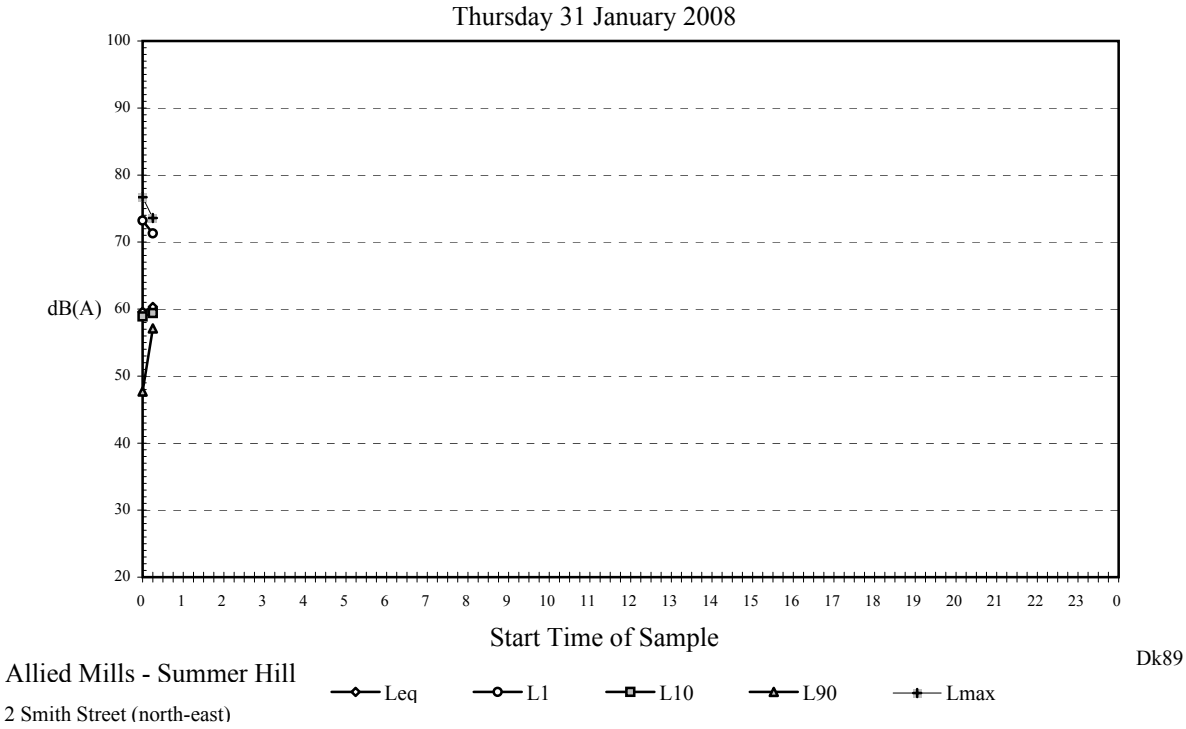

Allied Mills - Summer Hill

2 Smith Street (north-east)

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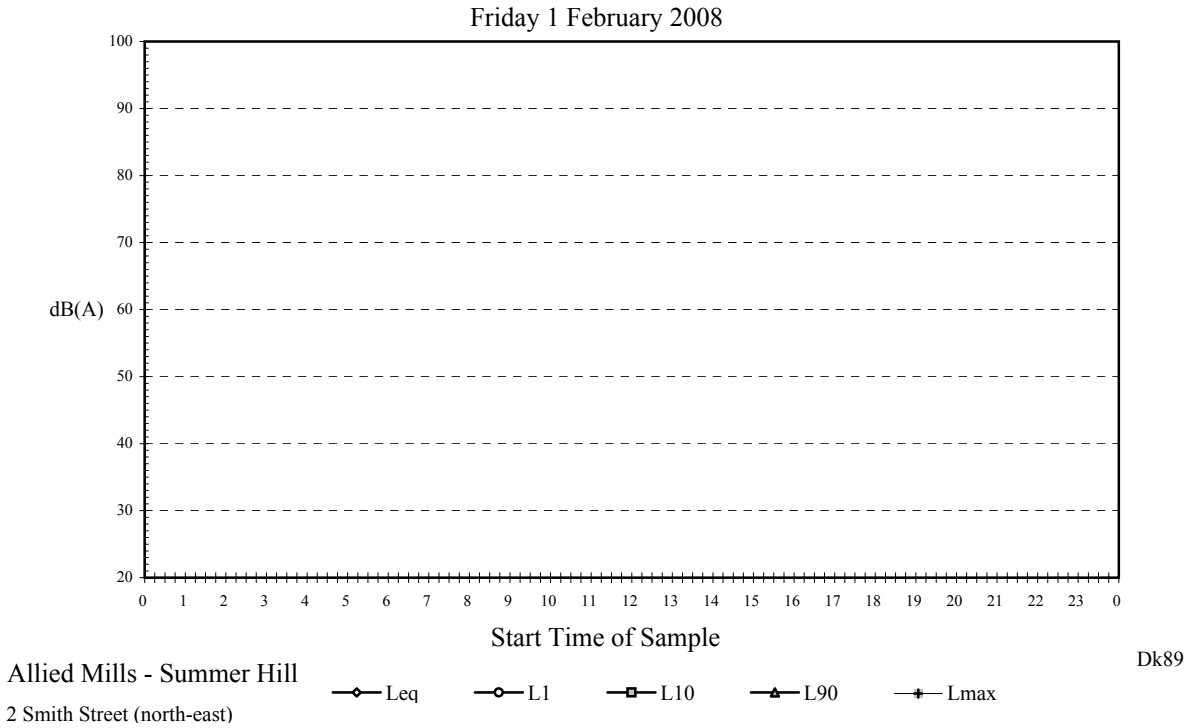

Allied Mills - Summer Hill

2 Smith Street (north-east)

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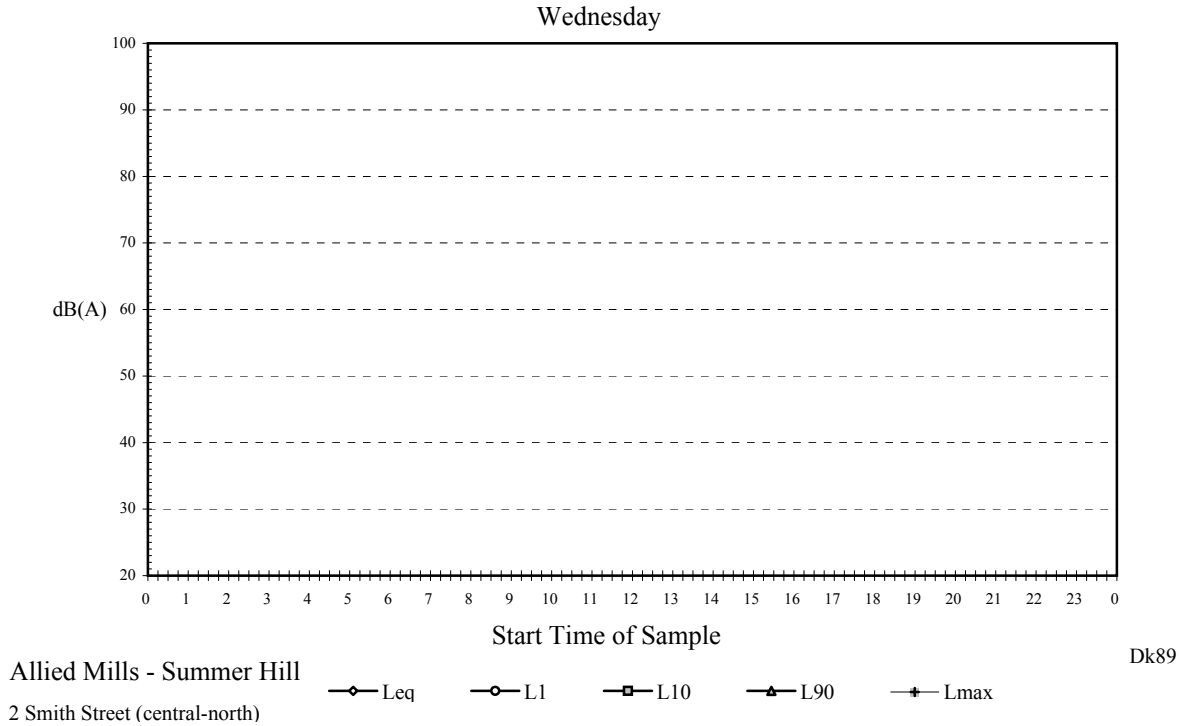

