MATRIX ACOUSTIC DESIGN CONSULTANTS

Frampton Garage
6 The Causeway
Coalpit Heath
South Gloucestershire
BS36 2PD

NOISE IMPACT ASSESSMENT

Acoustics Report 2007/R01
17th June 2020

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1. Introduction

This acoustic report documents a noise impact assessment of activity noise emissions from Frampton Garage's new additional workshop at 6 The Causeway, Coalpit Heath, South Gloucestershire; Figure 1 and 2.

The report is divided into the following sections:

- Section 2: The Development
- Section 3: Noise Criteria
- Section 4: Noise Survey
- Section 5: Noise Impact Assessment
- Section 6: Conclusion
- Appendix A: Noise monitor and weather station data
- Appendix B: Calculations
- Appendix C: Fan noise data

2. The Development

2.1 Workshop

Frampton Garage's new additional workshop is a single storey building, located at the north-east corner of Frampton Garage's car park at 6 The Causeway, Coalpit Heath, South Gloucestershire; Figure 1 and 2.

The workshop, which contains two bays, is constructed of masonry walls, concrete floor and pitched concrete tiled roof with plasterboard ceiling; there are no acoustically absorbing materials within the space. The building only has one single small double-glazed window, which is located on the east façade. Access to the building is via metal doors on the south facade or via metal roller shutter doors on each bay on the west façade.

We understand that the roller shutter doors are opened for vehicle access and when ventilation is required (either for cooling during warm weather or to disperse exhaust fumes).

The opening hours of the workshop, which are the same as Frampton Garage's main workshop located on Lower Stone Close, are

- Monday – Friday: 08:00 – 18:00hrs
- Saturday: 08:00 – 13:00hrs

Vehicles access the workshop via the car park entrance off The Causeway.

2.2 Assessed noise sensitive receptors

For the assessment the four nearest dwellings to the north, east, south and west of the workshop have been considered, namely; Figure 1

- Dwelling A: Rear façade and garden directly face the west façade (roller shuttered bays) of the workshop. However, the office building fully shields Bay 2. Along the eastern boundary is a 1.8m high close-boarded timber fence
- Dwelling B: Front façade has a clear view of both bays
- Dwelling C: Dwelling and rear garden only have a view of the rear (east) façade of the workshop
- Dwelling D: Dwelling does not have any windows with a view of the front façade of the dwelling. 2m high close-boarded timber fence along the boundary of the rear garden at Frampton Garages' car park.

2.3 Site Context

Frampton Garage's main workshop, which is located on Lower Stone Close, has been operating as a car workshop for over 30 years. Some degree of car workshop noise emissions are therefore within context of the local area.

Road traffic is the dominant underlying noise source affecting the area, notably traffic on the busy A432 (this lies approximately 350m south-east of the site and therefore the noise emissions are influenced by the prevailing south-westerly breeze).

