# Great Wolf Resort Bicester. Soundproofing of buildings.

## 1. Introduction.

Condition 20 attached to the planning permission for Great Wolf Lodge states the following:

"Prior to commencement of development, a scheme for the soundproofing of the buildings shall be submitted to and approved in writing by the local planning authority. Thereafter, the measures shall be implemented in strict accordance with the approved details prior to occupation of the development and shall be retained as such."

Context is provided in respect of the condition in the supporting text as below:

"In the interests of biodiversity, conditions relating to the submission of: a Landscape and Ecological Management Plan (12); tree, shrub and scrub removal (22); the protection of great crested newts (23, 27, 28 & 29) and the provision of the green roof (33) are reasonable and necessary. In the interests of safety, including highway safety, conditions relating to: the provision of fire hydrants (7); access to the A4095 (15) and the achievement of Secure by Design principles (26) are reasonable and necessary. In the interests of protection of neighbours' living conditions and guest comfort conditions relating to: ventilation of cooking odours (18); the timing of construction works (19); soundproofing (20) and external lighting (21) are reasonable and necessary."

This condition relates to:

- Noise breakout.
  Noise breaking out of the building envelope and affecting neighbouring sensitive receptors.
- Noise transmission.
  Noise transfer from noisy uses within the development affecting hotel guestroom occupants.
- External noise intrusion.
  Internal noise levels within the hotel due to ambient noise intruding from outside.

This note sets out the scheme of soundproofing for approval by Cherwell District Council as the local planning authority.

## 2. Relevant criteria.

### 2.1 Existing noise climate.

The following table indicates the typical prevailing noise climate at the site, this was included in the EIA Noise and Vibration Chapter:

| Measurement position | Day-time ambient $L_{Aeq,\ 16\ hours}$ | Night-time ambient $L_{Aeq,\ 8\ hours}$ | Typical day-time background $L_{A90,\ 1\ hour}$ | Typical night-time background $L_{A90,\ 15\ min}$ |
|---|---|---|---|---|
| L1 | 62 dB | 58 dB | 55 dB | 47 dB |
| L2 | 57 dB | 53 dB | 47 dB | 44 dB |

Table 1: Typical prevailing noise climate.

The noise monitoring positions are shown in the Appendix. For this assessment position L2 is considered to be representative of the noise climate at the closest receptors.

## 2.2 Noise breakout.

This section considers noise from internal leisure activities breaking through to outside and affecting residential properties. This type of noise is not well documented and there is limited published guidance from which to derive assessment criteria. The following guidance is the most applicable published documentation and has been used as a means of assessing noise breakout.

### 2.2.1 DEFRA Noise from Pubs and Clubs

Noise intrusion from sports/leisure activity noise including amplified music can be more disturbing to residents than noise such as road traffic, which is often referred to in published guidance as anonymous, in that it is not distinctive. Acceptability of such noise is not well defined; one means of assessing would be to use criteria developed for entertainment noise that the Noise Act is based upon. DEFRA Noise from Pubs and Clubs (Phase II) NANR 163 (May 2006) provides guidance on the acceptability of noise from entrainment related sources.

The following table shows a reproduced summary of the correlation of the metrics in that research with human response to entertainment noise. It was found that the absolute $L_{Aeq,T}$ parameter provides the best correlation with subject response under laboratory testing.

| Semantic Descriptor | Absolute $L_{Aeq,5minutes}$ (dB) |
|---|---|
| Clearly acceptable | 17.0 |
| | 20.4 |
| | 23.8 |
| | 27.2 |
| Just acceptable | 30.6 |
| Just unacceptable | 34.0 |
| | 37.4 |
| | 40.8 |
| | 44.2 |
| Clearly unacceptable | 47.5 |

Table 2: Semantic descriptor and associated values of acceptability

### 2.2.2 Amplified Music as a Nosie Nuisance (Craik & Stirling)

In respect of entertainment type noise there are no nationally recognised standards that are available to be adopted by Local Authorities. Prior research (Craik 1986) which was undertaken in relation to discotheque music with high levels of bass content suggests criteria such as 20 dB below the ambient level without music has zero percent dissatisfaction.