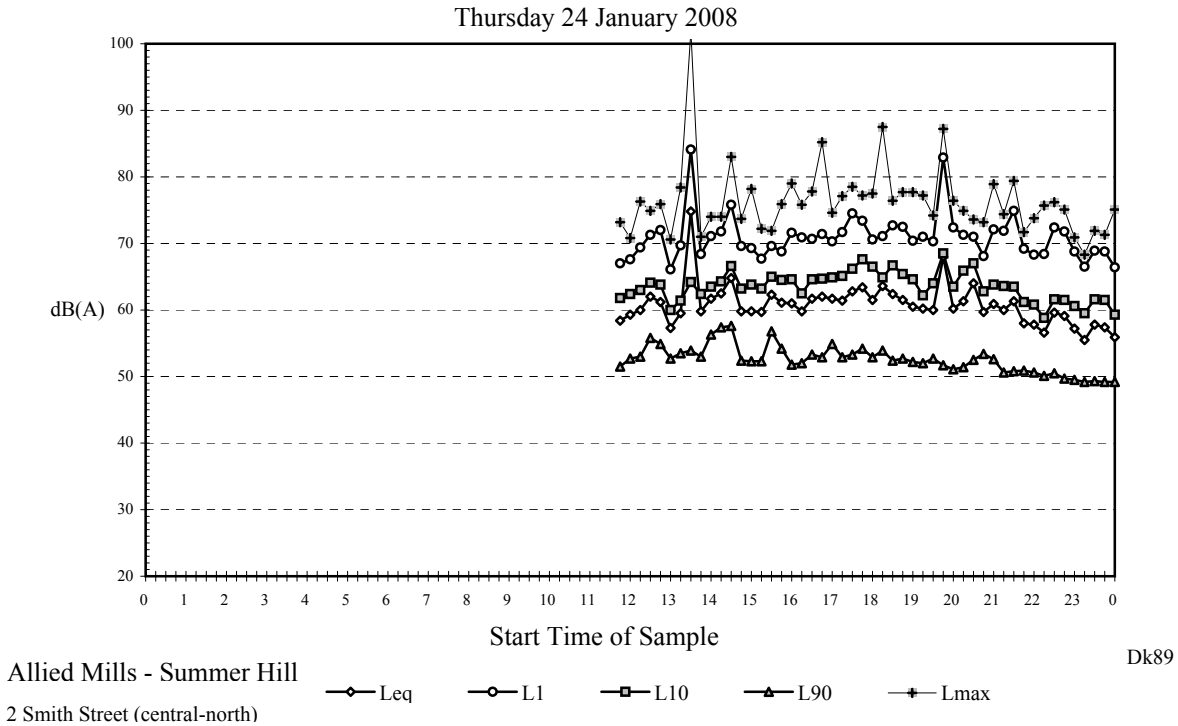

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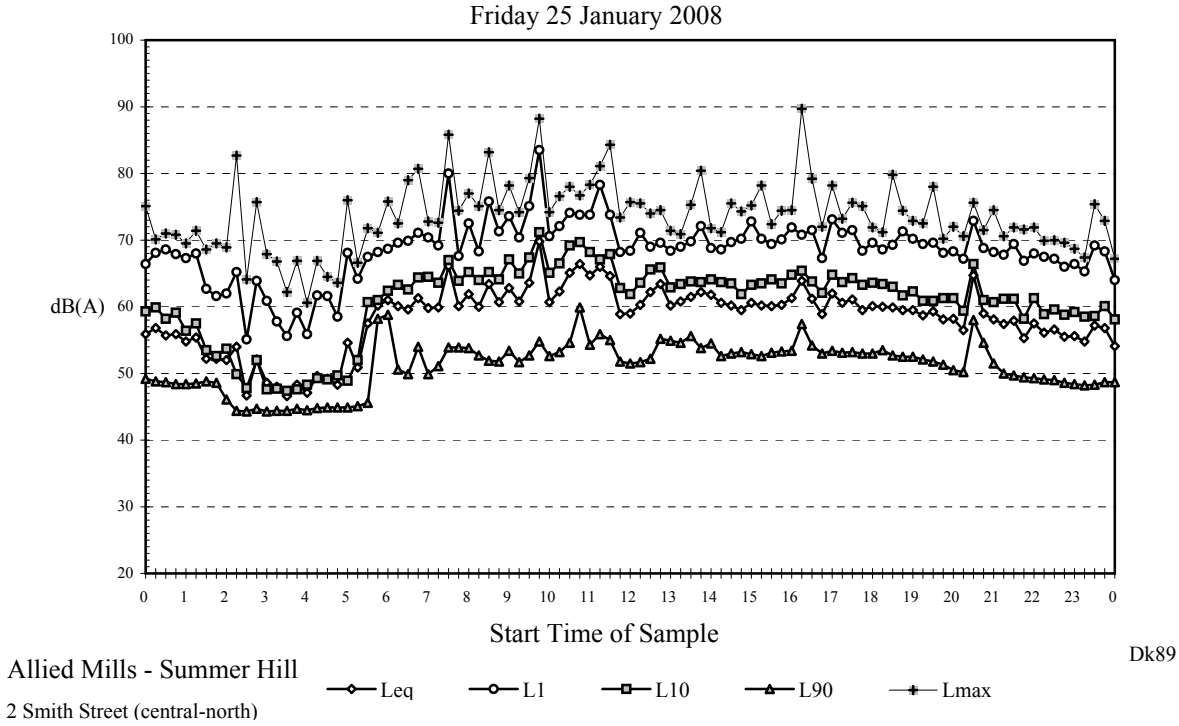

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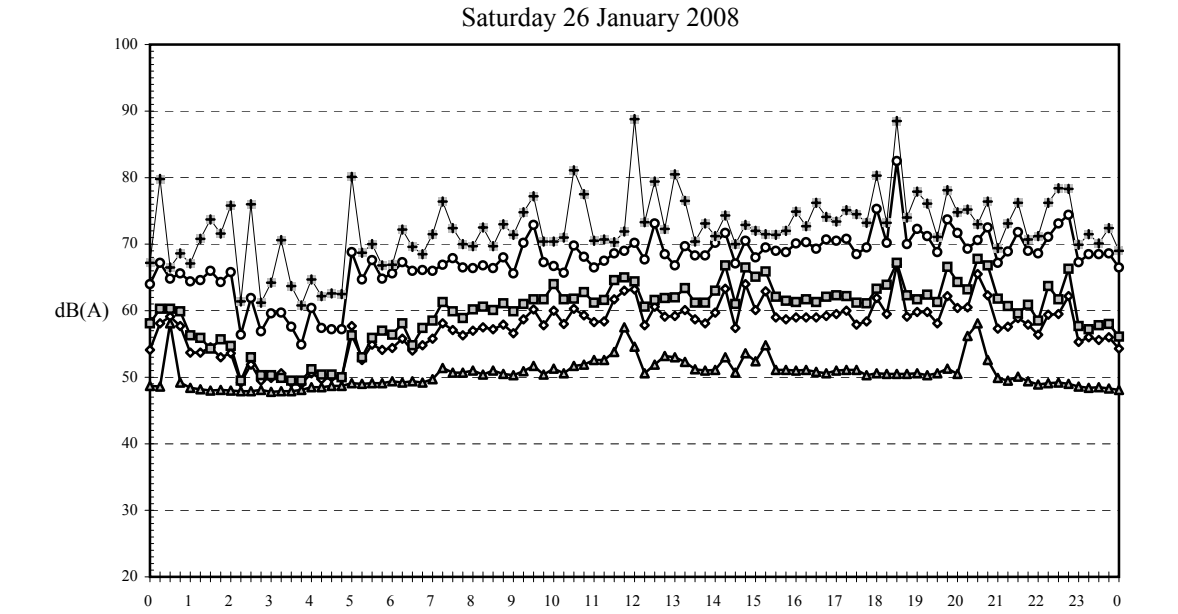
Allied Mills - Summer Hill