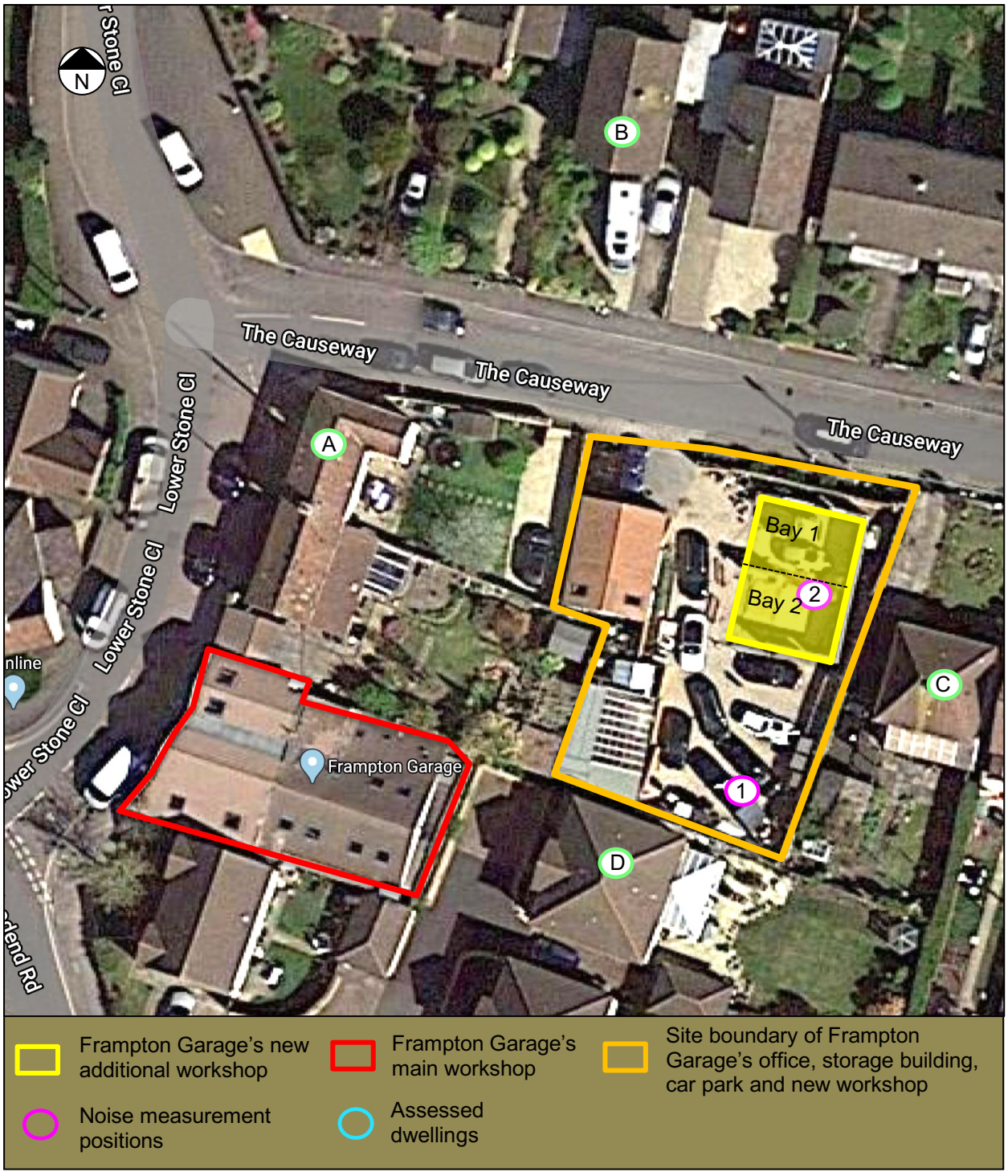


Figure 1. Aerial view (source: www.bing.com) showing footprint of Frampton Garage's new additional workshop, assessed dwellings and noise monitor locations

Views of workshop west façade, with bay roller shutter doors open and closed

View of workshop south façade with Dwelling C in the background

View of workshop east façade from The Causeway

View of the workshop from The Causeway

Figure 2. Site photos

3. Noise Criteria

3.1 BS4142:2014

BS4142:2014 provides a methodology to assess the impact of industrial and commercial noise affecting dwellings, whereby the 'typical' background noise level is deducted from the industrial noise Rating Level (industrial noise corrected to account for the 'on-time' and noise character of the noise source). The following guidance is given based on the established difference:

- A difference of around +10dB or more is likely to be an indication of significant adverse impact, depending on context
- A difference of +5dB is likely to be an indication of an adverse impact, depending on context
- The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on context

Context, as defined in BS4142:2014, includes the consideration of the following factors:

- The absolute level of the noise emissions
- Character and level of the residual sound compared to the character and level of the Specific Level
- Sensitivity of the receptor and any acoustic design measures (e.g. façade sound insulation, use of mechanical ventilation and acoustic screening) incorporated at premises used for residential purposes

To take account of industrial/commercial noise sources that do not operate continually an 'on-time' correction is applied using:

$$- 10 \log (r/r_{ref})$$

Where:

$r_{ref.}$ = reference time (1hr between 07:00 – 23:00hrs and 15 minutes between 23:00 – 07:00hrs)
r = total 'on-time' during the reference period

Note that the shorter reference time interval between 23:00 – 07:00hrs is designed to penalise industrial/commercial noise events that occur during the night.

BS4142 provides four noise character correction categories with associated penalties that must be applied when determining the Rating Level, namely:

- **Tonality:**
  - Not perceptible = 0dB
  - Just perceptible = +2dB
  - Clearly perceptible = +4dB
  - Highly perceptible = +6dB
- **Impulsivity:**
  - Not perceptible = 0dB
  - Just perceptible = +3dB
  - Clearly perceptible = +6dB
  - Highly perceptible = +9dB

- **Intermittency:** +3dB if the intermittency of operation is readily distinctive against the residual noise environment
- **Other:** +3dB applied if the specific sound is neither tonal or impulsive but features noise characteristics that are readily distinctive against the residual noise environment

4. Noise Survey

A noise survey has been conducted to establish the general environmental noise levels of the area and typical source noise levels generated within the workshop.

- **Survey dates**: Thursday 6th – Saturday 8th February 2020
- **Weather:**
  - Precipitation: Dry
  - Wind speed: < 5m/sec;
  - Wind direction:
    - Thursday 6/2/20: Easterly
    - Friday 7/2/20: Southernly
    - Saturday 8/2/20: South-westerly
  - The weather conditions will not have adversely affected the noise measurements.
- **Noise monitor locations:** With the microphones attached to tripods the noise monitors were located at Positions 1 and 2; Position 1 was within Frampton Garage's car park adjacent to Dwellings C and D rear gardens, whereas Position 2 was within the workshop between the two bays
- **Equipment:** Brüel & Kjær Type 2238 (Positions 1 & 2)
- **Calibration:** Noise monitors were calibrated before and after the survey using a Brüel & Kjær Type 4231 calibrator with no deviations found

Position 1 measurements were free-field. Position 2 measurements are internal reverberant levels. Full tabulated results are given in Tables A1 and A2, Appendix A.

Note that the workshop was only operational over the Thursday and Friday. We were informed that the activities undertaken in the workshop were representative of those that typically occur.

4.1 Survey observations

During the survey it was observed that:

- Noise emissions from Frampton Garages' new workshop consisted of:
  - Music playback via a portable radio
  - Hammering/use of power tools
  - Vehicle engines
  - Mechanics talking
- Workshop activity noise was not audible over the general environmental noise at Position 1 (note that the roller shutter bay doors were closed)
- No car park movements observed
- No external plant was audible
- The dominant underlying noise source was distant road traffic on the busy A432 (approximately 350 south-east of the site)
- Noise emissions from Frampton Garage's main workshop (Lower Stone Close) could be heard at a low level at dwellings to the rear of their workshop

4.2 Survey findings

Frampton Garage's new workshop was only operational during Thursday and Friday of the survey. Figure 3 provides the recorded 1hr ambient noise levels made within the workshop during this period (Position 2). Elevated noise levels can clearly be identified during the workshop hours, with ambient noise levels ranging between $L_{Aeq,1hr}$ 52 – 76dB.