In the research this was related to internal noise levels in the affected property, it is assumed that this would apply as the attenuation of an open window would apply to both ambient noise and entertainment related noise. The ambient noise was a short term measurement, so equates to background.

Assuming a very worst case of night operation, the typical background noise level is 44 dB LA90. This would infer a limit of 24 dB $L_{Aeq,T}$ (i.e. 44-20=24) at the residential properties affected to comfortably protect against dissatisfaction.

### 2.2.3 Criterion.

On this basis the development has been designed based on a criterion of 24 dB $L_{Aeq,T}$ at the facades of the nearby residential properties. This corresponds to 'clearly acceptable' in absolute terms based on DERFRA guidance (particularly since internal noise levels would be lower) and a very low likelihood of dissatisfaction in relative terms based on the Craik & Stirling research.

### 2.3 Noise transmission.

For the hotel bedrooms, internal sound insulation performance should comply with Approved Document E of the Building Regulations as 'rooms for residential purpose'. Recommendations for non-residential areas are based on good practice guidance.

The internal walls and floors therefore have been designed and constructed such that the resultant in-situ constructions shall achieve the following minimum airborne room to room level differences.

| Adjacency | Airborne sound insulation (on-site performance) |
|---|---|
| Bedroom to public rooms such as restaurant, conference room, bar | $D_{nT,w}$ 65 dB |

Table 2: Internal sound insulation criteria

Noise breaking out of the building envelope and transmitting into guestrooms of the hotel should achieve 10 dB below the external noise intrusion criteria given in the following subsection of this report (Table 3).

### 2.4 External noise intrusion.

The fabric of the buildings is to be constructed such that the resultant in-situ internal noise levels due to eternal noise intrusion shall not exceed the below criteria in Table 1. These criteria are based on the guidance contained in British Standard BS 8233:2014 and World Health Organization guidance (World Health Organization, 2000) (World Health Organization, 2009).

| Area | Time | Noise level |
|---|---|---|
| Bedrooms | Daytime (07:00 to 23:00) | $L_{Aeq,16hours}$ 35 dB |
| | Night-time (23:00 to 07:00) | $L_{Aeq,8hours}$ 30 dB<br>$L_{Amax}$ 45 dB to not be regularly exceeded at night |

Table 3: External noise intrusion criteria.

## 3. External noise levels.

Based on the results of an environmental survey, the typical measured external ambient sound levels incident on facades of the proposed development are provided in Table 2 below along with the maximum sound levels not typically exceeded for more than 12 times during the night (23:00 – 07:00).

| Location | Period | Sound Levels |
|---|---|---|
| Facades facing M40 | Daytime | $L_{Aeq,16\ h}$ 66 dB |
| | Night-time | $L_{Aeq,8\ h}$ 62 dB<br>$L_{Amax(fast)}$ 73 dB (typical) |
| Facades facing delivery bay access | Daytime | $L_{Aeq,16\ h}$ 63 dB |
| | Night-time | $L_{Aeq,8\ h}$ 59 dB<br>$L_{Amax(fast)}$ 86 dB (typical) |
| Facades facing A4095 | Daytime | $L_{Aeq,16\ h}$ 55 dB |
| | Night-time | $L_{Aeq,8\ h}$ 50 dB<br>$L_{Amax(fast)}$ 60 dB (typical) |

Table 4: Measured external noise levels for outline façade analysis.

# 4. Scheme of soundproofing.

## 4.1 Noise breakout.

The development façades comprise glazed elements and cladding.