Leq L1 L10 L90 Lmax

2 Smith Street (central-north)



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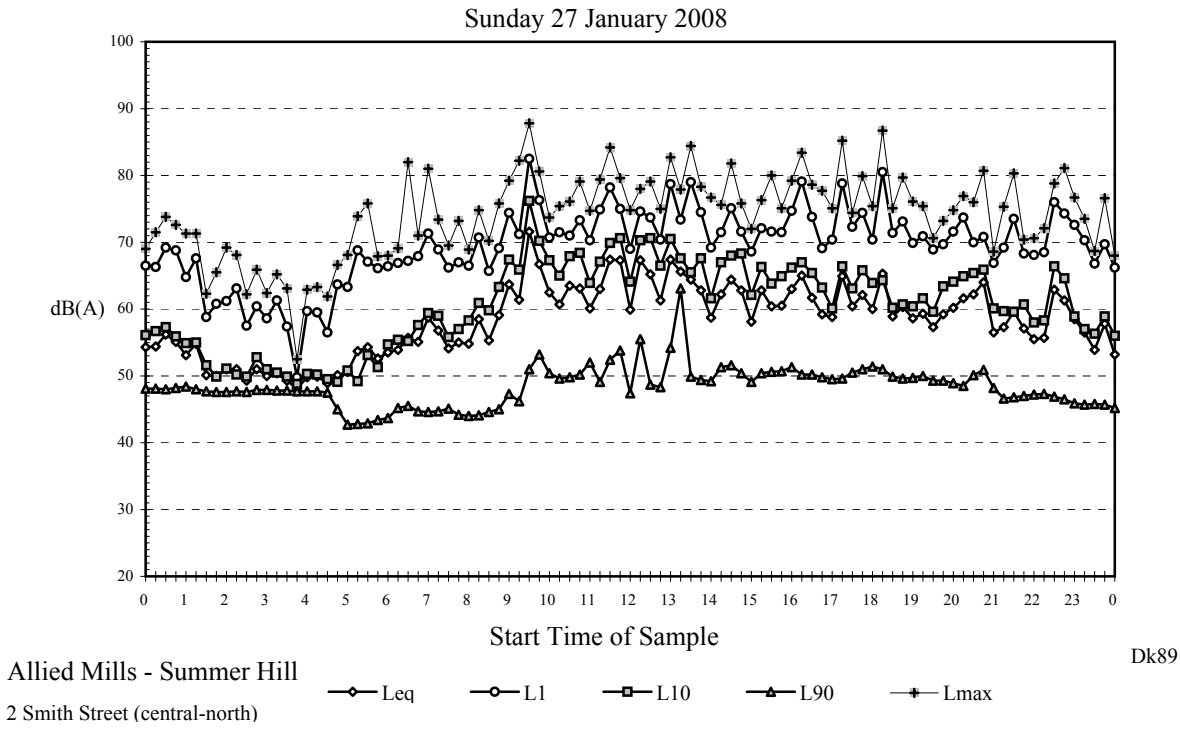
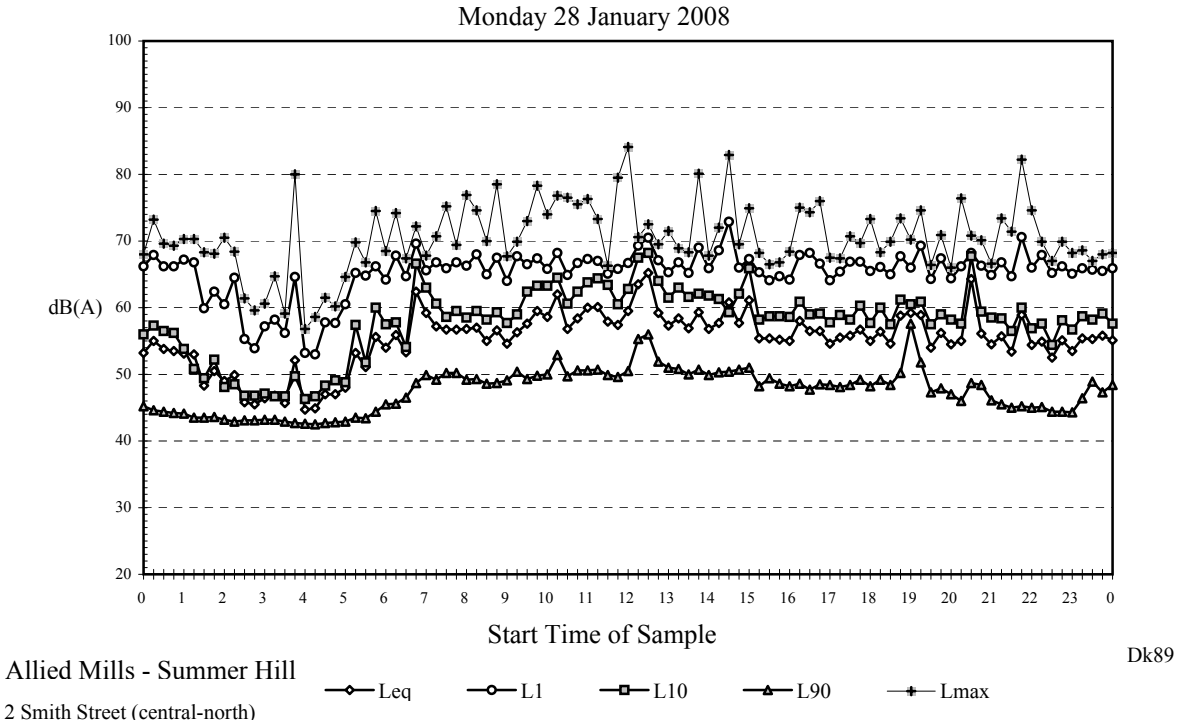
Allied Mills - Summer Hill

Leq L1 L10 L90 Lmax

2 Smith Street (central-north)

Ambient Sound Pressure Levels





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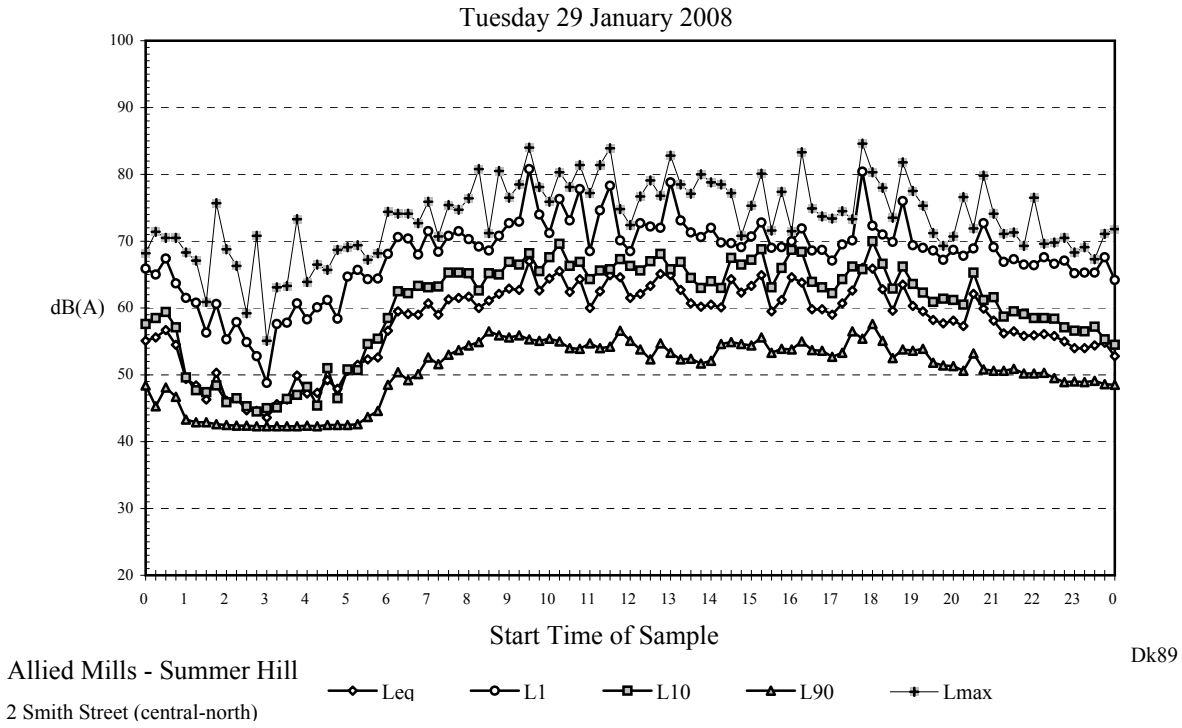