Reviewing the survey data an internal workshop activity noise level of $L_{Aeq,1hr}$ 72dB is considered a suitable representative value for the purpose of the assessment; for the majority of the time the internal workshop activity noise levels are below this level.

Figure 3. Position 2 - internal workshop activity noise levels

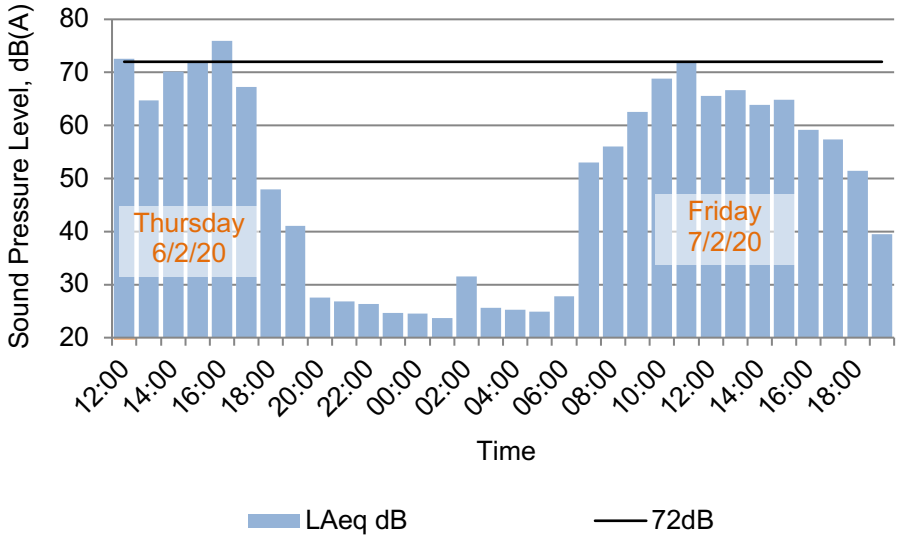
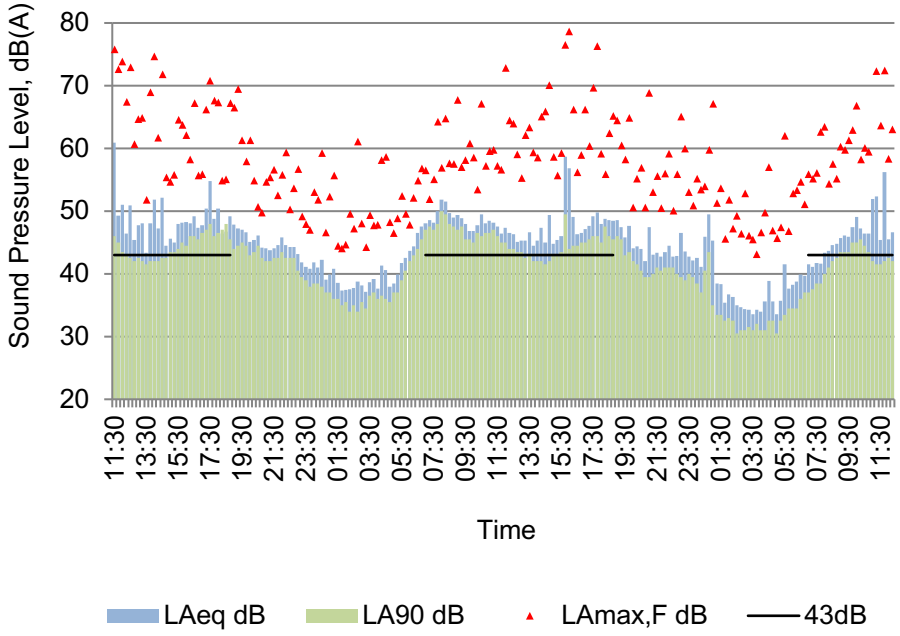


Figure 4 shows the variation in the measured maximum (L_{Amax}), ambient (L_{Aeq}) and background (L_{A90}) noise levels over the survey period at Position 1. As can be seen there is the expected variation in the noise levels in relation to road traffic noise, with identifiable peaks during the morning and evening rush hours and a significant drop in noise levels during the night period.

Figure 4. Position 1 - environmental noise levels (free-field)



There is no correlation in the noise levels recorded within the workshop and those made at Position 1. This indicates that with the roller shutter doors closed (which we understand was the case throughout the survey period) the influence of the workshop activity noise at Position 1 was negligible.

From the survey data a typical background noise level during the opening hours of the workshop has been established as L_{A90} 43dB. This value is considered representative to the typical background noise levels at the nearest noise sensitive receptors.

5. Noise Impact Assessment

5.1 Deviation of workshop activity Rating Levels

Using the established representative activity noise levels within the workshop, noise emissions and corresponding Rating Levels have been calculated at the four noise sensitive receptors identified in Figure 1; Appendix B.

For the calculations the following have been taken into account:

- **BS4142 character corrections:** The workshop activity noise consists of various noise sources, which will be intermittent and on occasion tonal and/or impulsive. To account for the various noise characteristics a global +6dB correction has been applied
- **Façade sound insulation:** The roller shutters will acoustically be the weakest element of the building envelope, with a sound reduction of around R_w 18dB
- **Shielding correction:** where the line of sight of the roller shutter doors/bay opening is fully blocked by either a building or solid fence/wall, 10dB shielding correction has been applied. Where the line of sight is partially blocked the shielding correction has been reduced to 5dB.