Table 5 shows the predicted acoustic performances of the cladded elements and glazed options. This shows that the sound insulation provided by the cladded elements are superior to the glazing. The glazed options have been designed to manage external noise intrusion (discussed in Section 4.3); these are visually depicted in Figure 1.

| Element | Acoustic performance | Spectrum | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 63 Hz | 125 Hz | 250 Hz | 500 Hz | 1 kHz | 2 kHz | 4 kHz |
| Cladded elements | $R_w$ 48 dB ($C_{tr}$ -4 dB) | 21 | 31 | 41 | 49 | 50 | 46 | 53 |
| Glazing Option 1 | $R_w$ 39 dB ($C_{tr}$ -5 dB) | 22 | 23 | 29 | 39 | 40 | 39 | 51 |
| Glazing Option 2 | $R_w$ 36 dB ($C_{tr}$ -5 dB) | 20 | 22 | 28 | 37 | 39 | 37 | 44 |
| Glazing Option 3 | $R_w$ 32 dB ($C_{tr}$ -3 dB) | 20 | 24 | 22 | 31 | 31 | 34 | 36 |

Table 5: Acoustic performances of façade elements

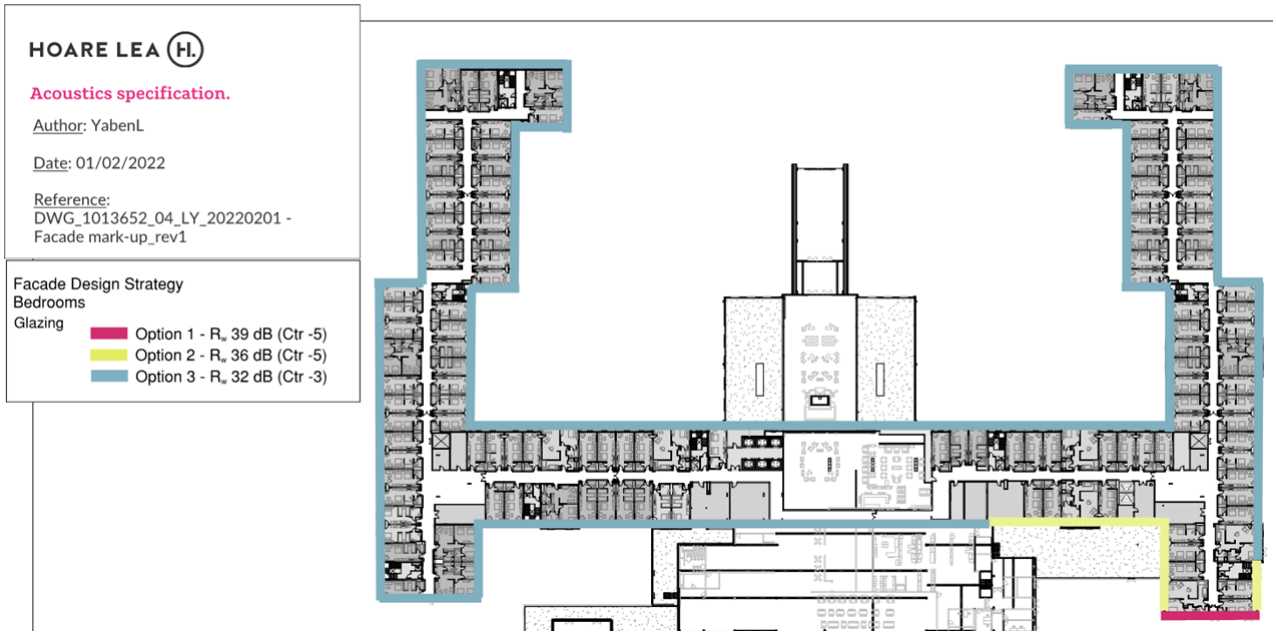



Figure 1: Glazing options included in design

An acoustic model has been compiled in the software CadnaA based on sound breaking out of the building envelopes, the lowest specification of glazing has been used. Internal sound pressure levels have been assumed, as defined in Table 7. Sound is assumed to propagate externally in accordance with the guidance contained in ISO 9613-2 (International Organization for Standardization, 1996). Figure 2 shows that the predicted external noise levels at the nearest neighbouring residential receptors comply with the criteria in Table (for both daytime and night-time periods).