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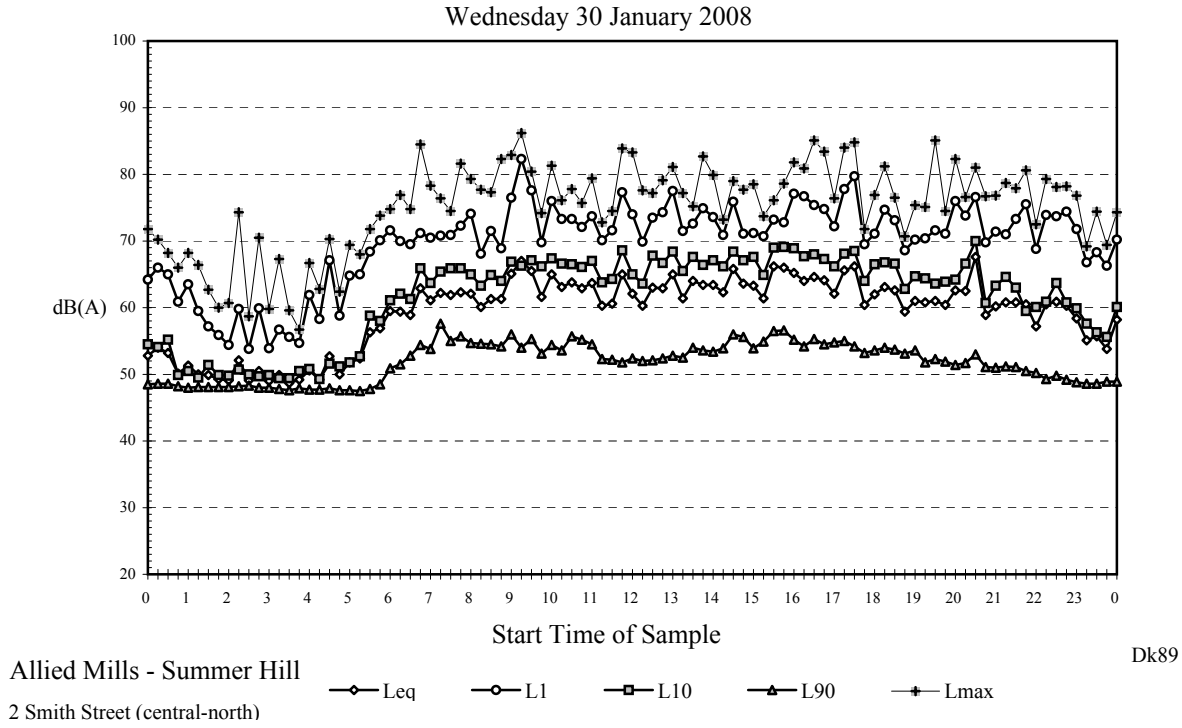
Allied Mills - Summer Hill

2 Smith Street (central-north)



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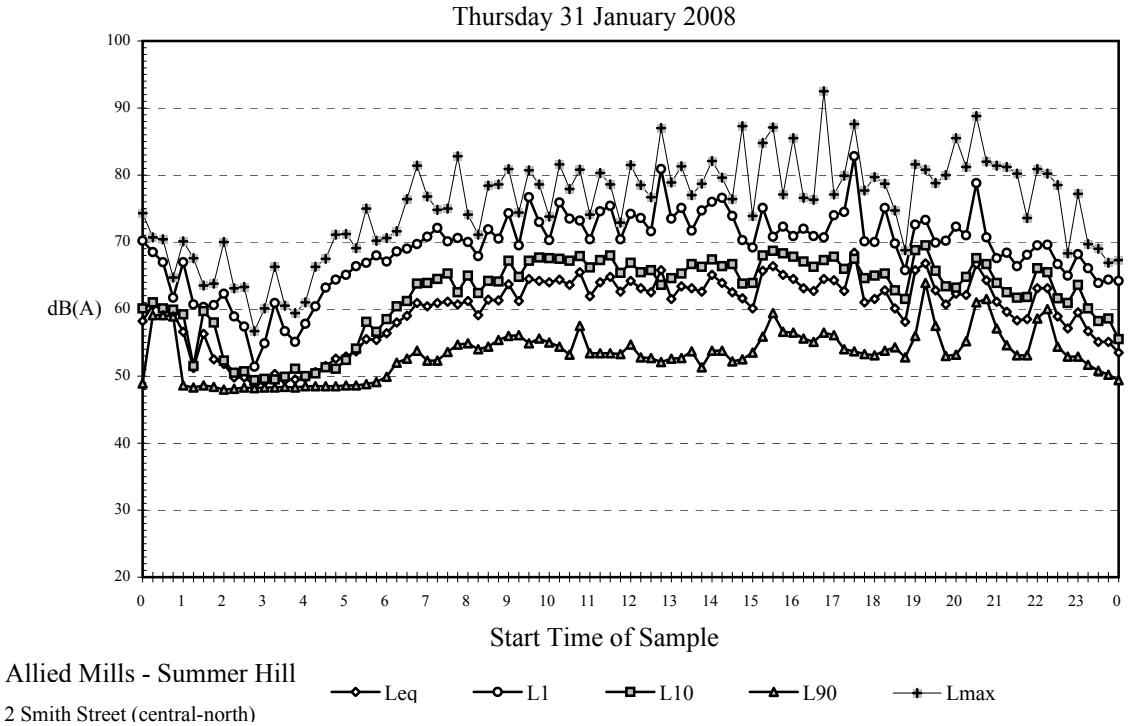
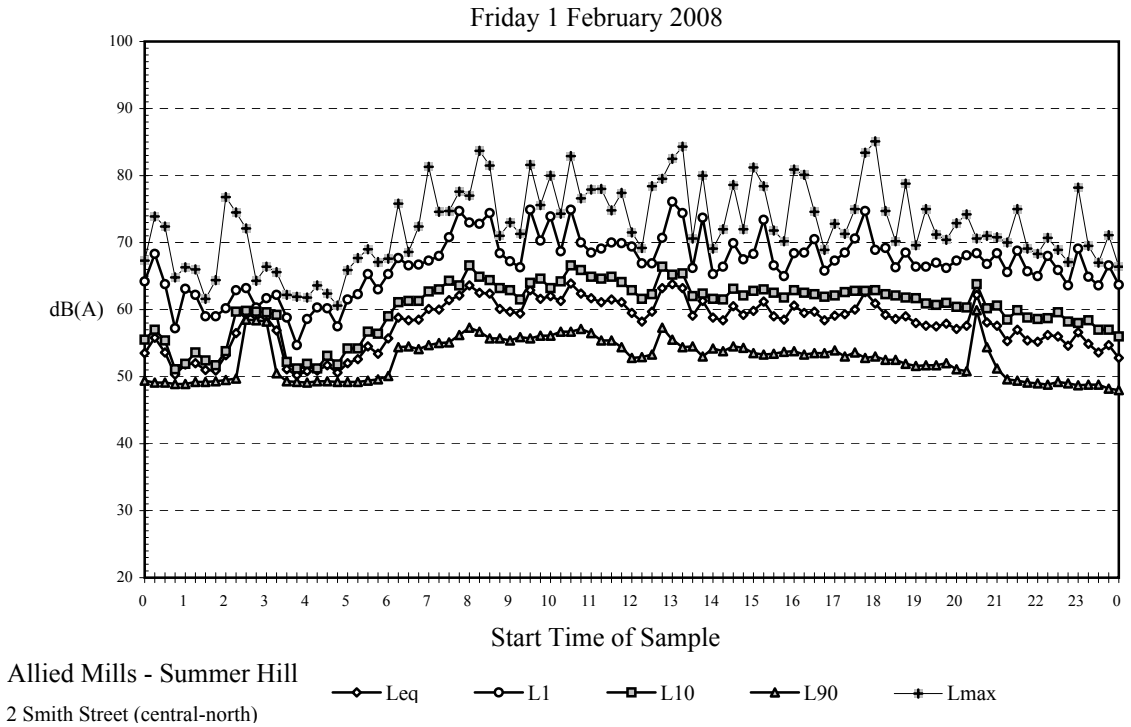
Allied Mills - Summer Hill