Table 1 provides the resultant Rating Level for three scenarios of the bay roller shutter doors, namely:

- Both roller shutter doors fully closed
- Both roller shutter doors half open
- Both roller shutter doors fully open

Table 1. Calculated Rating and Assessment Levels at Receptors A - D; Figure 1

Receptor	A						B			C			D		
	Rear façade			Rear garden			Front façade			Rear garden			Rear garden		
Roller shutter door	Closed	Half open	Fully open	Closed	Half open	Fully open	Closed	Half open	Fully open	Closed	Half open	Fully open	Closed	Half open	Fully open
Rating Level, dB	32	46	48	34	49	51	37	52	54	35	46	48	34	45	47
Typical L_{A90} dB	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43
Assessment Level, dB	-11	3	5	-9	6	8	-6	9	11	-9	3	5	-9	2	4

5.2 Noise Impact

We define Assessment Level = Rating Level – typical L_{A90} dB

As can be seen in Table 1 the resultant Assessment Levels for each of the three assessed scenarios

- Both roller shutter doors fully closed: Assessment Levels in all cases <0dB. This indicates a BS4142 **low** noise impact
- Both roller shutter doors half open: Assessment Levels up to 9dB depending on receiver location. Indicates an **adverse** noise impact.
- Both roller shutter doors fully open: Assessment Levels exceeded +10dB. Indicates a **significant adverse** noise impact

As can be seen the noise emissions are within acceptable level when the roller shutters are closed at all of the assessed receptors. However, with the roller shutter doors partially or fully open there is the potential for an adverse to significant adverse noise impact depending on the activities being undertaken within the workshop. It is therefore advised that if workshop activities are required to be undertaken whilst the roller shutter doors are open (as we understand is the situation during warm weather and for ventilation of exhaust fumes), mitigation measures are advised.

5.3 Mitigation measures

To reduce the noise emissions from the garage workshop the following measures are recommended:

- **Acoustic absorption:** The internal surfaces of the workshop are hard highly reflective acoustic surfaces, with the result that the reverberant noise within the garage amplifies the workshop activity noise emissions. By adding acoustic absorption within the workshop the reverberant noise level will be reduced, resulting in a reduction in the overall noise emissions.

  Typically the acoustic absorption would be installed on the ceiling or at high level, with the total area coverage dependant on the absorber performance (commercial absorbers typical range from the highest performance Class A to a Class C) and the desired reverberation reduction.

  Via calculation a 6dB reduction in the reverberant noise level within the workshop has been established with the installation of a Class A absorber of area equal to the ceiling area. It should be noted that as the absorbers can be retro fitted, further absorption can be included if required.

  There are many commercially available acoustic absorbers ranging from suspended sails to direct fix tiles. Example acoustic absorber manufacturers are:

  - Echophon: www.ecopon.co.uk
  - Hodgson & Hodgson: www.acoustic.co.uk
  - Armstrong: www.armstrong.co.uk
  - Rockfon: www.rockfon.co.uk
  - Soundsorba: www.soundsorba.com
  - The woolly shepherd: www.wooleyshepherd.co.uk

  Alternatively bespoke absorbers can be constructed onsite. A typical construction would be 25mm dense mineral fibre faced with an acoustically transparent material (i.e. a material that air can pass through) behind timber slats or perforated metal/timber sheeting (there must be a minimum 40% free area).

- **Car park entrance gate:** The car park has entrance gates (which were observed during the site visit to be left open during the opening hours of the workshop) consisting of two metal gates clad with a lightweight material; see Figure 5. Useful shielding attenuation of noise emissions from workshop bays (when roller shutter doors are open) for Receptor B can be achieved by closing the gates. To maximse the shielding attenuation the sound insulation of the gates should be upgraded and height increased to 1.8m (i.e. the height of the adjacent timber fence); a suitable sound insulation upgrade would be the replacement of the lightweight cladding with 18mm marine ply. Any gaps around the perimeters of the gates, for example the gap between the car park floor and the gates, should be as small as practical. With this upgrade a shielding attenuation of noise emissions of between 5 – 10dB is expected for Receptor B.