| Internal space | Reverberant sound pressure level | Spectrum | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 63 Hz | 125 Hz | 250 Hz | 500 Hz | 1 kHz | 2 kHz | 4 kHz |
| Waterpark | 88 dBA | 72 | 74 | 77 | 84 | 84 | 81 | 74 |
| Lobby area | 88 dBA | 88 | 80 | 80 | 89 | 88 | 78 | 73 |
| Restaurant | 80 dBA | 67 | 75 | 74 | 77 | 76 | 73 | 67 |

Table 6: Internal reverberant sound pressure levels assumed in noisy areas

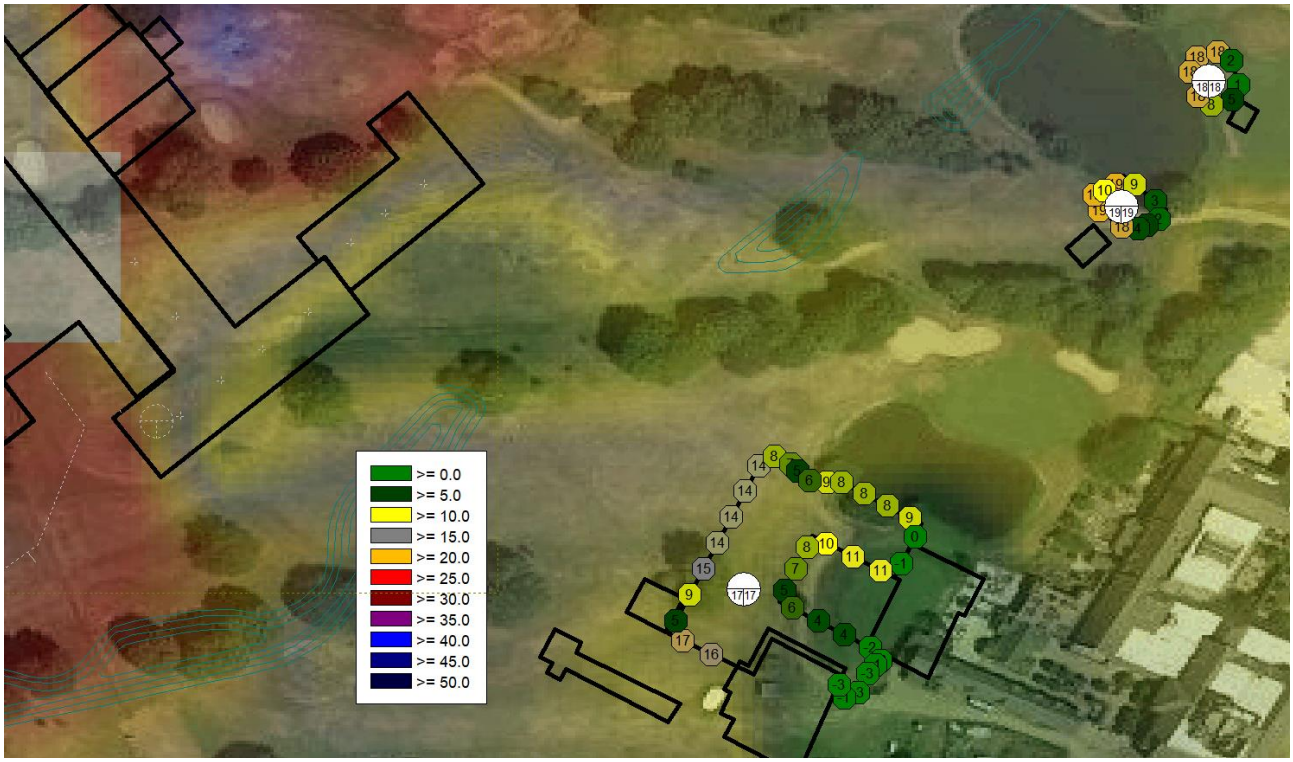



Figure 2: Breakout noise levels at neighbouring facades

The highest predicted noise level at the facades of the neighbouring properties is 19 dB $L_{Aeq,T}$ this is considered a very low noise level and is below the criterion of 24 dB $L_{Aeq,T}$.