2 Smith Street (central-north)

Ambient Sound Pressure Levels





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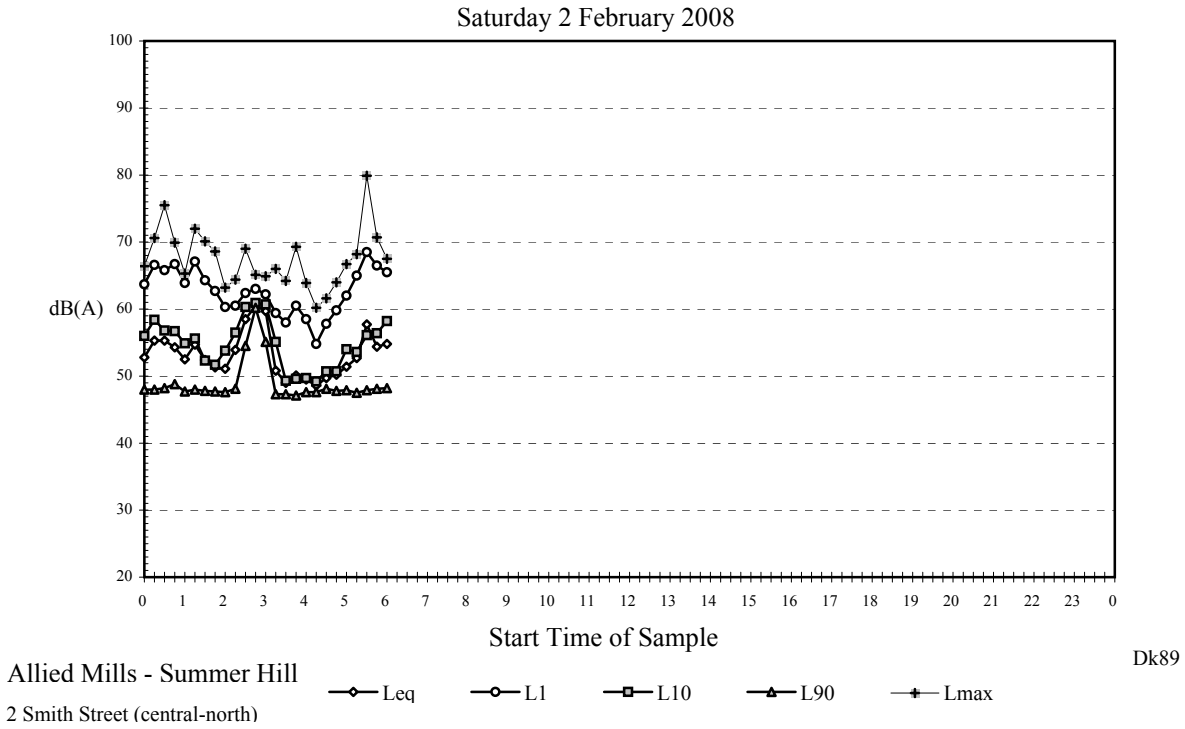

Allied Mills - Summer Hill

2 Smith Street (central-north)

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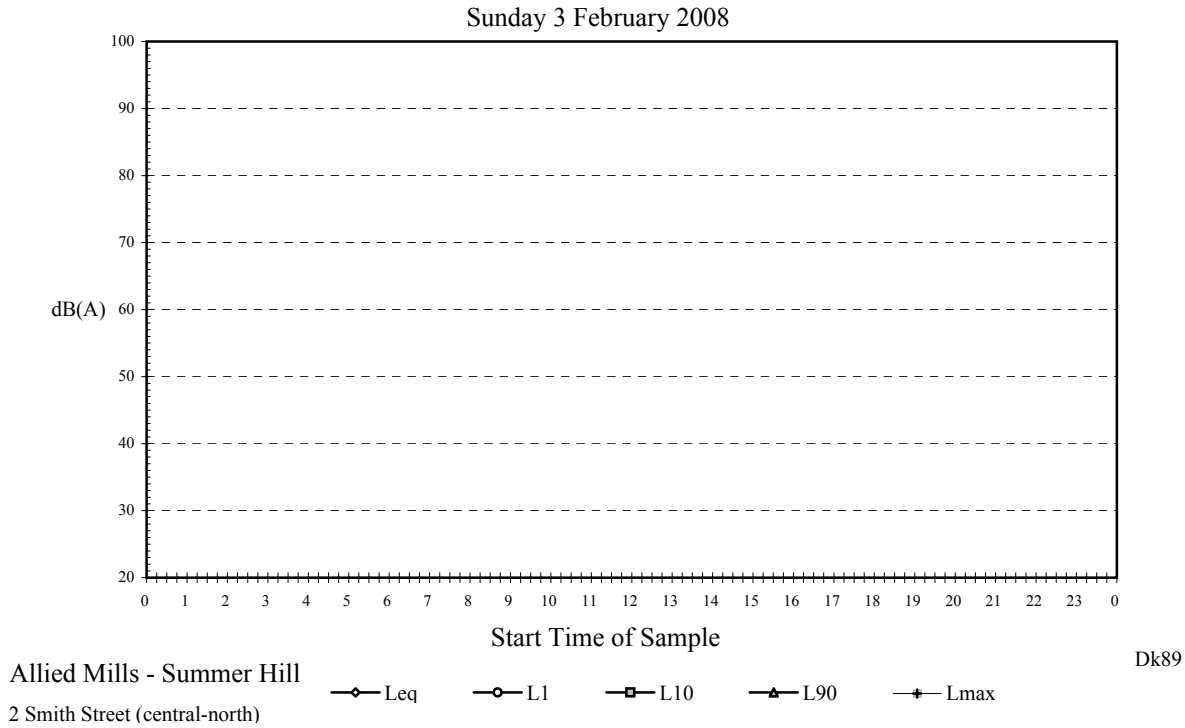
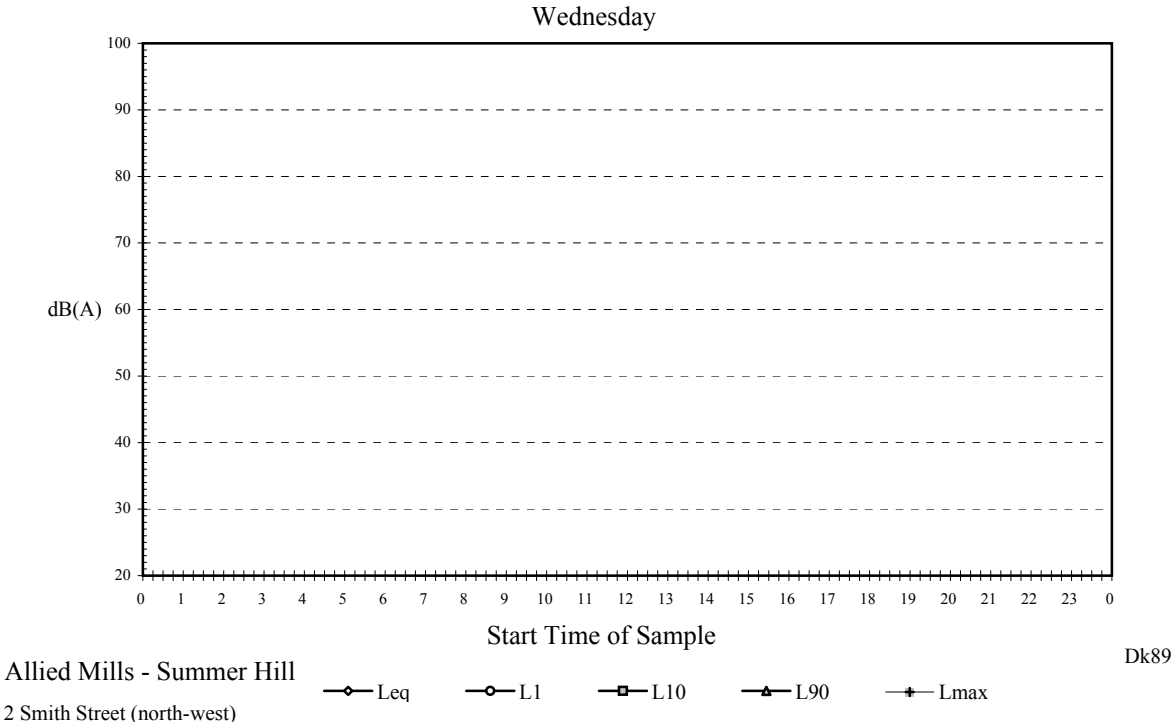