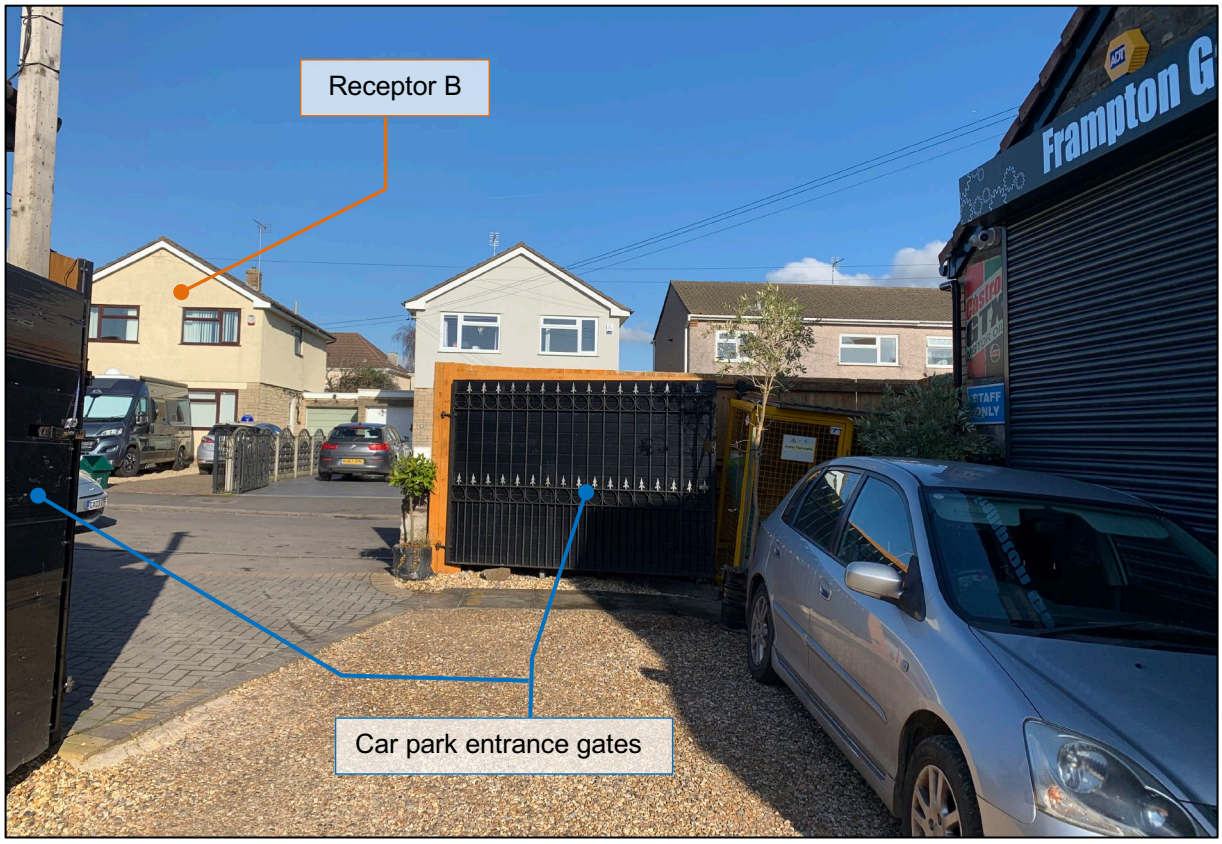


Figure 5. Photo with car park entrance gates identified

- **Roller shutter doors:** For higher noise producing workshop activities the roller shutter doors should be closed whenever practical. If ventilation is needed the roller shutter doors should only be half open; this not only reduces the free-area for noise transmission but also maximises the shielding attenuation provided by the closed car park gate for Receptor B.
- **Radio:** The radio, which will typically be a constant noise source, has the advantage that its amplitude can be controlled. It is therefore advised that staff are reminded that the radio volume must be kept at a considerate level, and located so that the speaker faces into the workshop i.e. not facing toward the bay openings.

Table 2 provides the reduced Rating and Assessment Levels with the implementation of the above mitigation measures.

Table 2. Calculated Rating and Assessment Levels at Receptors A - D with the implementation of advised mitigation measures

Receptor	A						B			C			D		
	Rear façade			Rear garden			Front façade			Rear garden			Rear garden		
Roller shutter door	Closed	Half open	Fully open	Closed	Half open	Fully open	Closed	Half open	Fully open	Closed	Half open	Fully open	Closed	Half open	Fully open
Rating Level, dB	26	40	42	28	43	45	26	41	43	29	40	42	28	39	41
Typical L_{A90} dB	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43
Assessment Level, dB	-17	-3	-1	-15	0	2	-17	-2	0	-15	-3	-1	-15	-4	-3

As can be seen in Table 2 in all cases the reduced noise emissions result in Assessment Levels <5dB, which indicates that an adverse noise impact will be avoided. With the roller shutter doors half open the Assessment Levels do not exceed 0dB, indicating a low noise impact.

We therefore conclude that with the implementation of the suggested mitigation measures the garage workshop activity noise emissions will be sufficiently reduced to acceptable levels.

5.4 Calculation uncertainty

With all calculations there is a level of uncertainty, which in this case we do not expect to be greater than +/-3dB (3dB is a just perceptible change in noise level). This small level of uncertainty is not considered to have any significance to the outcome of the assessment.

6. Conclusion

The activity noise emissions from Frampton Garages' new workshop have been assessed in accordance with BS4142 based on surveyed internal workshop noise levels and general environmental noise levels of the surrounding area.

For the assessment three scenarios of the two workshop bay roller shutter doors have been reviewed, namely:

- Both roller shutter doors fully closed
- Both roller shutter doors half open
- Both roller shutter doors fully open

Via calculation (Appendix B) it has been demonstrated that with the roller shutter doors closed the BS4142 noise impact will be low at the nearest noise sensitive receptors (A - D, Figure 1). However, with the roller shutter doors partially or fully open, as is required for cooling and/or ventilation of fumes, the noise impact has the potential to be adverse to significant adverse depending on the workshop activities being undertaken.

To reduce the workshop activity noise emissions mitigation measures have been advised, consisting of:

- Roller shutter doors: roller shutter doors kept closed during higher noise producing actives when practical; when ventilation is required during workshop activities the roller shutter doors should only be half open
- Acoustic absorption: acoustic absorption added to the workshop; ideally a Class A absorber of total area equal to the ceiling area
- Car park entrance gate: gate kept closed when the bay roller shutters are open; gate sound insulation and height increased
- Radio: volume of radio kept to considerate levels; radio located so that the speaker facings away from the bay openings

With the implementation of the advised mitigation measures, it has been established that the garage workshop activity noise emissions will be sufficiently reduced such that they will not result in an adverse noise impact.