## 4.2 Noise transmission.

Within the hotel there are bedrooms above the lobby space, where activity may take place from time to time.

To manage internal airborne sound transfer, the concrete separating floor is enhanced with a mass barrier ceiling. This comprises two layers of plasterboard with a void containing absorptive material suspended on acoustic isolators, the following specification is proposed to facilitate compliance with the sound insulation criteria in Table 2:

– Bedroom to Restaurant/Lobby: separating floor $R_w$ 70 dB at least $D_{nT,w}$ 65 dB

The resulting noise intrusion is less than 20 dB $L_{Aeq,T}$ this is in compliance with the stated noise intrusion criteria.

Figure 3 shows the predicted noise levels on hotel apartment facades from noise breaking out of internal areas, through façade glazing. The development has a sealed façade (to manage external noise intrusion as described in Section 4.3). Therefore, the predicted external noise levels shown in Figure 3 are negligible in comparison to the predicted external noise levels described in the following section of this report.

Figure 3: Predicted noise levels on hotel facade from internal uses noise breakout

As can be seen the worst case noise level affecting the façade is 29 dB $L_{Aeq,T.}$ The internal noise intrusion is less than 10 dB $L_{Aeq,T}$ so not considered further.

### 4.3 External noise intrusion.

Table 7 shows the predicted external noise levels incident on the development facades, based on surrounding sources of noise.

| Location | Period | Sound Levels |
|---|---|---|
| Facades facing M40 | Daytime | $L_{Aeq,16\ h}$ 66 dB |
| | Night-time | $L_{Aeq,8\ h}$ 62 dB<br>$L_{Amax(fast)}$ 73 dB (typical) |
| Facades facing delivery bay access | Daytime | $L_{Aeq,16\ h}$ 63 dB |
| | Night-time | $L_{Aeq,8\ h}$ 59 dB<br>$L_{Amax(fast)}$ 86 dB (typical) |
| Facades facing A4095 | Daytime | $L_{Aeq,16\ h}$ 55 dB |
| | Night-time | $L_{Aeq,8\ h}$ 50 dB<br>$L_{Amax(fast)}$ 60 dB (typical) |

Table 7: External noise levels incident on development facade

The façade acoustic performance requirements in Table 5 work to protect against the external levels shown in Table 7. Using the façade sound insulation specifications and the prevailing external noise levels the internal noise levels required are met in the bedrooms.

## 5. Summary.

The following are the acoustic considerations to discharge Condition 20, a short statement in respect of compliance is provided against each item:

- Noise breakout.
  The development facades have been designed so that noise breaking out of the building envelope and affecting neighbouring sensitive receptors complies with criteria derived based on the best available industry standard guidance.
- Noise transmission.
  The development has been designed so that noise transfer from noisy uses within the development affecting hotel guestroom occupants complies with Building Regulations and industry standard criteria.
- External noise intrusion.
  The façade of the development has been designed so that internal noise levels within the hotel due to ambient noise intruding from outside meet the relevant British standard criteria.

In summary, the requirements of Condition 20 are met by the development.

## References.

DEFRA Noise from Pubs and Clubs (Phase II) NANR 163 (May 2006).