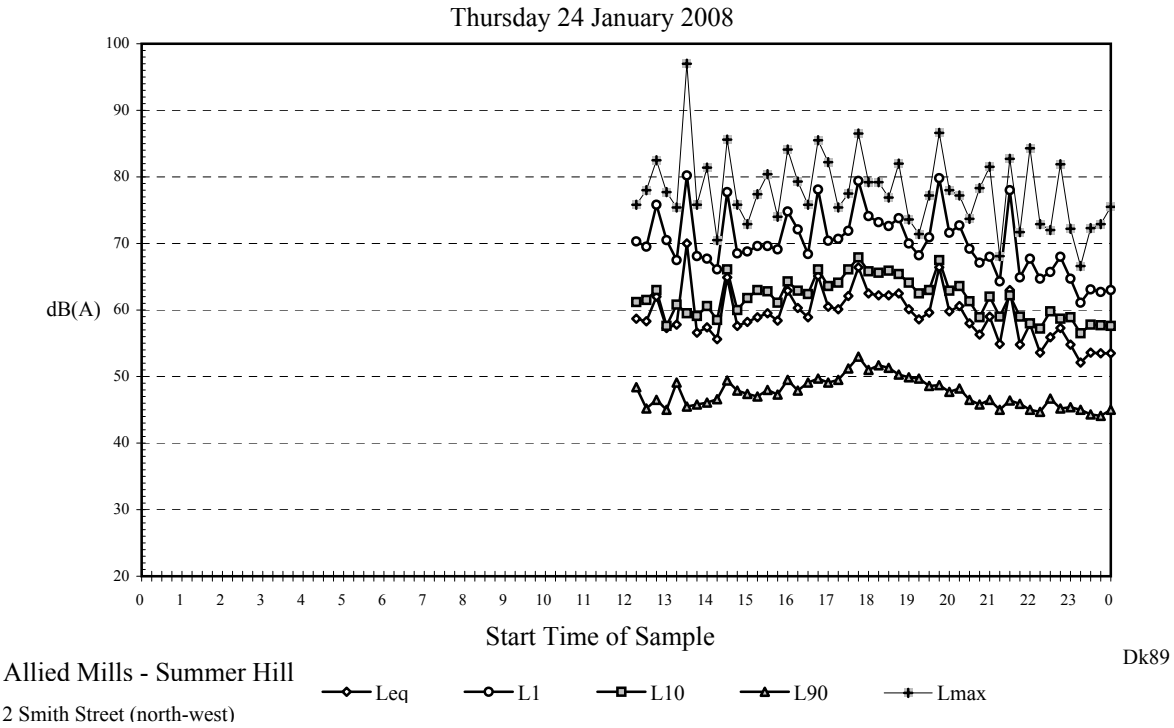
Allied Mills - Summer Hill

2 Smith Street (central-north)

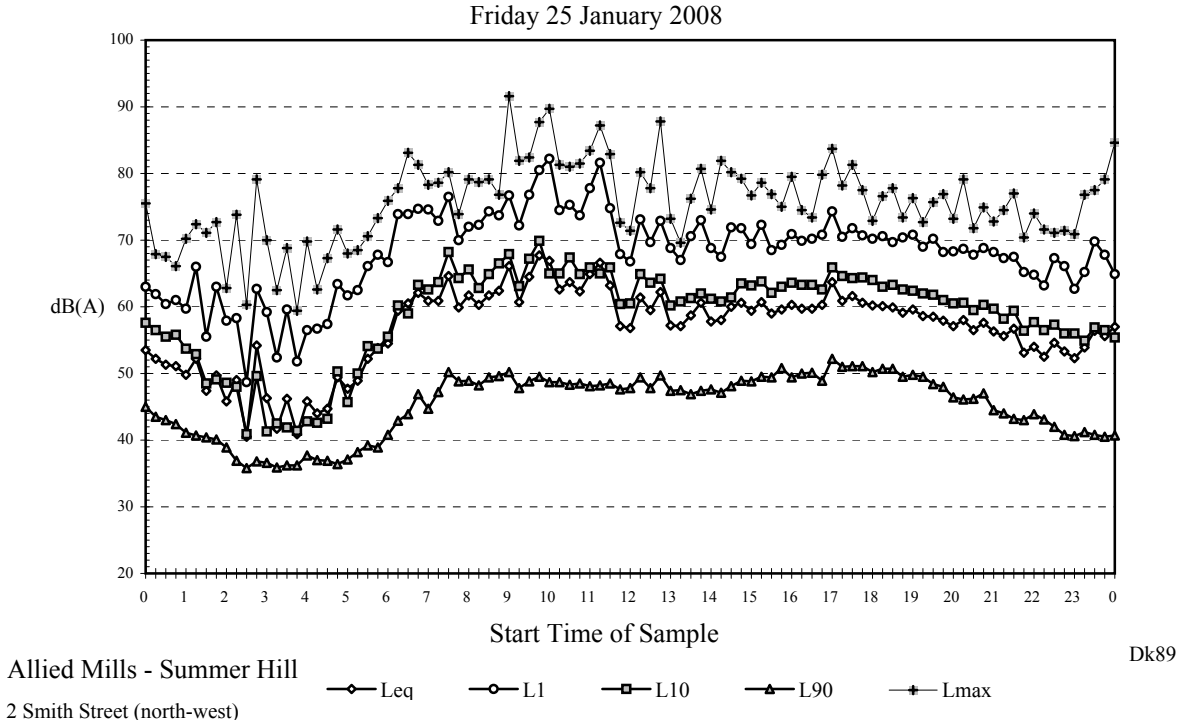
Dk89

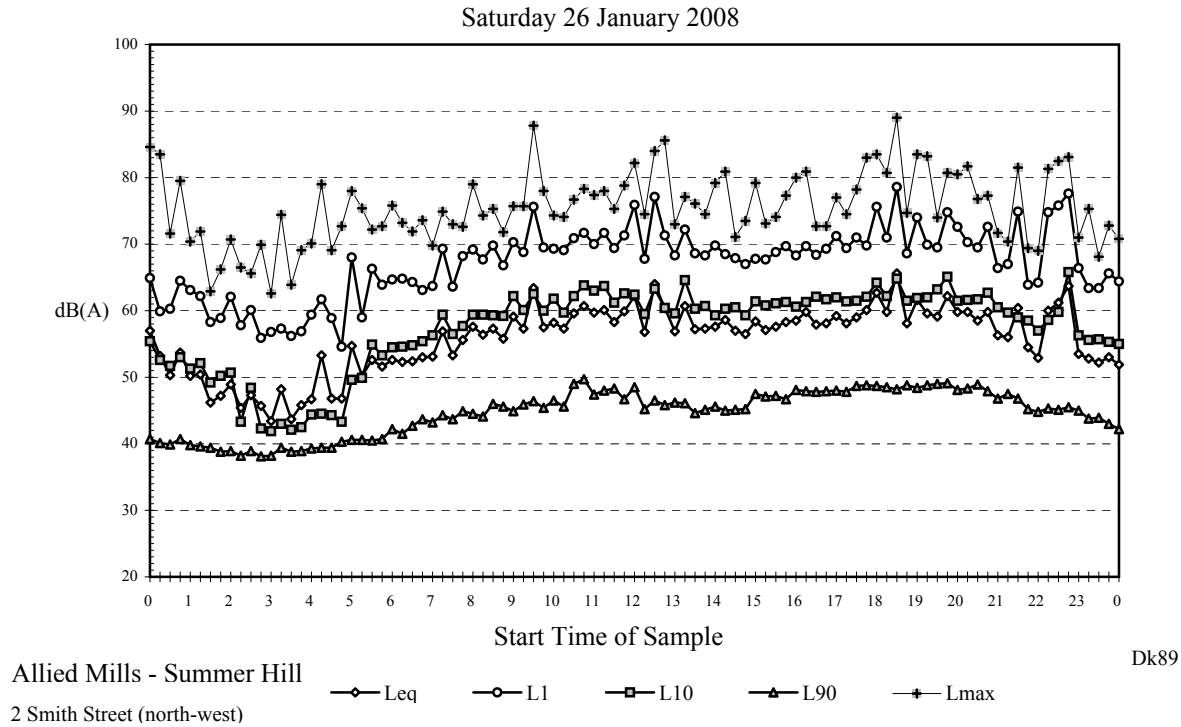
Ambient Sound Pressure Levels