Table A1. Position 1 noise monitor data (free-field values) - general environmental noise																
Start Time	$L_{Amax,F}$ dB	$L_{Aeq,15min}$ dB	$L_{A90,15min}$ dB	Start Time	$L_{Amax,F}$ dB	$L_{Aeq,15min}$ dB	$L_{A90,15min}$ dB	Start Time	$L_{Amax,F}$ dB	$L_{Aeq,15min}$ dB	$L_{A90,15min}$ dB	Start Time	$L_{Amax,F}$ dB	$L_{Aeq,15min}$ dB	$L_{A90,15min}$ dB
11:30	75.8	57.9	41.0	00:00	53.1	41.8	38.5	12:30	64.0	46.3	44.0	01:00	67.1	45.3	35.0
11:45	72.7	46.3	40.0	00:15	51.8	41.0	38.5	12:45	59.1	45.1	43.5	01:15	51.3	38.5	33.5
12:00	73.9	51.0	38.5	00:30	59.3	42.2	38.0	13:00	55.3	45.3	43.5	01:30	53.7	38.4	33.5
12:15	67.5	45.4	38.0	00:45	46.6	39.1	37.0	13:15	62.1	45.3	42.5	01:45	45.6	35.4	32.5
12:30	73.0	46.9	37.5	01:00	52.3	39.9	37.0	13:30	63.4	46.6	43.0	02:00	51.8	36.7	33.0
12:45	60.7	40.4	37.0	01:15	55.7	40.8	36.0	13:45	59.4	44.5	42.0	02:15	47.2	36.3	32.5
13:00	64.7	43.7	37.5	01:30	44.5	38.6	36.0	14:00	58.6	45.3	42.0	02:30	49.3	35.0	30.5
13:15	64.9	44.1	37.0	01:45	44.1	37.3	35.0	14:15	65.1	47.3	42.0	02:45	46.4	34.7	31.0
13:30	51.8	39.4	36.5	02:00	44.7	37.4	35.5	14:30	65.9	45.0	41.5	03:00	52.9	34.4	31.0
13:45	69.0	44.1	37.0	02:15	49.6	37.5	34.0	14:45	70.1	49.4	42.0	03:15	46.1	34.3	31.5
14:00	74.7	47.8	37.0	02:30	47.2	37.7	35.0	15:00	58.7	44.8	43.0	03:30	45.5	33.6	31.0
14:15	61.7	43.2	37.0	02:45	61.1	38.8	34.0	15:15	55.7	45.4	43.0	03:45	43.2	34.3	32.0
14:30	71.8	48.1	37.5	03:00	48.1	38.2	35.5	15:30	59.3	46.0	43.5	04:00	46.6	34.0	31.0
14:45	55.4	40.5	37.5	03:15	44.3	37.1	34.5	15:45	76.5	58.7	49.5	04:15	49.8	35.6	31.0
15:00	54.7	41.6	38.5	03:30	49.4	38.7	36.5	16:00	78.7	56.8	44.0	04:30	57.0	38.9	32.5
15:15	55.8	41.0	38.5	03:45	47.7	39.2	37.0	16:15	66.2	49.1	44.5	04:45	46.9	35.6	32.5
15:30	64.6	44.0	39.0	04:00	47.9	37.6	36.0	16:30	56.2	46.3	44.5	05:00	45.7	33.6	30.5
15:45	63.8	44.2	40.0	04:15	58.2	41.3	36.5	16:45	59.0	46.5	45.0	05:15	47.4	35.7	32.5
16:00	62.1	44.3	39.5	04:30	58.7	40.6	36.0	17:00	66.2	47.1	45.0	05:30	62.0	41.5	33.5
16:15	58.3	44.1	41.0	04:45	48.3	38.0	35.5	17:15	60.4	47.6	45.5	05:45	46.8	37.6	34.5
16:30	67.2	45.2	41.0	05:00	46.5	38.5	37.0	17:30	69.7	49.2	46.0	06:00	52.9	38.3	34.5
16:45	55.7	43.3	40.5	05:15	48.9	39.9	37.0	17:45	76.3	49.8	46.0	06:15	53.4	38.8	34.5
17:00	55.9	43.7	41.5	05:30	52.4	41.7	39.0	18:00	59.2	48.0	45.0	06:30	54.7	39.9	36.0
17:15	66.2	46.4	42.0	05:45	49.6	42.5	40.5	18:15	55.9	48.8	47.5	06:45	51.1	39.7	37.0
17:30	70.8	50.8	43.0	06:00	47.9	43.7	42.0	18:30	62.5	48.6	46.0	07:00	55.9	41.5	37.0
17:45	67.7	48.8	43.0	06:15	52.1	44.4	43.0	18:45	65.2	48.5	45.5	07:15	55.2	41.1	37.5
18:00	67.4	50.4	43.5	06:30	54.9	46.5	44.0	19:00	64.5	48.6	46.0	07:30	56.1	41.7	38.5
18:15	54.9	46.4	44.0	06:45	56.8	47.5	45.5	19:15	60.5	47.4	45.5	07:45	62.7	41.6	38.5
18:30	55.1	46.7	45.0	07:00	56.5	48.1	47.0	19:30	58.3	45.8	43.0	08:00	63.5	43.4	40.0
18:45	67.2	49.2	45.5	07:15	51.9	48.6	47.5	19:45	64.9	47.6	43.5	08:15	54.4	43.7	41.0
19:00	66.5	47.9	44.0	07:30	55.1	48.2	47.0	20:00	50.6	44.1	42.0	08:30	57.6	44.6	42.0
19:15	69.5	47.2	44.5	07:45	64.3	50.0	48.0	20:15	55.2	44.4	41.5	08:45	55.2	44.8	42.5
19:30	61.3	47.0	45.0	08:00	56.9	51.8	50.0	20:30	56.9	44.0	40.5	09:00	60.3	45.7	43.5
19:45	58.0	46.6	44.5	08:15	64.8	51.5	49.5	20:45	50.6	42.0	39.5	09:15	59.8	46.1	43.5
20:00	61.3	45.1	43.0	08:30	57.7	49.7	48.0	21:00	68.9	47.4	39.5	09:30	61.3	45.9	43.5
20:15	54.9	45.4	43.5	08:45	57.6	49.0	47.5	21:15	53.1	43.1	40.0	09:45	63.0	47.4	45.0
20:30	50.7	46.1	44.5	09:00	67.8	49.4	47.0	21:30	55.6	43.4	41.0	10:00	66.8	49.1	45.0
20:45	49.8	44.2	42.5	09:15	57.0	48.9	47.5	21:45	50.5	42.8	40.5	10:15	58.3	47.2	45.5
21:00	54.7	44.1	42.0	09:30	58.2	48.0	45.5	22:00	56.0	43.5	41.0	10:30	60.1	46.4	44.5
21:15	55.4	43.8	42.0	09:45	60.8	46.8	45.5	22:15	59.2	44.5	41.0	10:45	59.5	46.4	43.5
21:30	56.6	44.1	42.5	10:00	58.6	46.8	45.0	22:30	50.1	42.8	41.0	11:00	80.1	51.9	42.0
21:45	52.5	44.6	42.5	10:15	53.5	47.8	46.5	22:45	55.9	42.9	40.0	11:15	72.3	52.3	41.5
22:00	55.8	45.8	43.5	10:30	67.1	49.5	46.0	23:00	65.1	46.5	39.5	11:30	63.7	45.4	41.5
22:15	59.4	44.6	42.5	10:45	57.2	48.1	46.5	23:15	60.0	43.6	39.0	11:45	72.5	56.2	42.0
22:30	50.3	44.3	42.5	11:00	59.6	48.5	46.5	23:30	53.1	42.8	40.0	12:00	58.4	45.5	42.5
22:45	53.7	44.3	42.5	11:15	59.8	48.2	47.0	23:45	50.9	42.1	39.5	12:15	63.1	46.6	42.0
23:00	56.7	43.2	40.5	11:30	57.2	47.5	46.0	00:00	55.2	42.5	38.5				
23:15	49.2	41.8	39.5	11:45	56.6	46.4	45.0	00:15	53.5	41.1	37.0				
23:30	48.0	41.1	39.0	12:00	72.9	47.3	45.0	00:30	54.0	45.9	40.5				
23:45	47.0	40.8	38.0	12:15	64.5	46.5	44.0	00:45	59.8	49.5	43.5				