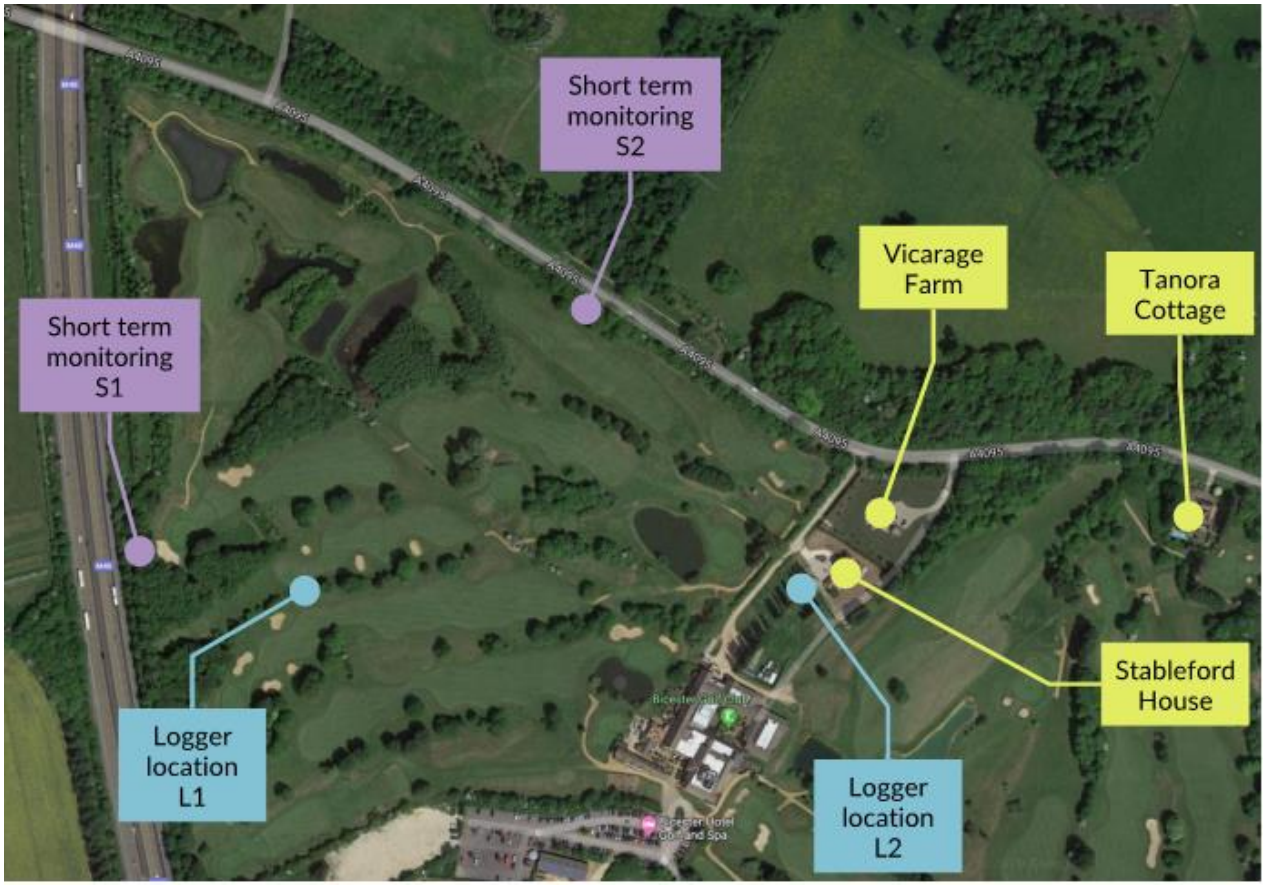
Amplified music as a nuisance, Craik & Stirling, Applied Acoustics 19 (1986)

International Organization for Standardization. (1996). ISO 9613-2 Acoustics - Attenuation of sound during propagation outdoors - Part 2: General method of calculation.

World Health Organization. (2000). Guidelines for Community Noise. Geneva.

World Health Organization. (2009). Night Noise Guidelines. Copenhagen, Denmark.

# Appendix.




Noise monitoring locations