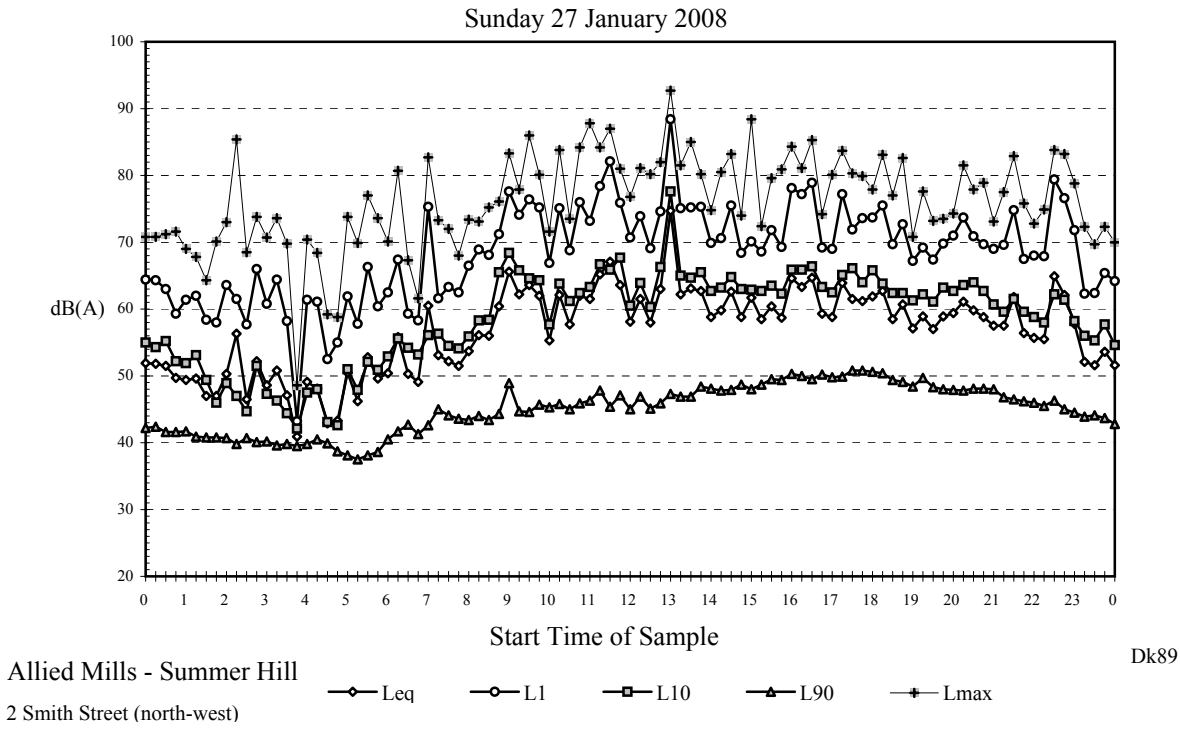


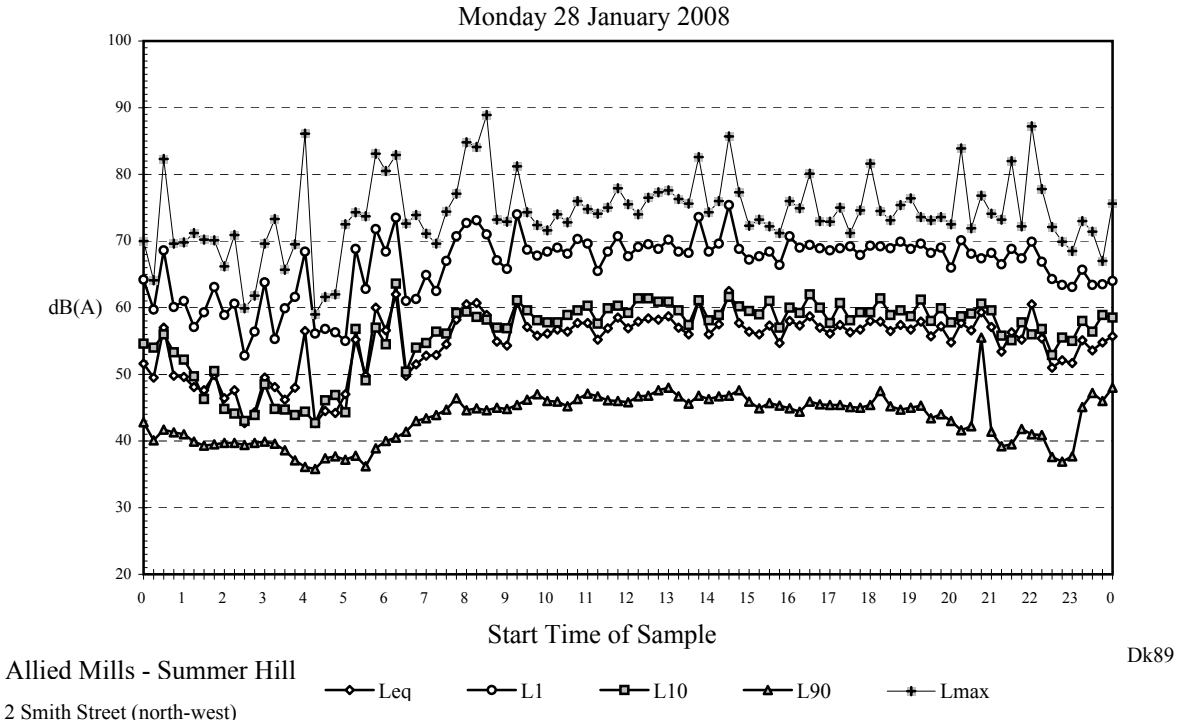
Ambient Sound Pressure Levels



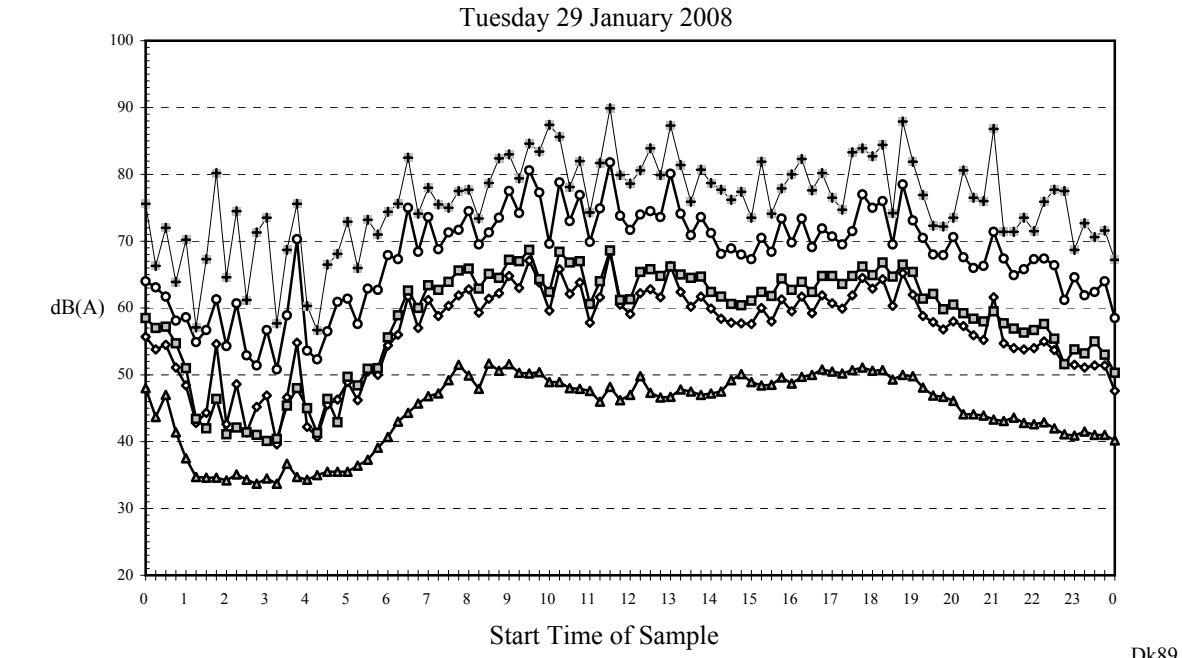


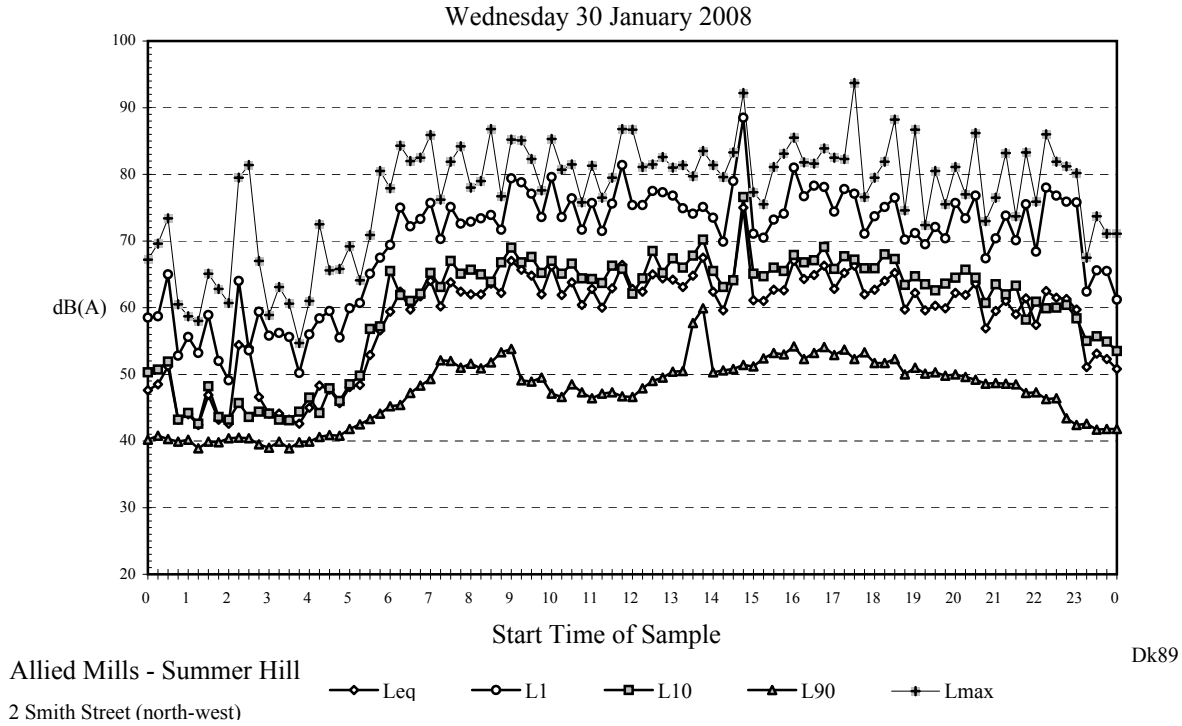