Table A2. Position 2 noise monitor data (internal reverberant levels with workshop)			
Start Time	$L_{Aeq,1hr}$ dB	Start Time	$L_{Aeq,1hr}$ dB
12:00	72.6	04:00	25.3
13:00	64.7	05:00	24.9
14:00	70.1	06:00	27.8
15:00	72.0	07:00	53.0
16:00	75.9	08:00	56.0
17:00	67.3	09:00	62.6
18:00	48.0	10:00	68.8
19:00	41.1	11:00	72.0
20:00	27.5	12:00	65.6
21:00	26.8	13:00	66.6
22:00	26.4	14:00	63.9
23:00	24.6	15:00	64.8
00:00	24.5	16:00	59.2
01:00	23.7	17:00	57.4
02:00	31.5	18:00	51.5
03:00	25.6	19:00	39.5

B1. Workshop activity noise emissions calculations

For the calculations the following corrections have been used:

- **Façade composite sound reduction:** Assumed sound reduction of the building envelope elements:
  - Roller shutter doors: R_w 18dB
  - External wall: R_w 45dB
  - Roof: R_w 40dB
  - Metal doors on south façade: R_w 20dB
  - Window on east façade: R_w 29dB
- **Distance correction:** 10 x Log (2 x π x d2), where d = distance between façade and receptor
- **Façade area correction:** 10 x Log(r), where r is the area of the noise radiating façade. Note that for the calculations the noise radiating facades have been taken to be the façade facing the receptor and the west façade (i.e. the façade with the acoustic roller shutter doors/bay openings – the weakest element of the building envelope)
- **Shielding correction:** where the line of sight of the roller shutter doors/bay opening is fully blocked by either a building or solid fence/wall, 10dB shielding correction has been applied. Where the line of sight is partially blocked the shielding correction has been reduced to 5dB.
- **BS4142 character corrections:** The workshop activity noise consists of various noise sources, which will be intermittent and on occasion tonal and/or impulsive. To account for the various noise characteristics a global +6dB correction has been applied

Table B1 provides the existing Rating Level based on the established representative internal workshop activity noise level. Table B2 provides the calculation of the reduced Rating Level as a result of the inclusion of acoustic absorption within the workshop (assumed Class A absorber of equal area of the ceiling) and closed/upgraded car park entrance gates.