Ambient Sound Pressure Levels



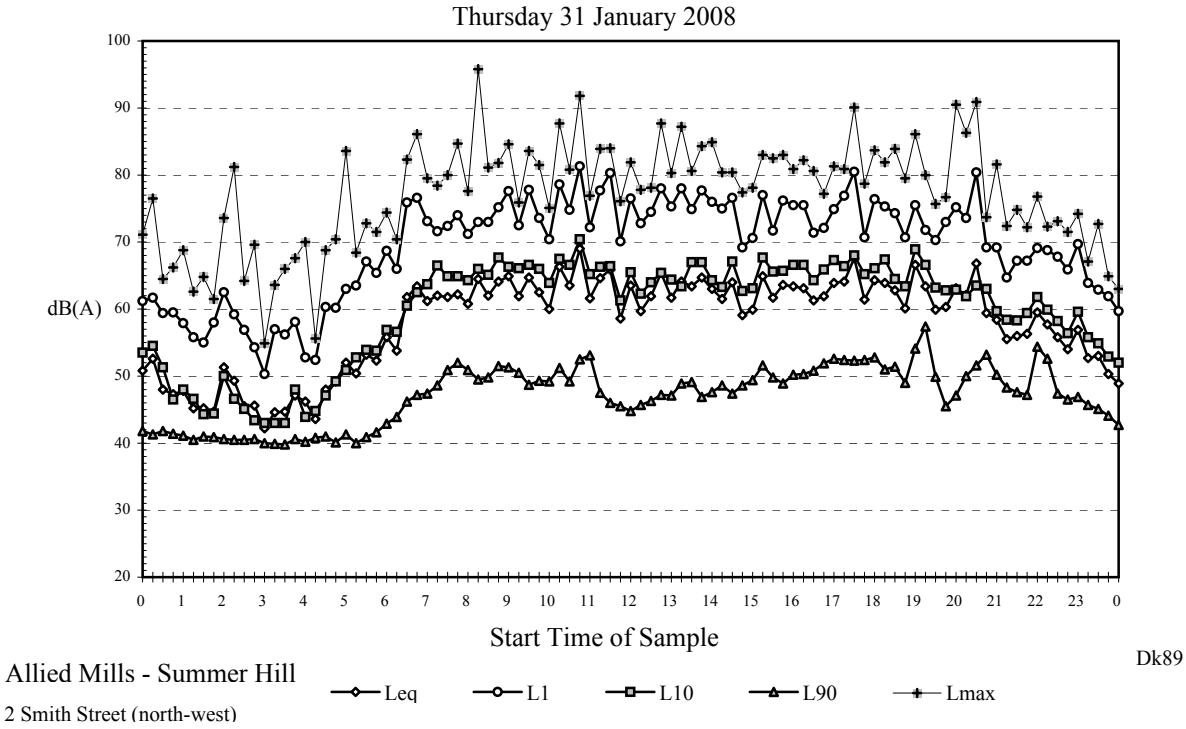


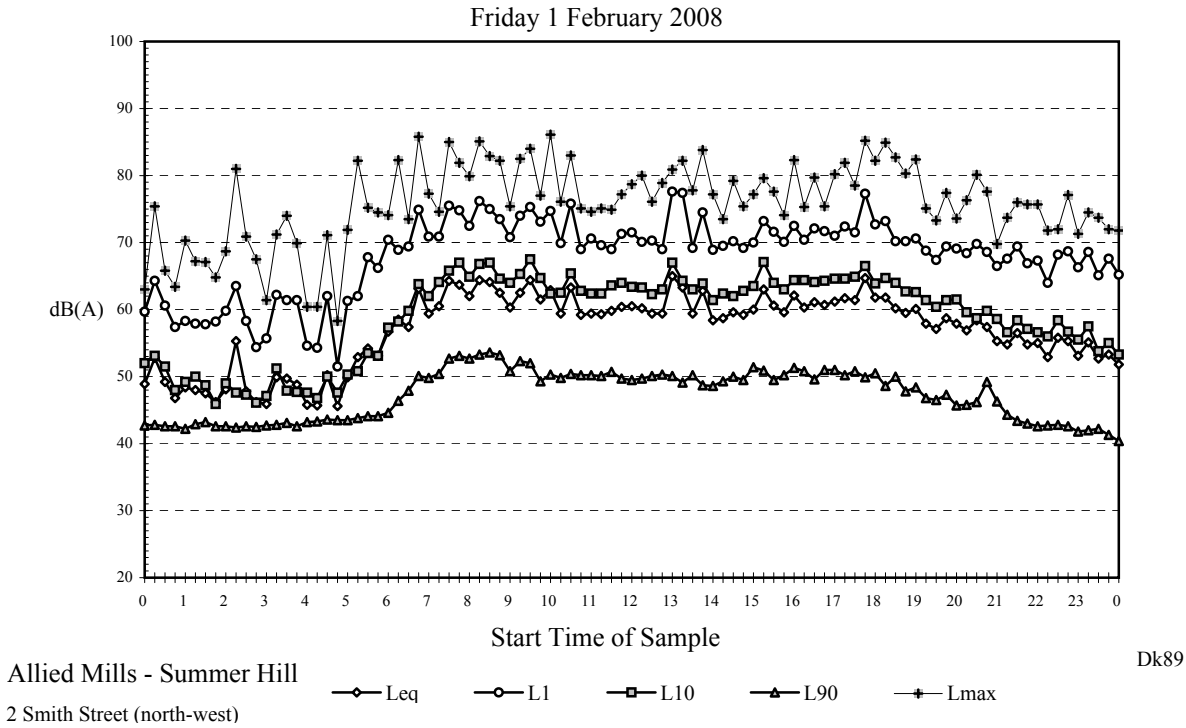
Ambient Sound Pressure Levels





Ambient Sound Pressure Levels





Ambient Sound Pressure Levels