Table B1. Calculation of existing workshop activity Rating Levels at Receptors A - D														
Receptor		Dwelling A rear façade		Dwelling A rear garden		Dwelling B front façade			Dwelling C rear garden			Dwelling D rear garden		
Radiating garage façade		West		West		North	West		East	West		South	West	
		Bay 1	Bay 2	Bay 1	Bay 2		Bay 1	Bay 2		Bay 1	Bay 2		Bay 1	Bay 2
Internal workshop Lp, dB		72	72	72	72	72	72	72	72	72	72	72	72	72
Global corrections	Façade area, m2	31	31	31	31	57	31	31	62	31	31	57	31	31
	Area correction, dB	14.9	14.9	14.9	14.9	17.6	14.9	14.9	17.9	14.9	14.9	17.6	14.9	14.9
	Distance to receptor, m	26.5	27.6	19.8	20.9	28.0	29.2	34.5	5.0	22.9	18.3	17.0	26.9	21.0
	Distance correction, dB	36.4	36.8	33.9	34.4	36.9	37.3	38.7	22.0	35.2	33.2	32.6	36.6	34.4
	Shielding correction, dB	5	10	5	10	0	0	0	0	10	10	0	10	10
	BS4142 character correction, dB	6	6	6	6	6	6	6	6	6	6	6	6	6
Roller shutter doors closed														
Composite Rw dB		20.7	20.7	20.7	20.7	41.6	20.7	20.7	42.2	20.7	20.7	31.1	20.7	20.7
Rating Level at receptor, dB		30.8	25.4	33.3	27.8	17.0	34.9	33.5	31.8	27.0	29.0	31.9	25.6	27.8
Aggregate Rating Level, dB		31.9		34.4		37.3			34.5			34		
Roller shutter half open														
Composite Rw dB		6.2	6.2	6.2	6.2	41.6	6.2	6.2	42.2	6.2	6.2	31.1	6.2	6.2
Rating Level at receptor, dB		45.3	39.9	47.8	42.3	17.0	49.4	48.0	31.8	41.5	43.5	31.9	40.1	42.3
Aggregate Rating Level, dB		46.4		48.9		51.8			45.8			44.6		
Roller shutter fully open														
Composite Rw dB		4.2	4.2	4.2	4.2	41.6	4.2	4.2	42.2	4.2	4.2	31.1	4.2	4.2
Rating Level at receptor, dB		47.3	41.9	49.8	44.3	17.0	51.4	50.0	31.8	43.5	45.5	31.9	42.1	44.3
Aggregate Rating Level, dB		48.4		50.9		53.8			47.7			46.5		

Table B2. Calculation of workshop activity Rating Levels at Receptors A - D with advise mitigation measured implemented														
Receptor		Dwelling A rear façade		Dwelling A rear garden		Dwelling B front façade			Dwelling C rear garden			Dwelling D rear garden		
Radiating garage façade		West		West		North	West		East	West		South	West	
		Bay 1	Bay 2	Bay 1	Bay 2		Bay 1	Bay 2		Bay 1	Bay 2		Bay 1	Bay 2
Internal workshop Lp, dB		72	72	72	72	72	72	72	72	72	72	72	72	72
Global corrections	Façade area, m2	31	31	31	31	57	31	31	62	31	31	57	31	31
	Area correction, dB	14.9	14.9	14.9	14.9	17.6	14.9	14.9	17.9	14.9	14.9	17.6	14.9	14.9
	Distance to receptor, m	26.5	27.6	19.8	20.9	28.0	29.2	34.5	5.0	22.9	18.3	17.0	26.9	21.0
	Distance correction, dB	36.4	36.8	33.9	34.4	36.9	37.3	38.7	22.0	35.2	33.2	32.6	36.6	34.4
	Shielding correction, dB	5	10	5	10	0	5	5	0	10	10	0	10	10
	BS4142 character correction, dB	6	6	6	6	6	6	6	6	6	6	6	6	6
	RT reduction, dB	6	6	6	6	6	6	6	6	6	6	6	6	6
Roller shutter doors closed														
Composite Rw dB		20.7	20.7	20.7	20.7	41.6	20.7	20.7	42.2	20.7	20.7	31.1	20.7	20.7
Rating Level at receptor, dB		24.8	19.4	27.3	21.8	11.0	23.9	22.5	25.8	21.0	23.0	25.9	19.6	21.8
Aggregate Rating Level, dB		25.9		28.4		26.4			28.5			28		
Roller shutter half open														
Composite Rw dB		6.2	6.2	6.2	6.2	41.6	6.2	6.2	42.2	6.2	6.2	31.1	6.2	6.2
Rating Level at receptor, dB		39.3	33.9	41.8	36.3	11.0	38.4	37.0	25.8	35.5	37.5	25.9	34.1	36.3
Aggregate Rating Level, dB		40.4		42.9		40.8			39.8			38.6		
Roller shutter fully open														
Composite Rw dB		4.2	4.2	4.2	4.2	41.6	4.2	4.2	42.2	4.2	4.2	31.1	4.2	4.2
Rating Level at receptor, dB		41.3	35.9	43.8	38.3	11.0	40.4	39.0	25.8	37.5	39.5	25.9	36.1	38.3
Aggregate Rating Level, dB		42.4		44.9		42.8			41.7			40.5		
Note that for the calculation it has been assumed that the car park entrance gates are closed, providing 5dB shielding attenuation for Receptor B.														